1.2.2

Supporting Documents-

Department of Electrical Engineering

Copy of Syllabus of All Programs Offered Indicating Credits/Electives Approved by Board

SCHEME & SYLLABUS OF B. Tech. 1st & 2nd SEMESTE

(Common to all B. Tech. Disciplines)

Batch-2011

By
Department of Academics

PUNJAB TECHNICALUNIVERSITY

Gogandap

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala

Punjab Technical University

PTU/ DA/ 17th May 2011
B. Tech. 1st & 2nd Semester Batch-2011

Physics Group **B. Tech. First Semester** **Contact Hours: 32 Hrs.**

Course Code	Course Name	Load Allocation			Marks Distribution			Credits
		L	T	P	Internal	External	Total	
BTPH101	Engineering Physics	3	1	-	40	60	100	4
BTAM101	Engineering Mathematics-I	4	1	-	40	60	100	5
BTHU101	Communicative English	3	0	-	40	60	100	3
BTEE 101	Basic Electrical and Electronics Engineering	4	1	-	40	60	100	5
HVPE101	Human Values and Professional Ethics	3	-	-	40	60	100	3
BTPH102	Engineering Physics Laboratory	-	-	2	30	20	50	1
BTHU102	Communicative English Laboratory	-	-	2	30	20	50	1
BTEE102	Basic Electrical and Electronics Engineering Laboratory	-	-	2	30	20	50	1
BTMP101	Manufacturing Practice	-	-	6	60	40	100	3
Total	5Theory Courses + 4 Laboratory Courses	17	3	12	350	400	750	26

Chemistry Group **B. Tech. First Semester** **Contact Hours: 34 Hrs**

Course Code	Course Name	Load Allocation			Marks Distribution			Credits
		L	T	P	Internal	External	Total	
BTCH 101	Engineering Chemistry	3	1	-	40	60	100	4
BTAM101	Engineering Mathematics-I	4	1	-	40	60	100	5
BTME101	Elements of Mechanical Engineering	4	1	-	40	60	100	5
BTCS 101	Fundamentals of Computer Programming and IT	3	-	-	40	60	100	3
EVSC 101	Environmental Science	2	0	-	40	60	100	2
BTCH102	Engineering Chemistry Laboratory	-	-	2	30	20	50	1
BTME102	Engineering Drawing	1	-	6	40	60	100	4
BTCS 102	Fundamentals of Computer Programming and IT Laboratory	-	-	4	30	20	50	2
BTME103	Engineering Computer Graphics Laboratory	-	-	2	30	20	50	1
Total	6Theory Courses + 3 Laboratory Courses	17	3	14	330	420	750	27

Head
Department of Electrical Engineering
... University

26

Physics Group **B. Tech. Second Semester** **Contact Hours: 32 Hrs.**

Course Code	Course Name	Load Allocation			Marks Distribution			Credits
		L	T	P	Internal	External	Total	
BTPH101	Engineering Physics	3	1	-	40	60	100	4
BTAM102	Engineering Mathematics-II	4	1	-	40	60	100	5
BTHU101	Communicative English	3	0	-	40	60	100	3
BTEE 101	Basic Electrical and Electronics Engineering	4	1	-	40	60	100	5
HVPE101	Human Values and Professional Ethics	3	-	-	40	60	100	3
BTPH102	Engineering Physics Laboratory	-	-	2	30	20	50	1
BTHU102	Communicative English Laboratory	-	-	2	30	20	50	1
BTEE102	Basic Electrical and Electronics Engineering Laboratory	-	-	2	30	20	50	1
BTMP101	Manufacturing Practice	-	-	6	60	40	100	3
Total	5Theory Courses + 4 Laboratory Courses	17	3	12	350	400	750	26

Chemistry Group **B. Tech. Second Semester** **Contact Hours: 34 Hrs.**

Course Code	Course Name	Load Allocation			Marks Distribution			Credits
		L	T	P	Internal	External	Total	
BTCH 101	Engineering Chemistry	3	1	-	40	60	100	4
BTAM102	Engineering Mathematics-II	4	1	-	40	60	100	5
BTME101	Elements of Mechanical Engineering	4	1	-	40	60	100	5
BTCS 101	Fundamentals of Computer Programming and IT	3	-	-	40	60	100	3
EVSC 101	Environmental Science	2	0	-	40	60	100	2
BTCH102	Engineering Chemistry Laboratory	-	-	2	30	20	50	1
BTME102	Engineering Drawing	1	-	6	40	60	100	4
BTCS 102	Fundamentals of Computer Programming and IT Laboratory	-	-	4	30	20	50	2
BTME103	Engineering Computer Graphics Laboratory	-	-	2	30	20	50	1
Total	6Theory Courses + 3 Laboratory Courses	17	3	14	330	420	750	27

First Semester + Second Semester + General Fitness= 750 +750+100= 1600 Marks

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

Punjab Technical University

PTU/ DA/ 17th May 2011
B. Tech. 1st & 2nd Semester Batch-2011

BTPH 101 Engineering Physics

Objective/s and Expected outcome:

The objective of the course is to develop a scientific temper and analytical capability in the engineering graduates through the learning of physical concepts and their application in engineering & technology. Comprehension of some basic physical concepts will enable graduates to think logically the engineering problems that would come across due to rapidly developing new technologies. The student will be able to understand the various concepts effectively; logically explain the physical concepts; apply the concept in solving the engineering problem; realize, understand and explain scientifically the new developments and breakthroughs in engineering and technology; relate the developments on Industrial front to the respective physical activity, happening or phenomenon.

PART A

1. **EM waves & Dielectrics:** Physical significance of Gradient, Divergence & Curl, Relationship between Electric Field & Potential, Dielectric polarization, displacement Current, Types of polarization, Maxwell"s Equations, Equation of EM waves in free space, velocity of EM waves, Poynting vector, Electromagnetic Spectrum (Basic ideas of different region). **(5)**
2. **Magnetic Materials & Superconductivity:** Basic ideas of Dia, Para, Ferro & Ferri, Ferrites, Magnetic Anisotropy, Magnetostriction its applications in production of Ultrasonic waves, Superconductivity, Superconductors as ideal diamagnetic materials, Signatures of Superconducting state, Meissner Effect, Type I & Type II superconductors, London Equations, Introduction to BCS theory. **(5)**
3. **Elements of crystallography:** Unit cell, Basis, Space lattice, Crystal Systems, Miller Indices of Planes & Directions in cubic system, Continuous & Characteristic X-Rays, X-Ray Diffraction & Bragg"s law in Crystals, Bragg"s spectrometer, X-ray radiography. **(5)**
4. **Lasers:** Spontaneous & Stimulated emissions, Einstein"s Coefficients, Population Inversion, Pumping Mechanisms, Components of a laser System, Three & four level laser systems; Ruby, He-Ne, CO_2 and semiconductor Lasers, Introduction to Holography. **(5)**

PART B

5. **Fibre Optics:** Introduction, Acceptance Angle, Numerical Aperture, Normalized frequency, Modes of propagation, material dispersion & pulse broadening in optical fibres, fibre connectors, splices and couplers, applications of optical fibres. **(5)**

6. **Special Theory of Relativity:** Concept of Ether, Michelson Morley Experiment, Einstein"s postulates, Lorentz transformation equations; length, time and simultaneity in relativity, addition of velocity, variation of mass with velocity, Mass-Energy and Energy-momentum relations. **(5)**

7. **Quantum Theory:** Need and origin of quantum concept, Wave-particle duality, Matter waves, Group & Phase velocities, Uncertainty Principle, Significance & normalization of wave function, Schrodinger wave equation: time independent & dependent, Eigen functions & Eigen values, particle in a box. **(5)**

8. **Nanophysics:** Nanoscale, surface to volume ratio, electron confinement, nanoparticles (1D, 2D, 3D), Nanomaterials, Unusual properties of nanomaterials, synthesis of nanomaterials- ball milling and sol-gel techniques, Carbon nanotubes (synthesis and properties), applications of nanomaterials. **(5)**

<u>Suggested Readings / Books:</u>

1. Physics for Scientists & Engineers (Vol. I & II), Serway & Jewett, 6th Edition., Cengage Learning.
2. Engineering Physics, Malik; HK, Singh; AK, Tata McGraw Hill,
3. Materials Science & Engg., Raghvan V.,Prentice Hall of India.
4. Concepts of Modern Physics, Beiser; A., Mahajan; S., Choudhary; SR, Tata McGraw Hill.
5. Solid State Physics, Dan Wei, Cengage Learning.
6. Introduction to Solids, Azaroff LV, Tata Mc Graw Hill.
7. Physics; A calculus based approach (Vol. I & II) Serway; RA & Jewitt; JW, Cengage Learning.Materials Science & Engineering, Callister; WD, John Wiley & Sons.
8. Introduction to Electrodynamics, Griffiths; DJ, Prentice Hall.
9. Lasers & Optical engineering, Dass; P, Narosa Publishers.
10. Optical Fibre system, Technology, Design & Applications, Kao; CK, McGraw Hill.
11. Laser Theory & Applications, Thygrajan; K, Ghatak; AK, Mc Millan India Ltd.

Punjab Technical University

PTU/ DA/ 17th May 2011
B. Tech. 1st & 2nd Semester Batch-2011

BTAM 101Engineering Mathematics-I

Objective/s and Expected outcome

"Math and basic science are certainly the foundations of any engineering program. This fact will not change in the foreseeable future" said by Ellis et al. Engineering Mathematics is an essential tool for describing and analyzing engineering processes and systems. Mathematics also enables precise representation and communication of knowledge. Core mathematics courses have broader objectives than just supporting engineering programs. The learning objectives of core mathematics courses can be put into three categories: (1) Content Objectives: Students should learn fundamental mathematical concepts and how to apply them. (2) Skill Objectives: Students should learn critical thinking, modeling/problem solving and effective uses of technology. (3) Communication Objectives: Students should learn how to read mathematics and use it to communicate knowledge. The students are expected to understand the fundamentals of the mathematics to apply while designing technology and creating innovations.

PART A

1. **Differential Calculus:** Curve tracing: Tracing of Standard Cartesian; Parametric and Polar curves; Curvature of Cartesian, Parametric and Polar curves. **(6)**
2. **Integral Calculus:** Rectification of standard curves; Areas bounded by standard curves; Volumes and surfaces of revolution of curves; Applications of integral calculus to find centre of gravity and moment of inertia. **(6)**
3. **Partial Derivatives:** Function of two or more variables; Partial differentiation; Homogeneous functions and Euler"s theorem; Composite functions; Total derivative; Derivative of an implicit function; Change of variable; Jacobians. **(6)**
4. **Applications of Partial Differentiation:** Tangent and normal to a surface; Taylor"s and Maclaurin"s series for a function of two variables; Errors and approximations; Maxima and minima of function of several variables; Lagrange"s method of undetermined multipliers. **(6)**

Head
Department of Electrical Engineering
I.K. Gujral Punjab Techn...

PART B

5. **Multiple Integrals:** A brief introduction of cylinder, cone and standard conicoids. Double and triple integral and their evaluation, change of order of integration, change of variable, Application of double and triple integration to find areas and volumes. **(6)**
6. **Vector Calculus:** Scalar and vector fields, differentiation of vectors, velocity and acceleration. Vector differential operators: Del, Gradient, Divergence and Curl, their physical interpretations. Formulae involving Del applied to point functions and their products. Line, surface and volume integrals. **(8)**
7. **Application of Vector Calculus:** Flux, Solenoidal and Irrotational vectors. Gauss Divergence theorem. Green"s theorem in plane, Stoke"s theorem (without proofs) and their applications. **(4)**

Suggested Readings / Books

1. Thomes, G.B, Finney, R.L. Calculus and Analytic Gemetry, Ninth Edition, Peason Education.
2. Kreyszig, E., Advanced Engineering Mathematics, Eighth edition, John wiley.
3. Peter. V. O" Nil, Advanced Engineering Mathematics, Wordsworth Publishing Company.
4. Jain, R.K and Lyengar, S.R.K., Advanced Engineering Mathematics, Narosa Publishing Company.
5. Grewal, B.S., Higher Engineering Mathematics, Khanna Publishers, New Delhi.
6. Taneja, H.C., Engineering Mathematics, Volume-I & Volume-II, I.K. Publisher.
7. Babu Ram, Advance engineering Mathematics, Pearson Education.
8. Bindra,. J.S., Applied Mathematics, Volume-I, Kataria Publications.

Gegandeep

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

NA

Punjab Technical University

PTU/ DA/ 17th May 2011
B. Tech. 1st & 2nd Semester Batch-2011

BTHU 101 Communicative English

Objective/s and Expected outcome:

The objective is to help the students to become independent users of english language. Students should be able to understand spoken and written english language of varied complexity on most including some abstract topics; particularly the language of their chosen technical field. They must show awareness of appropriate format and a capacity for explaining their views in a rational manner. The students should be able to converse fluently, without strain with international speakers of english in an accent and lexis that is widely understood across the globe. They will be able to produce on their own texts which are clear and coherent.

1. **Reading:** Reading texts of varied complexity; speed reading for global and detailed meaning; processing factual and implied meanings
2. **Vocabulary:** Building up and expansion of vocabulary; active use of the prescribed expressions in the appropriate context
3. **Grammar:** Revising and practicing a prescribed set of grammar items; using grammar actively while processing or producing language
4. **Writing:** The qualities of good writing; Learning the prescribed written expressions of conventional use; writing business letters, emails; reports, summaries and various forms of descriptive and argumentative essays

Learning and Teaching Activities:

PART A (Reading)

The prescribed reading textbook for students will be S. P. Dhanavel English and Communication Skills for Students of Science and Engineering (with audio CD), Orient Blackswan. They will go through the reading texts themselves with the help of a dictionary or word power as given at the end. As they progress from one reading to another they should learn to read fast with greater degree of understanding of both concrete and abstract topics. While taking up the textbook lessons in the classroom, the teacher shall ensure that students can do the following:

i. Identify the significant points and conclusions as given in the text.

ii. Handle large texts (even outside the prescribed book) with overall comprehension of the links between arguments and the finer distinction between stated and implied meanings.

iii. Generally read the stance or the point of view of the writer and present it in the form of a summary

Head
Department of Electrical Engineering
Technical Univer

iv. Use the vocabulary learnt in the lessons (especially given in „word power") productively in various writing tasks as suggested at the end of each lesson.

v. Profitably use the grammatical items as discussed at the end of each lesson while producing language for communication.

Besides the textbook, the teacher must insist that students extend their reading by taking up additional texts of their own choice.

PART B (Writing)

In addition to the various exercises given at the end of each lesson of Dhanavel"s book, the teacher shall use Anne Laws Writing Skills, Orient Blackswan to teach the language and conventions of writing. The students must learn the language that expresses various cognitive functions that are frequently used in writing. With the help of the teacher who will give them adequate practice, the students should be able to:

i.Convey information on concrete or abstract topics with clarity and precision.

ii. Write about objects or events with appropriate detail in both descriptive and narrative form.

iii. Explain ideas and build up arguments with adequate support in a convincing manner.

iv. Use language with some degree of flexibility in consideration to the reader.

v.Produce effectively such forms of professional writing as business letter, emails, notes, memos, reports summaries etc.

While teaching, the teacher must inculcate in students the habit of revising their writing. The teacher can also use and recommend the relevant sections of the following books for developing writing skills in students.

Suggested Readings/ Books

1. Vandana R Singh, The Written Word, Oxford University Press, New Delhi

2. KK Ramchandran, et al Business Communication, Macmillan, New Delhi

3. Swati Samantaray, Busines Commnication and Commnicative English, Sultan Chand, New Delhi.

4. S.P. DhanavelEnglish and Communication Skills for Students of Science and Engineering (with audio CD)

Gagandeep

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144606

MP

Punjab Technical University

PTU/ DA/ 17th May 2011
B. Tech. 1st & 2nd Semester Batch-2011

BTEE 101 Basic Electrical and Electronics Engineering

Objective/s and Expected outcome:

This course is mandatory for all the branches for understanding the basic concepts of Electrical and Electronics Engineering. Students of all branches have to deal with the applications of Electrical Engineering and Electronics Engineering. This course gives a basic knowledge of circuits, transducers, semiconductor devices with which a building of innovative technology can be created. The students are expected to learn and understand the importance and applications of electric and electronics material. This knowledge give them a brief outline of the fundamentals that would be the foundations of todays" and tomorrow"s technology.

Part A (Electrical Engineering)

1. Direct Current (DC) Circuits:

Circuit elements and connected terminology, Kirchoff"s Laws- Statement and Illustrations, Method of solving circuits by Kirchoff"s law, Star-Delta Conversion, Computation of resistance at constant temperature, resistance at different temperatures, Ohm"s Law- Statement, Illustration and Limitation, Units- Work, Power and Energy (Electrical, Thermal and Mechanical). DC Transients for RL and RC series circuits (7)

2. Alternating Current (AC) Fundamentals:

Generation of alternating electro-motive force EMF, Concept of 3-phase EMF Generation, Peak, Root Mean Square and Average value of alternating current, Phasor representation of alternating quantities, Analysis of AC Circuit Representation of Alternating Quantities in Rectangular and polar forms. Introduction of Resistive, Inductive & Capacitive circuits and their series and parallel combinations. Concept of resonance in series and parallel circuits, Analysis of balanced 03 phase system with star-delta connections. (7)

3. Magnetic Circuits and Transformer:

Comparison between magnetic and electric circuits, Magnetic effects of electric current, Current carrying conductor in magnetic field, Law of Electromagnetic Induction and its law, Self Inductance, Mutual Inductance, Coupling Coefficient between two magnetically coupled circuits, Single Phase Transformer: Construction, Working principle, Efficiency, Voltage regulation and applications. (7)

Head ... of Electrical Engineering ... Technical Unit

4. Rotating Electrical Machines:

D.C. machines (motors and generators), Three phase Induction motor, Synchronous machines (motors and generators): construction, working principle, classification and applications. **(7)**

Part B (Electronics Engineering)

5. Transducers:

Introduction, working and application of LVDT, Strain Gauge and Thermistor. Introduction and application of Digital Multimeter. **(7)**

6. Semiconductor Devices:

Principle of operation characteristic and application of PN Junction Diode, Rectifiers, Zener Diode, Principle of operation characteristic and application of Bipolar Junction Transistor, Principle of operation and characteristic Field Effect Transistor, Regulated Power Supply. **(7)**

7. Digital Electronics:

Binary, Octal and Hexadecimal number System & its arithmetic operations, Logic gates, Introduction of R-S, J-K, D and T Flip Flops & its truth tables. **(6)**

Suggested Readings/ Books

1. Basic Electrical and Electronics and Computer Engineering by R Muthusubramanian, S Salivahanan,K A Muraleedharan, Tata McgrawHill
2. A Textbook of Electrical Techology by B.L Theraja.& A.K Theraja, S Chand publishers.
3. Electrical Technology, Edward Hughes, Addisin Wesley Longman Limited.
4. A Course in electrical and electronic Measurements & Instumentation by A.K Sawhney, Dhanpat Rai & Co.

Punjab Technical University

PTU/ DA/ 17th May 2011
B. Tech. 1st & 2nd Semester Batch-2011

EVSC 101 Environmental Science

Objective/s and Expected outcome:

Upon successful completion of the course, students should be able to:

1. Measure environmental variables and interpret results
2. Evaluate local, regional and global environmental topics related to resource use and management
3. Propose solutions to environmental problems related to resource use and management
4. Interpret the results of scientific studies of environmental problems
5. Describe threats to global biodiversity, their implications and potential solutions

Part A

1. **Introduction:** Definition and scope and importance of multidisciplinary nature of environment. Need for public awareness. **(2)**
2. **Natural Resources:** Natural Resources and associated problems, use and over exploitation, case studies of forest resources and water resources. **(4)**
3. **Ecosystems:** Concept of Ecosystem, Structure, interrelationship, producers, consumers and decomposers, ecological pyramids-biodiversity and importance. Hot spots of biodiversity **(4)**
4. **Environmental Pollution:** Definition, Causes, effects and control measures of air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards. Solid waste Management: Causes, effects and control measure of urban and industrial wastes. Role of an individual in prevention of pollution. Pollution case studies. Disaster Management : Floods, earthquake, cyclone and landslides. **(5)**

PART B

5. Social Issues and the Environment From Unsustainable to Sustainable development, Urban problems related to energy, Water conservation, rain water harvesting, watershed management. Resettlement and rehabilitation of people; its problems and concerns. Case studies. Environmental ethics: Issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies. Wasteland reclamation. Consumerism and waste products. Environment Protection Act. Air (Prevention

Head ... Electrical Engineering

and Control of Pollution) Act. Water (Prevention and control of pollution) Act. Wildlife Protection Act, Forest Conservation Act, Issues involved in enforcement of environmental legislation Public awareness **(5)**

6. Human Population and the Environment, Population growth, variation among nations. Population explosion - Family Welfare Programme. Environment and human health, Human Rights, Value Education, HIV/AIDS. Women and child W elfare. Role of Information Technology in Environment and human health. Case studies **(4)**

Suggested Readings / Books

1. Agarwal, K. C. 2001 Environment Biology, Nidi Publ. Ltd. Bikaner.
2. Jadhav, H & Bhosale, V.M. 1995. Environment Protection and Laws. Himalaya Pub House, Delhi 284p.
3. Rao M. N. & Datta A.K. 1987. Waste Water Treatment. Oxford & IBH Publ. Co. Pvt. Ltd. 345 p.
4. Principle of Environment Science by Cunninghan, W.P.
5. Essentials of Environment Science by Joseph.
6. Environment Pollution Control Engineering by Rao, C.S.
7. Perspectives in Environmental Studies by Kaushik, A.
8. Elements of Environment Science & Engineering by Meenakshi.
9. Elements of Environment Engineering by Duggal.

Gagandeep

BTPH 102 Engineering Physics Laboratory

1. To study the magnetic field of a circular coil carrying current.
2. To find out polarizability of a dielectric substance.
3. To study the laser beam characteristics like; wave length using diffraction grating aperture & divergence.
4. To study laser interference using Michelson"s Interferometer.
5. Study of diffraction using laser beam and thus to determine the grating element.
6. To determine numerical aperture of an optical fibre.
7. To determine attenuation & propagation losses in optical fibres.
8. To find out the frequency of AC mains using electric-vibrator.
9. To find the refractive index of a material using spectrometer.
10. To find the refractive index of a liquid.
11. To study B-H curve using CRO.
12. To find the velocity of ultrasound in liquid.
13. To determine the grain size of a material using optical microscope.

Note: Each student is required to perform at least ten experiments

Suggested Readings / Books

1. Practical Physics, C.L. Arora, S. Chand & Co.
2. Practical Physics, R.S. Sirohi, Wiley Eastern.

Gagandeep

BTHU 102 Communication Skills Laboratory

Lab Exercises

Listening and Speaking

The audio CD accompanying S.P. Dhanavel"s book shall be played in the lab to get the students familiar with the standard spoken English. The students must develop a high degree of understanding of spoken material as used in academic and professional environment. The teacher shall help them in the following:

a) With the accent of the speaker if it is unfamiliar to them.

b) The Standard English sounds and pronunciation of words.

c) With the topical vocabulary and the idiomatic expressions which are generally part of colloquial speech.

d) With the implied relationships in larger texts, if they are not stated explicitly.

In addition to the above, extended listening sessions shall be arranged to promote speaking activities among students. For this purpose, a set of twin books ***K. Sadanand and S. Punitha Spoken English Part I and II, A Foundation Course (with audio CD), Orient Blackswan,*** is prescribed for use. The teachers shall play the CDs selectively in the lab and involve the students in the practice work based on them. While taking up lessons, the teacher must promote the use of dictionaries for correct pronunciation and give ample practice on word stress and weak forms.

The students are also supposed to supplement their listening practice by regularly viewing news/knowledge channels on the TV or lecture videos on the internet.

At the end of a session, a good speaker must:

a) Be able to produce long turns without much hesitation in an accent that is understood all around.

b)Have ready access to a large lexis and conventional expressions to speak fluently on a variety of topics.

c) Have a knack for structured conversation or talk to make his transitions clear and natural to his listeners.

The teacher may use following different classroom techniques to give practice and monitor the progress of the students:

- role play
- question-answer
- discussion
- presentation of papers
- seminars

Gagandeep
Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

Punjab Technical University

PTU/ DA/ 17th May 2011
B. Tech. 1st & 2nd Semester Batch-2011

BTEE 102 Basic Electrical and Electronics Engineering Laboratory

List of Experiments to be performed

1. To verify Ohm"s Law and its limitations.
2. To verify Kirchoff's Laws.
3. To measure the resistance and inductance of a coil by ammeter-voltmeter method.
4. To find voltage-current relationship in a R-L series circuit and to determine the power factor of the circuit.
5. To verify the voltage and current relations in star and delta connected systems.
6. To measure power and power factor in a single- phase AC circuit.
7. To verify series and parallel resonance in AC circuits.
8. To observe the B-H loop of ferromagnetic core material on CRO.
9. To use a bridge rectifier for full- wave rectification of AC supply and to determine the relationship between RMS and average values of the rectified voltage.
10. To measure the minimum operating voltage, current drawn, power consumed, and the power factor of a fluorescent tube light.
11. To verify the working of a). Thermocouple b). Strain Gauge c). LVDT.
12. To verify the rating of compact fluorescent lamp (CFL).
13. To obtain the characteristics of a P-N junction diode.
14. To verify the truth table of logic gates.
15. To connect the following ,measuring instruments to measure current, voltage and power in AC/DC circuits:
    i. Moving Coil Instruments
    ii. Moving Iron Instruments
    iii. Dynamometer Instruments
    iv. Multimeter- both Digital and Analog Type
16. To obtain the characteristics of a transistor under common base (CB) and common emitter (CE) configuration.
17. To perform open- and short circuit tests on a single phase transformer and calculate its efficiency
18. To start and reverse the direction of rotation of a
    i. DC motor
    ii. Induction motor

Note: Each student is required to perform at least ten experiments

Suggested Readings / Books

1. S.K. Bhattacharya and R.K. Rastogi, Experiments in Electrical Engineering, New Age International Publishers Ltd., New Delhi.
2. D.R. Kohli and S.K. Jain, Experiments in Electrical Machines.

BTMP 101 Manufacturing Practice

PART A

1. **Carpentry and Pattern Making:** Various types of timber and practice boards, defects in timber, seasoning of wood; tools, wood operation and various joints; exercises involving use of important carpentry tools to practice various operations and making joints.
2. **Foundry Shop:** Introduction to molding materials; moulds; use of cores; melting furnaces; tools and equipment used in foundry shops; firing of a cupola furnace; exercises involving preparation of small sand moulds and castings.
3. **Forging Practice:** Introduction to forging tools; equipments and operations; forgability of metals; exercises on simple smithy; forging exercises.
4. **Machine Shop:** Machines, Grinders etc; cutting tools and operations; exercises involving awareness.

PART B

5. **Welding Shop:** Introduction to different welding methods; welding equipment; electrodes; welding joints; welding defects; exercises involving use of gas/electric arc welding.
6. **Electrical and Electronics Shop:** Introduction to electrical wiring; preparation of PCBs involving soldering applied to electrical and electronic applications; exercises preparation of PCBs involving soldering applied to electrical and electronic applications.
7. **Sheet Metal:** Shop development of surfaces of various objects; sheet metal forming and joining operations, joints, soldering and brazing; exercises involving use of sheet metal forming operations for small joints.
8. **Fitting Shop:** Introduction of fitting practice and tools used in fitting shop; exercise involving marking, cutting, fitting practice (Right Angles), male-Female mating parts practice, trapping practice.

Suggested Readings/ Books

1. Raghuwanshi, B.S. ; A course in Workshop technology, Vol 1 & II, Dhanpat Rai & Sons , New Delhi.
2. Jain, R.K.; Production Technology, Khanna Publishers, New Delhi.
3. Singh, S, ; Manufacturing Practice, S.K. Kataria & Sons, New Delhi

NA

Punjab Technical University PTU/ DA/ 17th May 2011

B. Tech. 1st & 2nd Semester Batch-2011

BTCH101 Engineering Chemistry

Objective/s and Expected outcome:

The objective of the Engineering Chemistry is to acquaint the student with the basic phenomenon/concepts of chemistry, the student face during course of their study in the industry and Engineering field. Some new topics have been introduced to the syllabus for the development of the right attitudes by the engineering students to cope up with the continuous flow of new technology. The student with the knowledge of the basic chemistry, will understand and explain scientifically the various chemistry related problems in the industry/engineering field. The student will able to understand the new developments and breakthroughs efficiently in engineering and technology. The introduction of the new topics will make the engineering student upgraded with the new technologies.

PART A

1. Spectroscopy and its Applications: An introduction

- **UV/Visible Spectroscopy:** Selection rules; Line widths and intensity of spectral lines; Principle and instrumentation; Electronic Transitions; Chromophores & auxochromes; Factors affecting λ_{Max} & intensity of spectral lines; Franck-Condon principle; Applications.
- **IR Spectroscopy:** Principle and instrumentation; Vibrational frequency; Fundamental modes of vibrations and types; Anharmonics; Factors affecting vibrational frequency; Applications.
- **NMR Spectroscopy:** Principle & instrumentation; Chemical shift; Spin-Spin Splitting; High resolution NMR spectrum (PMR only). **(7)**

2. Photochemistry:

Introduction; Photo-physical & photochemical processes; Light sources in photochemistry; Beer-Lambert Law; Laws of Photochemistry; Quantum yield (primary and overall); Primary and secondary photochemical reactions; Jablonski diagram; Semiconductor photochemistry, Photovoltaic cells, Introduction to optical sensors, Introduction to supra-molecular photochemistry. **(5)**

3. Water and its Treatment:

Boiler feed water: Specification, Scales and sludge fermentation; Priming & foaming; Different methods of the water purifications and softening;

Head

Desalination of water; Water for domestic use: Specification; Disinfection of water. **(4)**

4. Green Chemistry and its Applications:

Introductory overview - Definition and concepts of Green chemistry; Emergence of Green chemistry; Twelve principles of Green Chemistry with emphasis on the use of alternative feedstock (bio-fuels); Use of innocuous reagents in natural processes; Alternative solvents; Design of the safer chemicals; Designing alternative reaction methodology. Microwave and ultrasonic radiation in Green synthesis - Minimizing energy consumption. **(4)**

PART B

5. Corrosion and its Prevention:

Introduction; Different types of corrosion - Wet and Dry corrosion; Different types of surface films; Mechanisms of wet corrosion; Galvanic corrosion; Galvanic Series; Concentration cell corrosion and differential aeration corrosion; Soil and microbial corrosions; waterline, stress corrosions; Various methods of corrosion control. **(5)**

6. Polymers and Reinforced Composites:

Introduction; Functionality; Types of polymerization; Specific features of polymers; Structures - regularity and irregularity; Tacticity of polymers; Average molecular weights and size; Determination of molecular weight by number average method; Effect of molecular weight on the properties of polymers; Introduction to polymer reinforced composite. **(5)**

7. Nanochemistry:

Introduction; Materials self-assembly; Moloecular vs. materials self-assembly; Self-assembling materials; Two dimensional assemblies; Mesoscale self assembly; Coercing colloids; Nanocrystals; Superamolecular structures; Nanoscale materials; Future perspectives. **(5)**

8. Petrochemicals:

Introduction; First, second & third generation petrochemicals; Primary Raw Materials for Petrochemicals.

Natural gas: Natural gas treatment processes; Natural gas liquids; Properties of natural gas; Crude oil: Composition of crude oil- Hydrocarbon compounds;

Non-hydrocarbon compounds; Metallic Compounds, Crude oil classification; Physical separation processes; Conversion processes; Production of ethylene and propylene. (5)

Suggested Readings / Books

1. William Kemp, Organic Spectroscopy, Palgrave Foundations, 1991.
2. D. A. Skoog, F. J. Holler and A. N. Timothy, Principle of Instrumental Analysis, 5th Edition., Saunders College Publishing, Philadelphia, 1998.
3. G. W. Castellan, Physical Chemistry, Narosa, 3rd Edition, 1995, reprint 2004.
4. C. P. Poole, Jr., F. J. Owens, Introduction to Nanotechnology, Wiley Interscience, 2003.
5. L.E.Foster, Nanotechnology, Science Innovation & Opportunity, Pearson Education, 2007.
6. M. Lancaster, Green Chemistry an Introductory Text, Royal Society of Chemistry, Cambridge, UK, 1st edition, 2010.
7. Sami Matar, Lewis F. Hatch, Chemistry of Petrochemical Processes, Second Edition, Gulf Publishing company, Houston, Texas, 2000.
8. Jones, Denny, Principles and Prevention of Corrosion, Upper Saddle River, New Jersey: Prentice Hall, 2nd edition, 1996.
9. Nicholas J Turro, Modern Molecular Photochemistry, University Science Books, Sausalito, California 2010.
10. Mohamed Belgacem, Alessandro Gandini, Monomers, Polymers and Composites from Renewable Resources, ELSEVIER, 2008.

Gagandeep

Lu

BTAM102 Engineering Mathematics-II

Objective/s and Expected outcome:

The learning objectives of core mathematics courses can be put into three categories:

Content Objectives: Students should learn fundamental mathematical concepts and how to apply them. **Skill Objectives:** Students should learn critical thinking, modeling/problem solving and effective uses of technology. **Communication Objectives:** Students should learn how to read mathematics and use it to communicate knowledge. The students are expected to understand the fundamentals of the mathematics to apply while designing technology and creating innovations.

PART A

1. Ordinary Differential Equations of first order

Exact Differential equations, Equations reducible to exact form by integrating factors; Equations of the first order and higher degree. Clairaut's equation. Leibniz's linear and Bernoulli's equation

(7)

2. Linear Ordinary Differential Equations of second & higher order

Solution of linear Ordinary Differential Equations of second and higher order; methods of finding complementary functions and particular integrals. Special methods for finding particular integrals: Method of variation of parameters, Operator method. Cauchy's homogeneous and Legendre's linear equation, Simultaneous linear equations with constant coefficients.

(7)

3. Applications of Ordinary Differential Equations

Applications to electric R-L-C circuits, Deflection of beams, Simple harmonic motion, Simple population model.

(7)

Head
Department of Electrical Engineering

PART B

4. Linear Algebra

Rank of a matrix, Elementary transfonnations, Linear independence and dependence of vectors, Gauss-Jordan method to find inverse of a matrix, reduction to normal form, Consistency and solution of linear algebraic equations, Linear transformations, Orthogonal transformations, Eigen values, Eigen vectors, Cayley-Hamilton Theorem, Reduction to diagonal form, orthogonal, unitary, Hermitian and similar matrices. **(7)**

5. Infinite Series

Convergence and divergence of series, Tests of convergence (without proofs): Comparison test, Integral test, Ratio test, Rabee's test, Logarithmic test, Cauchy's root test and Gauss test. Convergence and absolute convergence of alternating series **(7)**

6. Complex Numbers and elementary functions of complex variable

De-Moivre's theorem and its applications. Real and Imaginary parts of exponential, logarithmic, circular, inverse circular, hyperbolic, inverse hyperbolic functions of complex variables. Summation of trigonometric series. (C+iS method) **(7)**

Suggested Readings / Books:

1. Kreyszig,E., Advanced Engineering Mathematics, Eighth edition, John W iley.
2. Michael D. Greenberg., Advanced Engineering Mathematics, Second Edition, Pearson Education.
3. Peter. V. O'Nil, Advanced Engineering Mathematics, Wadsworth- Publishing Company.
4. Jain, R.K. and Iyengar, S.R.K., Advanced Engineering Mathematics, Narosa Publishing House, New Delhi.
5. Grewal, B.S., Higher Engineering Mathematics, Khanna Publishers, Delhi.
6. Pipes, L.A. and Harvill, L.R., Applied Mathematics for Engineers and Physicists, McGraw Hill
7. Taneja, H. C., Engineering Mathematics, Volume-I & Volume-II, 1. K. Publisher.
8. Babu Ram, Advance Engineering Mathematics, Pearson Education.
9. Bindra, J. S., Applied Mathematics, Volume-II, Kataria Publications.

BTME 101 Elements of Mechanical Engineering

Objectives and Expected Outcome:- In the vast spectrum of Mech. Engg., this subject gives a very very primitive but general information finding vide application in day to day life with emphasis upon the principles and fundamentals involved in the inter-conversion of thermal energy into mechanical energy and vice versa, viz. all Automobile, Air-Craft, Generator and other stationary Heat Engines besides cooling machinery like Refrigerators, Air-Conditioners and water-coolers etc. The subject also offers a birds eye-view to all students about the common engineering materials finding vide application in Mech. Engg. Industry and about their strength and other related vital aspects. Since every student of engineering is already exposed to all afore-said machinery, he/she would feel very much self-satisfied and self-confident after learning the basic intricacies and *whys* and *hows* related with the fundamentals of the aforesaid machinery.

PART-A

1. Basic Concepts of Thermodynamics **(08)**

Definition of thermodynamic: Need to study thermodynamics; Application areas of thermodynamic; Difference between Microscopic (or, Statistical) thermodynamics and Macroscopic(or, Classical) thermodynamics; Brief concept of continuum; **Thermodynamic System** : definition, types (Open, Closed and Isolated) and their examples; **Thermodynamic System Boundary** : definition, types and their examples; **Surroundings**; Control(fixed) mass and Control Volume concept and their example ; Thermodynamic State; **Thermodynamic Property**: definition, types citing their examples; condition for any quantity to be a property; State postulate; Thermodynamic equilibrium (which includes Thermal, Mechanical and Chemical equilibrium etc.); Thermodynamic path; **Thermodynamic process:** definition, **concept of reversible process**, quasi-static (or, quasi-equilibrium) process, irreversible process, conditions for reversibility and how these are met with, non-flow processes and flow processes, method of representation of reversible and irreversible process on property diagrams; Cyclic process; **Thermodynamic Cycle:** definition and its concept; Energy and its forms (microscopic and macroscopic); Physical insight to internal energy; Energy transfer across system boundary i.e. transient energies (heat and work);

Difference between heat and work; Sign conventions for heat and work interactions; heat and work as path functions; Equality of Temperature and Zeroth law of Thermodynamics.

2. First Law of Thermodynamics and its applications **(12)**

Definition, essence and corollaries or consequences of first law of Thermodynamics; Expressions for First law of Thermodynamics for a control mass undergoing a Cycle and for process (i.e., a change in state of a control mass) ; Concept of Enthalpy and total energy and differentiation between the two - a thermodynamic property; Compressible and incompressible substances, Specific heats, Difference between Internal Energy and Enthalpy of compressible and incompressible substances; Representation of first law of thermodynamics as rate equation; Analysis of non-flow/ flow process for a control mass undergoing constant volume, constant pressure, constant temperature, adiabatic and polytropic processes; Free Expansion Process and its examples, its representation on Property diagram; Review of concepts of control volume; Expressions of first law of thermodynamics for a control volume (i.e. open system) ; Steady State Steady Flow process and its examples; First law analysis of Steady State Flow process e.g. isochoric, isobaric, isothermal, isentropic and polytropic process; Throttling process and its applications; Flow energy or inertial energy of flowing fluids or, Energy transport by mass; Application of Steady State Flow Energy Equation to various engineering devices.

3. Second Law of Thermodynamics **(16)**

Limitations of first law of thermodynamics; and how 2nd law is fully able to explain away and thus overcome those shortcomings of Ist law; Thermal Reservoirs, source and sink (Low temperature and high temperatures); **Heat Engine, Heat Pump and Refrigerator**: definitions, working, efficiency/performance and their real life examples. Justification as to why the actual efficiency of Heat Pump and Refrigerator shall also be ≤ 100% though on the face of it seems to be more than 100%; Various statements of Second Law of Thermodynamics and their equivalence; Philosophy of Carnot cycle and its consequences viz. how each of the individual four processes constituting the cycle contribute in optimizing the output and efficiency of the cycle; **Carnot Engine, Carnot Refrigerator and Carnot Heat Pump:** definitions, working, efficiency/performance and Limitations of the cycle; Carnot theorem for heat engines, refrigerators and heat pumps; derivation of Carnot efficiency/COP (which seems to be more than 100%); Thermodynamic Temperature Scale; Clausius theorem and Inequality; Philosophy and concept of entropy; Entropy changes during various processes; Temperature - Entropy Chart and representation of various processes on it; Principle of Increase of Entropy; Applications of Entropy Principle; Quality of Energy viz. high and low grade energies; Degradation of Energy; Third Law of Thermodynamics.

PART-B

4. Gas Power Cycles **(12)**

Introduction; Concept and philosophy of Air Standard Cycle alongwith associated assumptions and advantages; Air Standard Efficiency; Nomenclature of reciprocating piston-cylinder arrangement with basic definitions such as swept volume, clearance volume, compression ratio, mean effective pressure etc; Otto Cycle (or constant volume heat addition cycle), Diesel cycle (or constant pressure heat addition cycle) and Dual cycle (Mixed or Composite or Limited Pressure cycle) with their representation on P-V and T-S charts, their Air-standard (thermal) Efficiencies; Brayton Cycle, Comparison of Otto, Diesel and Dual cycle under some defined similar parametric conditions; Introduction to heat engines; Merits of I.C. Engines and their important applications, Classification and constructional features of I.C. Engines; working of two stroke and four stroke Petrol and Diesel engines and their comparison.

5. Engineering Materials **(05)**

Materials and Civilization, Materials and Engineering, Classification of Engineering Materials, Mechanical Properties of Materials: elasticity, plasticity, strength, ductility, brittleness, melleability, toughness, resilience, hardness, machinability, formability, weldability. Properties, Composition, and Industrial Applications of materials: metals (ferrous- cast iron, tool steels, stainless steels and non ferrous- Aluminum, brass, bronze), polymers (natural and synthetic , thermoplastic and thermosetting), ceramics (glass, optical fibre glass, cements), composites (fibre reinforced, metal matrix), smart materials (piezoelectric, shape memory, thermochromic, photochromic, magnetorheological), Conductors, Semiconductors and insulators, Organic and Inorganic materials. Selection of materials for engineering applications.

6. Centroid, Centre of Gravity and Moment of Inertia: **(08)**

Difference between centre of gravity and centroid. Determination of position of centroid of plane geometric figures of I, U, H, L, T, C, Circular and Triangular Sections. Centroid of Composite Areas. Determination of position of Centre of Gravity (CG) of regular solids viz. Right Circular Cone, Solid Hemisphere, thin Hollow Hemisphere. Area moment of inertia & mass moment of inertia, Polar moment of inertia, Parallel axes Theorem (or transfer formula), Perpendicular axes Theorem, Radius of gyration, determination of area Moment of Inertia of I, U, H, L, T, C, Circular and Triangular Sections along various axes. Mass moment of Inertia of Circular Ring, Disc, Cylinder, Sphere and Cone about their axis of symmetry and other axes.

Suggested Readings / Books

1. Nag P.K., Engineering Thermodynamics, Tata McGraw Hill.
2. Yadav R., Thermodynamics and Heat Engines, Central Publishing House, Allahabad
3. Rogers G. and Mayhew Y., Engineering Thermodynamics, Pearson Education.
4. Cengel Y.A. and Boles M.A., Thermodynamics - An Engineering Approach, Tata McGraw Hill.
5. Rao Y.V.C., An Introduction to Thermodynamics, New Age International (P) Limited Publishers.
6. Spalding D. B., Cole E. H., Engineering thermodynamics, ELBS series
7. Bedi D.S., Element of Mechanical Engineering, Khanna Publishers New Delhi
8. Donald R. Askeland, Pradeep P. Phule, Essentials of materials Science and Engineering, Cenage Learning
9. A.K.Tayal Engineering Mechanics, Umesh Publications.

BTCS 101 Fundamentals of Computer Programming and IT

Objective/s and Expected outcome:

To familiarize the students of all branches in engineering with computer organization, operating systems, problem solving and programming in C++. After the students have successfully completed the course, they shall have sufficient knowledge of the basic computer operations and various programming techniques especially in C++.

PART A (Fundamentals of Computer and IT) (25%)

1. **Introduction to Computers**

   Define a Computer System, Block diagram of a Computer System and its working, associated peripherals, memories, RAM, ROM, secondary storage devices, Computer Software and Hardware. **(2)**

2. **Working Knowledge of Computer System**

   Introduction to the operating system, its functions and types, working knowledge of GUI based operating system, introduction to word processors and its features, creating, editing, printing and saving documents, spell check, mail merge, creating power point presentations, creating spreadsheets and simple graphs, evolution of Internet and its applications and services. **(3)**

3. **Problem Solving & Program Planning**

   Need for problem solving and planning a program; program design tools - algorithms, flow charts, and pseudocode; illustrative examples. **(2)**

PART B (Basics of Programming Using C++) (75%)

4. **Overview of C++ Language**

   Introduction to C++ language, structure of a C++ program, concepts of compiling and linking, IDE and its features; Basic terminology - Character set, tokens, identifiers, keywords, fundamental data types, literal and symbolic constants, declaring variables, initializing variables, type modifiers.

   (3)

5. **Operators and expressions**

Operators in C++, precedence and associativity of operators, expressions and their evaluation, type conversions.

(2)

6. **Beginning with C++ program**

Input/output using extraction (>>) and insertion (<<) operators, writing simple C++ programs, comments in C++, stages of program execution.

(4)

7. **Control Structures**

Decision making statements: if, nested if, if - else. Else if ladder, switch, Loops and iteration: while loop, for loop, do - while loop, nesting of loops, break statement, continue statement, goto statement, use of control structures through illustrative programming examples.

(4)

8. **Functions**

Advantages of using functions, structure of a function, declaring and defining functions, return statement, formal and actual arguments, const argument, default arguments, concept of reference variable, call by value, call by reference, library functions, recursion, storage classes. Use of functions through illustrative programming examples.

(4)

9. **Arrays and Strings**

Declaration of arrays, initialization of array, accessing elements of array, I/O of arrays, passing arrays as arguments to a function, multidimensional arrays. String as array of characters, initializing string variables, I / O of strings, string manipulation functions (strlen, strcat, strcpy, strcmp), passing strings to a function. Use of arrays and strings through illustrative programming examples.

(4)

10. **Concepts of Object Oriented Programming**

Introduction to Classes, Objects, Data abstraction, Data encapsulation, inheritance and polymorphis.

(2)

11. **Classes and Objects**

Head
Department of Electrical Engineering
Technical University

Defining classes and declaring objects, public and private keywords, constructors and destructors, defining member functions inside and outside of a class, accessing members of a class, friend function. Use of classes and objects through illustrative programming examples.

(4)

12. Basics of File Handling

Opening, reading, and writing of files, error handling during files operation. **(2)**

Suggested Readings/ Books

1. E. Balagurusamy, Object-Oriented Programming with C++, Tata McGraw Hill.
2. P. K. Sinha and Priti Sinha, Computer Fundamentals, BPB Publications.
3. Lafore R., Object Oriented Programming in C++, Waite Group.
4. Bjarne Stroustrup, The C++ Programming Language, Addison Wesley.
5. Lippman F. B, C++ Primer, Addison Wesley.
6. R. S. Salaria, Computer Concepts and Programming in C++, Salaria Publishing House.
7. Gurvinder Singh, Krishan Saluja, Fundamentals of Computer Programming & IT, Kalyani Publishers.
8. R. S. Salaria, Fundamentals of Computers, Salaria Publishing House.

HVPE 101 Human Values & Professional Ethics

Objective/s and Expected outcome:

To help the students to discriminate between valuable and superficial in the life. To help develop the critical ability to distinguish between essence and form, or between what is of value and what is superficial, in life - this ability is to be developed not for a narrow area or field of study, but for everyday situations in life, covering the widest possible canvas. To help students develop sensitivity and awareness; leading to commitment and courage to act on their own belief. It is not sufficient to develop the discrimination ability, it is important to act on such discrimination in a given situation. Knowingly or unknowingly, our education system has focused on the skill aspects (learning and doing) - it concentrates on providing to its students the skills to do things. In other words, it concentrates on providing "How to do" things. The aspects of understanding "What to do" or "Why something should be done" is assumed. No significant cogent material on understanding is included as a part of the curriculum. A result of this is the production of graduates who tend to join into a blind race for wealth, position and jobs. Often it leads to misuse of the skills; and confusion and wealth that breeds chaos in family, problems in society, and imbalance in nature. This course is an effort to fulfill our responsibility to provide our students this significant input about understanding. This course encourages students to discover what they consider valuable. Accordingly, they should be able to discriminate between valuable and the superficial in real situations in their life. It has been experimented at IIITH, IITK and UPTU on a large scale with significant results.

PART A

1. **Course Introduction - Need, Basic Guidelines, Content and Process for Value Education**
   - Understanding the need, basic guidelines, content and process for Value Education.

Head
Department of Electrical Engineering
Punjab Technical University

- Self Exploration-what is it?- its content and process; „Natural Acceptance" and Experiential Validation- as the mechanism for self exploration.
- Continuous Happiness and Prosperity- A look at basic Human Aspirations
- Right understanding, Relationship and Physical Facilities- the basic requirements for fulfillment of aspirations of every human being with their correct priority
- Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
- Method to fulfill the above human aspirations: understanding and living in **harmony** at various levels (6)

2. Understanding Harmony in the Human Being - Harmony in Myself!

- Understanding human being as a co-existence of the sentient „I" and the material „Body"
- Understanding the needs of Self („I") and „Body" - *Sukh* and *Suvidha*
- Understanding the Body as an instrument of „I" (I being the doer, seer and enjoyer)
- Understanding the characteristics and activities of „I" and harmony in „I"
- Understanding the harmony of I with the Body: *Sanyam* and *Swasthya*; correct appraisal of Physical needs, meaning of Prosperity in detail
- Programs to ensure *Sanyam* and *Swasthya* (6)

3. Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship

- Understanding harmony in the Family- the basic unit of human interaction
- Understanding values in human-human relationship; meaning of *Nyaya* and program for its fulfillment to ensure *Ubhay-tripti*; Trust (*Vishwas)* and Respect (*Samman)* as the foundational values of relationship
- Understanding the meaning of *Vishwas*; Difference between intention and competence
- Understanding the meaning of *Samman*, Difference between respect and differentiation; the other salient values in relationship
- Understanding the harmony in the society (society being an extension of family): *Samadhan, Samridhi, Abhay, Sah-astitva* as comprehensive Human Goals

- Visualizing a universal harmonious order in society- Undivided Society (*Akhand Samaj),* Universal Order (*Sarvabhaum Vyawastha*)- from family to world family! (6)

PART B

4. Understanding Harmony in the Nature and Existence - Whole existence as Co-existence

- Understanding the harmony in the Nature
- Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self-regulation in nature
- Understanding Existence as Co-existence (*Sah-astitva*) of mutually interacting units in all-pervasive space
- Holistic perception of harmony at all levels of existence (4)

5. Implications of the above Holistic Understanding of Harmony on Professional Ethics

- Natural acceptance of human values
- Definitiveness of Ethical Human Conduct
- Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
- Competence in professional ethics:
  - Ability to utilize the professional competence for augmenting universal human order
  - Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems
  - Ability to identify and develop appropriate technologies and management patterns for above production systems.
- Case studies of typical holistic technologies, management models and production systems
- Strategy for transition from the present state to Universal Human Order:
  - At the level of individual: as socially and ecologically responsible engineers, technologists and managers
  - At the level of society: as mutually enriching institutions and organizations (6)

Head
Department of Electrical Engineering
Punjab Technical University

Recommended Books:

1. R R Gaur, R Sangal, G P Bagaria, 2009, *A Foundation Course in Value Education.*

Suggested Readings / Books:

2. Ivan Illich, 1974, *Energy & Equity,* The Trinity Press, Worcester, and HarperCollins, USA
3. E.F. Schumacher, 1973, *Small is Beautiful: a study of economics as if people mattered*, Blond & Briggs, Britain.
4. A Nagraj, 1998, *Jeevan Vidya ek Parichay,* Divya Path Sansthan, Amarkantak.
5. Sussan George, 1976, *How the Other Half Dies,* Penguin Press. Reprinted 1986, 1991
6. PL Dhar, RR Gaur, 1990, *Science and Humanism*, Commonwealth Purblishers.
7. A.N. Tripathy, 2003, *Human Values*, New Age International Publishers
8. Subhas Palekar, 2000, *How to practice Natural Farming,* Pracheen(Vaidik) Krishi Tantra Shodh, Amravati.
9. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, *Limits to Growth - Club of Rome's report*, Universe Books.
10. E G Seebauer & Robert L. Berry, 2000, *Fundamentals of Ethics for Scientists & Engineers ,* Oxford University Press
11. M Govindrajran, S Natrajan & V.S. Senthil Kumar, *Engineering Ethics (including Human Values)*, Eastern Economy Edition, Prentice Hall of India Ltd
12. B P Banerjee, 2005, *Foundations of Ethics and Management,* Excel Books.
13. B L Bajpai, 2004, *Indian Ethos and Modern Management*, New Royal Book Co., Lucknow. Reprinted 2008.

Punjab Technical University

PTU/ DA/ 17th May 2011
B. Tech. 1st & 2nd Semester Batch-2011

BTCH 102 Engineering Chemistry Laboratory

1. Analysis of Effluents

- Determination of water by EDTA method.
- Determination of H_2O by dissolved oxygen analyzer.
- Determination of turbidity by Nephelometer
- Determination of Residual Chlorine.

2. Analysis of Fuels and Lubricants

- Determination of Moisture, Volatile and ash content by proximate analysis.
- Determination of Flash & Fire point by Abee"s Apparatus
- Determination of the viscosity.
- Determination of Acid Value and Aniline point of oil
- Determination of refractive index for oils.

3. Instrumental Analysis

- Determination λ-max by spectrophotometer and determination of unknown conc of binary mixture of two liquids.
- Determination of the surface tension by stalagmometer.
- Determination of the concentration of a solution conductometerically.
- Determination of the strength of a solution pH meterically.
- Distinction between acid, ester, ketone using IR spectrophotometer.
- Determination of bathochromic shifts, hypsochromic and hyperchromic, hypochromic shift of benzene and its derivatives

4. Chromatography

- Determination of Rf value of amino acid by TLC and identification of the amino acid present.
- Separation of metallic ions by paper chromatography.
- Separation of Ions by using complexing agents
- Separation of plant pigments, Chlorophyll and carotenoids by column chromatography.
- Determination of the ion exchange capacity of the given ion exchanger.
- Separation of ions by ion-exchange method.

5. Synthesis & Green Chemistry experiments

- Preparation of a polymer phenol/urea formaldehyde resin or hexamethylenediamine adipic acid polymer and determination of carbonyl value or acid value.
- Preparation of aspirin.
- Preparation of ethyl-2-cyano-3-(4"-methoxyphenyl)-propeonate (Microwave assisted reaction)
- Base catalyzed aldol condensation by Green Methodology
- Acetylation of primary amines using ecofriendly method.

Note: Each student is required to perform two experiments from each of the 5 titles (presented bold) depending on his/her Branch and Aptitude.

Suggested Readings / Books

1. Vogel A-I, Quantitative Inorganic Analysis, Oxford ELBS
2. Vogel A-I, Quantitative Organic Analysis, Oxford ELBS

3. dst.gov.in/green-chem.pdf (monograph of green chemistry laboratory experiments)

BTME 102 Engineering Drawing

Objective and Expected Outcome:

Main objective of the Engineering Drawing is to introduce the students to visual science in the form of technical graphics. General instructions related to Theory of Orthographic Projection of points, lines, planes and solids as per the BIS codes prevalent to drawing practice will be introduced initially. Section of solids, intersection and development of surfaces, isometric projection and orthographic projection of simple solids/blocks will further upgrade the basic understanding and visualization of geometrical objects and to certain extent the machine parts. Computer graphics will enable the students to strengthen the understanding through hands on training on any CAD software wherein they will be introduced to a number of assignments as mentioned in the said course.

PART A

1. Introduction

Engineering Drawing/Engineering Graphics/Technical Drawing - a Visual Science. Types of Engineering Drawing, Introduction to drawing equipment and use of instruments. Symbols and conventions in drawing Practice. Types of lines and their use, BIS codes for lines, Technical lettering as per BIS codes, Introduction to Dimensioning, Concepts of scale in drawing, Types of scales. Basic Definition of geometrical objects: Points, lines, planes and solids.

2. Theory of Projections

Relevance of projection, Type of projections, Perspective, Orthographic, Axonometric and their basic principles, System of orthographic projection: in reference to quadrants and octants, illustration through simple problems of projection.

3. Projection of Points

Projection of points in quadrants and octants. Projection of point on Auxiliary planes.

4. Projection of Lines

Parallel to both H P and V P, Parallel to one and inclined to other, and inclined to both, contained in profile plane. True length and angle orientation of straight line: rotation method and auxiliary plane method. Distance between two nonintersecting lines, and trace of line.

5. Projection of Planes

Difference between plane and lamina. Projection of lamina Parallel to one and perpendicular to other, Perpendicular to one and inclined to other, Inclined to both reference planes, and Lamina oblique to three reference planes. Application of auxiliary planes, and trace of planes.

6. Projection of Solids

Definition of solids, types of solids, and elements of solids. Projection of solids in first or third quadrant, with axis parallel to one and perpendicular to other, axis parallel to one inclined to other, axis inclined to both the principle plane, axis perpendicular to profile plane and parallel to both H P and V P. Visible and invisible details in the projection. Use rotation and auxiliary plane method to draw the projections.

PART B

7. Section of Solids

Definition of Sectioning and its purpose. Procedure of Sectioning, Types of sectional planes. Illustration through examples.

8. Intersection of Surfaces/Solids

Purpose of intersection of surfaces, Intersection between the two cylinder, two prisms, prism and pyramid, pyramid and pyramid, cylinder and prism, cone and cylinder, sphere and cylinder etc., use of cutting plane and line method.

9. Development of Surface

Purpose of development, Parallel line, radial line and triangulation method. Development of prism, cylinder, cone and pyramid surface for both right angled and oblique solids, and development of surface of sphere.

10. Isometric Projection

Classification of pictorial views, Basic Principle of Isometric projection, Difference between isometric projection and isometric drawing. Isometric projection of solids such as cube, prism, pyramid and cylinder, and assignments on isometric projection of simple machine parts.

11. Orthographic Projection

Review of principle of Orthographic Projection, Sketch/drawing of blocks, and of simple machine parts.

<u>**Suggested Readings / Books**</u>

1. Narayana K L and Kanaiah P, "Engineering Graphics", Tata McGraw Hill Publishing Company Limited, New Delhi.
2. Gill P S, "Engineering Graphics and Drafting", Katria and Sons, Delhi.
3. Bhat N D, "Elementary Engineering Drawing-Plane and solid Geometry", Chartotar Publishing House, Anand.
4. Luzzadde Warren J, "Fundamentals of Engineering Drawing", Prentice Hall of India Private Limited, New Delhi.
5. Bertoline G R , Wiebe E N, Miler G L L & Mother J L, "Technical Graphics Communication", Irwin McGraw Hill, New York.
6. A Text Book of Engg Drawing by R. K. Dhawan, S. Chand and Co. Ltd

Head
Department of Electrical Engineering
Punjab Technical University

BTCS102 Fundamentals of Computer Programming and IT

1. **Familiarization with the Computer System:**
   - To explain the part of the computer system such as system unit, input devices, output devices connected to the computer.
   - To explore the outside view of the system unit that includes the panels on front and ports at the rear
   - To explore the inside view of the system unit that includes the motherboard, processor, expansion slots, various add-on cards, storage devices, power supply, fans.
   - To understand the booting process that includes switching on the system, execution of POST routine, then bootstrap loader, and loading of the operating system, and getting it ready for use.
   - To introduce the graphical user interface (desktop) of Windows operating system
     - to explain the various elements of the desktop such as taskbar, icons (My Computer, Recycle Bin, etc.), short cuts, notification area.
     - to configure the desktop that include selecting the wall paper, selecting the screen saver with or without password protection, selecting the screen resolution and color quality.
2. **Navigating with Window Explorer:**
   - To navigate with the drives
   - To create new folders
   - To move folders from one drive to another drive
   - To move files from one folder to another folder
   - To search files and folders
   - To share files and folders
   - To view and/or change the attributes of the files and folders
3. **Working with Control Panel:**
   - To work with date and time
   - To create new user accounts
   - To install new hardware and configuring existing hardware
   - To install new software or remove existing installed software

 To configure network connections
To manage security profile

4. **Miscellaneous Features:**

 To work at the command prompt

 To open an application, folder, document or internet resource from the Run command

 To initialize storage media (formatting)

 To understand the menace of viruses

 To understand the working of virus guards and antivirus s oftware

5. **Exploring the Internet:**

 To understand the working of the internet that include the use of protocols, domains, IP addresses, URLs, web browsers, web servers, mail-servers, etc. To create email-account, sending mails, receiving mails, sending files as attachments, etc.

 To login to a remote computer

 To search information using search engines

6. **Microsoft Word:**

 To familiarize with parts of Word window To create and save a document

 To set page settings, create headers and footers To edit a document and resave it

 To use copy, cut and paste features

 To use various formatting features such as bold face, italicize, underline, subscript, superscript, line spacing, etc.

 To use spelling and grammar checking feature To preview print a document

7. **Microsoft Word continued:**

 To create a table with specified rows and columns To enter data in a table

 To select a table, a row, a column or a cell

 To inset new row and/or a column

 To delete a row and/or a column

 To split and merge a row, column or a cell

Head
Department of Electrical Engineering
Punjab Technical University
144006

 To understand the mail-merge and to use mail merge feature of MS-Word

8. **Microsoft Excel:**

 To familiarize with parts of Excel window

 To create and save a workbook with single and/or multiple worksheets To edit and format text as well numbers

 To apply operations on range of cells using built-in formulae To preview and print a worksheet

9. **Microsoft Excel continued:**

 To insert new row and/or column in a worksheet To delete a row and/or column in a worksheet To create a variety of charts

 To import and export data to or from worksheet

10. **Microsoft PowerPoint:**

 To familiarize with parts of PowerPoint window To create and save a new presentation

 To apply design templates to a presentation To insert, edit and delete a slide

 To use different views of slides

 To use slide show from beginning or from the current slide To preview and print a presentation

11. **Microsoft PowerPoint continued:**

 To check spellings in a presentation

 To add clip art and pictures in a slide

 To add chart, diagram and table in a slide

 To set animation for a selected slide and/or for entire presentation To create slide master and title master

 To create a custom show

12. Write a program to find the nature of the roots as well as value of the roots. However, in case of imaginary roots, find the real part and imaginary part separately.

13. Write a program, which takes two integer operands and one operator form user, performs the operation and then prints the result. (Consider the operators +,-,*, /,

% and use *switch* statement).For example, the input should be in the form: 5 + 3 the output should comes Result = 8

14. Fibonacci sequence is defined as follows: the first and second terms in the sequence are 0 and 1. Subsequent terms are found by adding the preceding two terms in the sequence. Write a program to generate the first *n* terms of the sequence. For example, for *n* = 8, the output should be 0 1 1 2 3 5 8 13

15. Write a program to print all the prime numbers between *m* and *n*, where the value of *m* and *n* is supplied by the user.

16. The number such as 1991, is a palindrome because it is same number when read forward or backward. Write a program to check whether the given number is palindrome or not.

17. A positive integer number IJK is said to be *well-ordered* if I<J<K. For example, number 138 is called *well-ordered* because the digits in the number (1, 3, 8) increase from left to right, *i.e.*, 1 < 3 < 8. Number 365 is not *well-ordered* because 6 is larger than 5. Write a program that will find and display all possible three digit *well-ordered* numbers. The program should also display the total number of three digit *well-ordered* numbers found.

18. Write a function to computer the highest common factor of integer numbers *m* and *n*. Use this function to find the highest common factor of integer numbers *a* and *b*.

19. Given the marks (out of 100) obtained by each student in a test of a class with *n* students. Write a program to obtain the following information:

(*a*) minimum and maximum marks score

(*b*) average score of the class, and

(*c*) number of students whose score is greater than class's average score

20. Write a program to multiply matrix $A_{m \times n}$ by $B_{p \times q}$, given that $n = p$.

21. Write a program to sort a list of *n* integer numbers in descending order using bubble sort method.

Head
Department of Electrical Engineering
Punjab Technical University
Jalandhar-144006

22. Create a class named *Student* with the appropriate data members and member functions to generate output comprising student's admission no., name, marks in five subjects and the %age of marks obtained. Write a program to use the *Student* class.

23. Create a class named *ComplexNumber* with the appropriate data members and constructors. Include member functions (defined inside the class) to perform the following operations:

(*a*) Inputting a complex number

(*b*) Outputting a complex number

(*c*) Arithmetic operations on two complex numbers

Write an appropriate program to demonstrate use of the *ComplexNumber* class.

24. Create a class named *Height* with *feet* and *inches* as its data members. Also include appropriate constructors (and destructor, if required). Include member functions (defined outside the class) to perform the following operations:

(*a*) Inputting a height of a person

(*b*) Displaying a height of a person

(*c*) To get height in inches

(*d*) To compare two heights

Write an appropriate program to demonstrate use of the *Height* class.

Note: Students are required to prepare a file containing lab exercises based on programming only, where as the oral examination will from the entire syllabus.

BTME 103 Engineering Computer Graphics Laboratory

Objective/s and Expected outcome:

Main objective of the Engineering Drawing is to introduce the students to visual science in the form of technical graphics. General instructions related to Theory of Orthographic Projection of points, lines, planes and solids as per the BIS codes prevalent to drawing practice will be introduced initially. Section of solids, int ersection and development of surfaces, isometric projection and orthographic projection of simple solids/blocks will further upgrade the basic understanding and visualization of geometrical objects and to certain extent the machine parts.

Lab Work I: Involves hands-on practice sessions related to 2-D computer sketching.

Exercise 1: Study and draw 2-D sketching entities like lines, rectangle, parallelogram polygon, circle etc., under SKETCH ENTITY MENU.

Exercise 2: (a) Rectangular array (b) Circular array

Exercise 3: Sketch of Metal grate

Exercise 4: Slotted Base

Exercise 5: Link

Exercise 6: Base Plate (Extruding the sketch)

Exercise 7: Bush (Revolve)

Exercise 8: Handle (Revolve)

Exercise 9: Flange coupling parts

Exercise 10: Bell Crank Lever

Lab Work-II: Using the geometric shape and size data learnt in Lab Work I, extrude or revolve the sketch to obtain 3-D drawing. Study and practice various options available for 3-D drawing.

Exercise-1: Bracket Lever

Exercise 2: Hand Wheel

Exercise 3: Hexagonal Nut and Bolt

Exercise 4: Keys

Exercise 5: Body of Solid Journal Bearing

Exercise 6: Shaft

Exercise 7: Cup of Screw Jack

Exercise 8: Screw Jack Body

Exercise 9: V-Block

Exercise 10: Gland

PUNJAB TECHNICAL UNIVERSITY

Scheme& Syllabus of
B. Tech. Electrical Engineering [EE]

Batch 2011

By
Board of Studies Electrical Engineering

69

Punjab Technical University

B.Tech Electrical Engineering (EE) Batch 2011

Note: There will be 04 weeks BTEE309 Institutional training after 2nd semester.
"S" for Satisfactory and US for unsatisfactory

Semester –III

Course Code	Course Title	L	T	P	Marks Distribution Internal	Marks Distribution External	Total Marks	Credits
BTAM-301	Engineering Mathematics-III	4	1	-	40	60	100	5
BTEE-301	Circuit Theory	4	1	-	40	60	100	5
BTEE-302	Transformers & Direct Current Machines	4	1	-	40	60	100	5
BTEE-303	Electrical Measurements & Instrumentation	4	1	-	40	60	100	5
BTEE-304	Electronic Devices and Circuits	4	1	-	40	60	100	5
BTEE-305	Laboratory-I (Semiconductor Devices and Circuit Theory)	-	-	2	30	20	50	1
BTEE-306	Laboratory-II (Electrical Machines -I)	-	-	2	30	20	50	1
BTEE-307	Laboratory-III (Electrical Measurements)	-	-	2	30	20	50	1
BTEE-309	Institutional Training (Undertaken after 2nd semester)				60	40	100	S/US
	Total	**20**	**5**	**6**	**350**	**400**	**750**	**28**

Semester –IV

Course Code	Course Title	L	T	P	Marks Distribution Internal	Marks Distribution External	Total Marks	Credits
BTEE-401	Asynchronous Machines	3	1	-	40	60	100	4
BTEE-402	Linear Control Systems	4	1	-	40	60	100	5
BTEE-403	Electromagnetic Fields	3	1	-	40	60	100	4
BTEC-404	Digital Electronics	3	1	-	40	60	100	4
BTEE-405	Power System-I (Transmission & Distribution)	3	1	-	40	60	100	4
BTEE-406	Power Plant Engineering	3	1	-	40	60	100	4
BTEE-407	Laboratory-IV (Instrumentation & Measuring Devices)	-	-	2	30	20	50	1
BTEE-408	Laboratory-V (Control System)	-	-	2	30	20	50	1
BTEC-409	Laboratory-VI (Electronic Circuits)	-	-	2	30	20	50	1
General Fitness					100	-	100	S/US
	Total	**19**	**6**	**6**	**430**	**420**	**850**	**28**

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University

Note: There will be 04 weeks BTEE509 Institutional training after 4th semester.
"S" for Satisfactory and US for unsatisfactory

Semester –V

Course Code	Course Title	L	T	P	Marks Distribution		Total Marks	Credits
					Internal	External		
BTEE-501	Synchronous Machines	4	1	-	40	60	100	5
BTEE-502	Electric Generation & Economics	4	1	-	40	60	100	5
BTEE-503	Microprocessors	4	1	-	40	60	100	5
BTEE-504	Power Electronics	4	1	-	40	60	100	5
BTEE-505	Numerical & Statistical Methods	4	1	-	40	60	100	5
BTEE-506	Laboratory-VII (Electrical Machines-II)	-	-	2	30	20	50	1
BTEE-507	Laboratory-VIII (Numerical Analysis)	-	-	2	30	20	50	1
BTEE-508	Laboratory-IX (Electrical: Estimation & Costing)	-	-	2	30	20	50	1
BTEE-509	Industrial Training (Undertaken after 4th semester)				60	40	100	S/US
	Total	**20**	**5**	**6**	**350**	**400**	**750**	**28**

Semester –VI

Course Code	Course Title	L	T	P	Marks Distribution		Total Marks	Credits
					Internal	External		
BTEE-601	Electric Power Utilization	3	1	-	40	60	100	4
BTEE-602	Power System-II (Switch Gear & Protection)	3	1	-	40	60	100	4
BTEE-603	Non-Linear & Digital Control Systems	4	1	-	40	60	100	5
BTEE-604	Microcontroller and PLC	3	1	-	40	60	100	4
BTYY-6XX	Open Elective	3	1	-	40	60	100	4
BTEE-605X	Elective-I	3	1	-	40	60	100	4
BTEE-606	Laboratory-X (Power Electronics & Drives)	-	-	2	30	20	50	1
BTEE-607	Laboratory-XI (Power System-II)	-	-	2	30	20	50	1
BTEE-608	Laboratory-XII (Micro controller & PLC)	-	-	2	30	20	50	1
General Fitness					100	-	100	S/US
	Total	**19**	**6**	**6**	**430**	**420**	**850**	**28**

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

Punjab Technical University

B.Tech Electrical Engineering (EE) Batch 2011

Semester –VII/VIII					
Course Code	**Course Title**	**Marks Distribution**		**Total Marks**	**Credits**
		Internal	**External**		
Industrial Training (One semester)					
BTEE-701	Software Training	150	100	250	8
BTEE-702	Industrial oriented Project Training	300	200	500	10
	Total	**450**	**300**	**750**	**18**

Semester –VII/VIII								
Course Code	**Course Title**	**L**	**T**	**P**	**Marks Distribution**		**Total Marks**	**Credits**
					Internal	**External**		
BTEE-801	Power System Analysis	3	1	-	40	60	100	4
BTEE-802	High Voltage Engineering	4	1	-	40	60	100	5
BTEE-803	Non-conventional Energy Sources	3	1	-	40	60	100	4
BTEE-804Y	Elective-II	3	1	-	40	60	100	4
BTEE-805Z	Elective-III	3	1	-	40	60	100	4
BTEE-806	Lab-XIII (Power System Analysis)	-	-	2	30	20	50	1
BTEE-807	Project Work	-	-	6	60	40	100	4
BTEE-808	Seminar	-	-	2	100	-	100	2
General Fitness					100	-	100	S/US
	Total	**16**	**5**	**10**	**490**	**360**	**850**	**28**

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

Elective	**Electrical Power Systems**	
Elective-I **(BTEE-605X)**	BTEE-605A	Computer Aided Electrical Machine Design
	BTEE-605B	Flexible AC Transmission Systems
Elective-II **(BTEE-804Y)**	BTEE-804A	Power System Operation and Control
	BTEE-804B	Energy Auditing and Management
Elective-III **(BTEE-805Z)**	BTEE-805A	Power Quality Monitoring and Conditioning
	BTEE-805B	HVDC Transmission
Elective	**Instrumentation and Control**	
Elective-I **(BTEE-605X)**	BTEE-605C	Instrumentation in Power System
	BTEE-605D	Biomedical instrumentation
Elective-II **(BTEE-804Y)**	BTEE-804C	Digital Signal Processing
	BTEE-804D	Industrial Process Control
Elective-III **(BTEE-805Z)**	BTEE-805C	Virtual Instrumentation
	BTEE-805D	Energy Efficient Machines
Elective	**Electronics and Computers**	
Elective-I **(BTEE-605X)**	BTEE-605E	Principles of Communication Systems
	BTEE-605F	Microelectronics Technology
Elective-II **(BTEE-804Y)**	BTEE-804E	Networks and Data Communication
	BTEE-804F	Data Mining and Pattern Recognition
Elective-III **(BTEE-805Z)**	BTEE-805E	Embedded Systems
	BTEE-805F	Visual Programming

OPEN ELECTIVES – offered by Electrical engineering department to be studied by other discipline students except Electrical Engineering and Electrical Engineering & Industrial Control students	
BTEE-609	Fundamentals of Electrical Machines
BTEE-610	Energy Auditing & Management
BTEE-611	Non-Conventional Energy Sources
BTEE- 612	Electrical Measurements

OPEN ELECTIVES –likely to be offered by other departments to be studied by Electrical Engineering students	
BTCE-6XX	Fluid Mechanics
BTHU-6XX	Entrepreneurships
BTME-6XX	Business Process and Re-engineering
BTHU-6XX/HU-251	Human Resource Management
BTAM-6XX/ CH-304	Optimization Techniques
BTCS-6XX/CS-304	Introduction to Business Systems
BTME-6XX/ME-251	Total Quality Management

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

BTEE-301 CIRCUIT THEORY

Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**4**	**1**	**0**
Total Marks:	**100**				

CIRCUITS CONCEPTS: Independent and dependent sources, Signals and wave forms: Periodic and singularity voltages, step, ramp, impulse, doublet, loop currents and loop equations, node voltage and node equations, Network Theorems: Superposition, Thevenin's, Norton's, Maximum Power Transfer, and Reciprocity.

TIME AND FREQUENCY DOMAIN ANALYSIS: Representation of basic circuits in terms of generalized frequency and their response, Laplace transform of shifted functions, transient and steady response, Time domain behaviors from poles and zeros, Convolution Theorem.

NETWORK SYNTHESIS: Network functions, Impedance and admittance function, Transfer functions, Relationship between transfer and impulse response, poles & zeros and restrictions, Network function for two terminal pair network, Sinusoidal network in terms of poles & zeros, Real liability condition for impedance synthesis of RL & RC circuits, Network synthesis techniques for 2-terminal network, Foster and Cauer forms.

FILTERS SYNTHESIS: Classification of filters, characteristics impedance and propagation constant of pure reactive network, Ladder network, T-section, π-section, terminating half section, Pass bands and stop bands, Design of constant-K, m-derived filters, Composite filters.

RECOMMENDED BOOKS:

1. Bird John, *Electrical Circuit Theory and Technology*, 2nd Ed., Newnes
2. Chakraborty, Abhijit, *Circuit Theory*, 2nd Edition, Dhanpat Rai, 2001
3. Chaudhury D. Roy, *Networks & Synthesis*, New Age International.
4. Edminister J.A., *Electric Circuits*, 4th Edition, Tata McGraw Hill, 2002
5. Iyer T.S.K.V., *Circuit Theory*, Tata McGraw Hill, 2006
6. Mohan, Sudhakar Sham, *Circuits & Networks Analysis and Synthesis*, 2nd Edition, Tata Mc Graw Hill, 2005
7. Van Valkenberg, M.E., *Network Analysis & Synthesis*, PHI learning, 2009
8. Van Valkenberg, M.E., *Network Analysis & Synthesis*, 3rd Edition, Pearson Education, 2006

***Note:** External question paper shall be set following guidelines to paper setter given at Page 61.*

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144606

BTEE-302 TRANSFORMERS AND DIRECT CURRENT MACHINES

Internal Marks:	**40**	**L**	**T**	**P**
External Marks:	**60**	**4**	**1**	**0**
Total Marks:	**100**			

TRANSFORMERS: Working principle, construction of single phase transformer, EMF equation, phasor diagrams on no-load and on loaded conditions, open circuit and short circuit tests, equivalent circuit parameters estimation, voltage regulation and efficiency, back to back test. Effect of saturation on exciting current and in-rush current phenomenon. Parallel operation of single phase transformers.

AUTO TRANSFORMERS: Principle of operation, equivalent circuit and phasor diagrams, comparison with two winding transformer.

THREE-PHASE TRANSFORMERS: Different types of winding connections, Voltage and current ratios, Parallel operation of three phase transformers. Three winding transformer's equivalent circuit, off-load and on-load tap changing transformer, Scott connections. Testing of transformers.

D.C. GENERATOR: Working principle , construction of DC Machines, Armature windings, single and double layer winding diagrams, E.M.F. and torque equations, armature reaction, effect of brush shift, compensating winding, commutation, causes of bad commutation, methods of improving commutation, methods of excitation of d.c. generators and their characteristics.

D.C. MOTOR: Working principle characteristics, starting of shunt and series motor, starters, speed control methods: field and armature control. Braking: plugging, dynamic and regenerative braking, Testing: Swinburn's test, Hopkinson test, Field test. Estimation of losses and efficiency.

BOOKS RECOMMENDED:

1. Bimbhra P.S., *Electrical Machinery, Khanna Publishers*
2. Fitzgerald A.E., Kingsley C. and Umans S.D., *Electric Machinery*, 6th Edition, McGraw Hill
3. Langsdorff E.H., *Principles of D.C. machines*, McGraw Hill
4. Nagrath I.J. and Kothari D.P., *Electrical Machines*, 4th Edition, Tata McGraw Hill,
5. Say M G, *Alternating Current Machines*, 5th edition, Sir Isaac Pitman & Sons Ltd.

Note: *External question paper shall be set following guidelines to paper setter given at Page 61.*

BTEE-303 ELECTRICAL MEASUREMENTS AND INSTRUMENTATION

Internal Marks: 40
External Marks: 60
Total Marks: 100

L	T	P
4	1	0

UNITS, DIMENSIONS AND STANDARDS: Introduction to MKS & Rationalised MKSA System, SI Units, Standards of EMF, Resistance, Capacitance and Inductance, Systematic errors

GENERAL THEORY OF ANALOG MEASURING INSTRUMENTS: Operating torque, damping & controlling torque, T/W ratio, Pointers & Scales. Principles of operation of various types of electro mechanical indicating / registering instruments viz. PMMC, dynamometer, induction, thermal, etc. for dc & ac measurement of voltage, current, power, frequency, phase & power factor etc., energy meter: their sources of error & compensation, shunts & multipliers, multi-meter.

POTENTIOMETERS: Basic D.C. potentiometer circuit, Modern form of D.C. potentiometer, measurement of voltage, current, Resistance and calibration of voltmeter & ammeter using D.C. potentiometer, volt ratio box, Self balancing potentiometer, A.C. potentiometers and their applications.

BRIDGES: Sources and Detectors, General equation for bridge balance, Wheatstone bridge and its sensitivity analysis, Kelvin double bridge, AC bridges: applications and conditions for balance, Maxwell's bridge, Hay's bridge, Schering bridge, Wien bridge, DeSauty's bridge, Insulation testing, Sources of errors in bridge circuits, Shielding of bridge elements, Wagner Earthling Device.

MAGNETIC MEASUREMENTS: Flux meter, B-H Curve, Hysteresis loop, Permeameters, AC Testing of Magnetic materials, Separation of iron losses, iron loss measurement by Wattmeter and Bridge methods.

INSTRUMENT TRANSFORMERS: Theory and construction of current and potential transformers, ratio and phase angle errors and their minimization, Characteristics of current transformers (CT).and potential transformers (PT). and their Testing.

BOOKS RECOMMENDED:

1. Bell David A., *Electronics Instrumentation and Measurements,* Prentice Hall, India
2. Golding Edward William and Widdis Frederick Charles, *Electrical Measurements and Measuring instruments,* Wheelers India
3. Helfrick A.D. and Cooper W.D., Modern *Electronic Instrumentation. & Measurement Techniques*, Prentice Hall
4. Murthy D. V. S., Transducers and Instrumentation, Prentice-Hall, India
5. Sawhney A. K., *A Course in Electrical & Electronics Measurement & Inst*rumentation., Dhanpat Rai & Sons.

Note: *External question paper shall be set following guidelines to paper setter given at Page 61.*

BTEE-304 ELECTRONIC DEVICES AND CIRCUITS

Internal Marks:	**40**		L	T	P
External Marks:	**60**		4	1	0
Total Marks:	**100**				

BASIC SEMICONDUCTOR AND DIODES: Intrinsic and extrinsic semiconductors, diffusion and drift currents, p-n junction under open-circuit, reverse bias and forward-bias conditions, p-n junction in the breakdown region, Ideal diode, terminal characteristics of junction diode, Load-line analysis of diode circuits, half wave rectifier and full wave rectifiers, Clippers and Clampers, capacitive filters, RC and LC filter, voltage multipliers. Principles, construction, characteristics and applications of Zener diodes, Light Emitting Diodes, Schottky Diode, Varactors

BIPOLAR AND UNIPOLAR TRANSISTORS: Bipolar junction transistor (BJT)- physical structure and modes of operation, Transistor characteristic and parameters, Common Base, Common Emitter and Common Collector Configurations, Transistor biasing, Transistor as a switch, Basics characteristics of an amplifier, Simple transistor model (r_e model), Common Emitter, Common Collector and Common base amplifiers, hybrid equivalent circuit, H-parameters, circuit analysis using h-parameters. Junction field effect transistor (JFET): Characteristics, parameters and biasing. Metal oxide field effect transistor (MOSFET): Characteristics, parameters and biasing. Class a power amplifier, Class B, Class AB Push-pull and Class C-amplifiers.

INTEGRATED CIRCUIT AND OPERATIONAL-AMPLIFIERS: Introduction to IC's, Op-Amps, Op-Amp Characteristics, Feedback, Different feedback configurations, Current– to–voltage converter and voltage-to-current converters, voltage and current amplifiers, mathematical operations using Op-Amp, summing, differential, integrating amplifiers, Comparators and Schmitt trigger

OSCILLATORS AND ACTIVE FILTERS: Oscillations, Feedback oscillator Principles,, RC phase shift oscillator, Wein bridge oscillator, Hartley oscillator, Colpitts oscillator, Crystal oscillators, frequency stability, negative resistance in oscillators. Active Filters (1st order) with low pass, high pass, band pass, band stop and all pass. Pin configuration of 555 timer, 555 timer as Oscillator: monostable, bistable and astable multivibrator.

REGULATED POWER SUPPLIES: Unregulated power supplies, line and load regulations, Zener diode voltage regulators, transistor series and shunt regulators, current limiting, Op-Amp voltage regulators, integrated circuit (LM-3XX) voltage regulators. Introduction to switching regulators. Working of Switched Mode Power Supply (SMPS).

BOOKS RECOMMENDED

1. Boylestad, Robert.L. *Electronic Devices and Circuit Theory,* Pearson Education
2. Cathey Jimmie J., *Theory and Problems of Electronic Devices and Circuits*, McGraw-Hill
3. Floyd Thomas L., *Electronic Devices*, Pearson Education
4. Gayakwad, Ramakant A. *OP-AMPS and Linear Integrated Circuits*, Prentice Hall of India
5. Malvino Albert Paul and Bates David, *Electronic Principles,* edition 7th, Tata McGraw Hill
6. Millman Jacob, *Integrated Electronic Devices and Circuits*, Tata McGraw Hill

Note: *External question paper shall be set following guidelines to paper setter given at Page 61.*

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

BTEE-305 Laboratory-I (Semi-conductor Devices and Circuit Theory)

			L	T	P
Internal Marks:	30		0	0	2
External Marks:	20				
Total Marks:	50				

List of Experiments:

1. To draw V-I characteristics of PN junction diode (Ge, Si, switching and signal).
2. To design half wave rectifier.
3. To design full wave and bridge rectifiers.
4. To study transistor characteristics in common base and common emitter configurations.
5. To study the FET characteristics.
6. To design, study and compare various transistor biasing techniques.
7. To design regulated power supply using zener diode/ voltage regulator IC.
8. To study of an emitter follower circuit.
9. To verify Superposition theorem.
10. To verify Norton's theorem.
11. To verify Thevenin's theorem.
12. To verify maximum power transfer theorem.
13. To study the response of constant K-filters.
14. To study the response of m-derived filters
15. Diode clippers and clampers.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144606

BTEE-306 Laboratory-II (Electrical Machines-I)

Internal Marks:	**30**	L	T	P
External Marks:	**20**	0	0	2
Total Marks:	**50**			

List of Experiments

1. To Load test on a single phase transformer.
2. To perform Open circuit and short circuit tests on a single phase transformer and hence find equivalent circuit, voltage regulation and efficiency.
3. To find the efficiency and voltage regulation of single phase transformer under different loading conditions.
4. To perform parallel operation of two single phase transformers.
5. To study the various connections of three phase transformer.
6. To perform Scott connections on three phase transformer to get two phase supply.
7. To study the constructional details of direct current (d.c.) machine and to draw sketches of different components.
8. To measure armature and field resistance of direct current (d.c.) shunt generator and to obtain its open circuit characteristics.
9. To obtain load characteristics of direct current (d.c.) shunt/series /compound generator.
10. To draw speed-torque characteristics of direct current (d.c.) shunt/series /compound generator.
11. To study direct current (d.c.) motor starters.
12. To perform Swinburne's test (no load test) to determine losses of direct current (d.c.) shunt motor.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

BTEE-307 Laboratory-III (Measurements)

Internal Marks:	**30**	**L**	**T**	**P**
External Marks:	**20**	**0**	**0**	**2**
Total Marks:	**50**			

List of experiments:

1. Study of principle of operation of various types of electromechanical measuring instruments.
2. a) To measure high value of DC current by a Low Range DC Ammeter and Shunt.
   b) To measure high value of DC voltage by a Low Range DC Voltmeter and Multiplier
3. a) To measure high value of AC Current by a Low Range AC Ammeter and Current Transformer.
   b) To measure high value of AC Voltage by Low Range Voltmeter and Potential Transformer
   Measurement of resistance using Wheatstone Bridge.
4. To measure active and reactive power in 3 phase balanced load by one wattmeter method.
5. To measure the active power in three phase balanced and unbalanced load by two wattmeter method and observe the effect of power factor variation on wattmeter reading.
6. To calibrate and use the Induction Energy Meter.
7. Measurement of resistance using Kelvin's Bridge.
8. Measurement of self inductance using Anderson's Bridge.
9. Measurement of capacitance using Schering Bridge.
10. Plotting of Hysteresis loop for a magnetic material using flux meter.
11. Measurement of frequency using Wein's Bridge.
12. To study the connections and use of Current and potential transformers and to find out ratio error.
13. Determination of frequency and phase angle using CRO.
14. Measurement of unknown voltage using potentiometer.
15. To find 'Q' of an inductance coil and verify its value using Q- meter.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144606

BTEE-401 ASYNCHRONOUS MACHINES

Internal Marks:	**40**	**L**	**T**	**P**
External Marks:	**60**	**3**	**1**	**0**
Total Marks:	**100**			

POLYPHASE INDUCTION MACHINES: Analogy between induction motor and transformer, production of rotating field in space distributed three-phase winding, constructional features, concept of slip and operation, rotor frequency, current and power, equivalent circuit, phasor diagram, torque-slip characteristics, effect of rotor circuit resistance, starting torque, crawling and cogging, cage motors(double cage and deep bar motor).

STARTING METHODS AND SPEED CONTROL: Starting methods, speed control: (i) control of speed of rotating field, (ii) control of slip speed. Effect of voltage injection in rotor circuit of slip ring induction motor. Motor tests for estimation of equivalent circuit parameters.

INDUCTION GENERATOR: Isolated and Grid mode operation, method of excitation, performance characteristics of three-phase self-excited induction generator.

SPECIAL PURPOSE MOTORS: Stepper Motors: construction, principle of operation and applications. Linear Induction Machines: construction, principle of operation and applications. Universal Motor: construction, principle of operation and applications.

SINGLE –PHASE MOTORS: Double revolving field theory, types of single phase motors, characteristics and equivalent circuit. Shaded pole motor: working principle and characteristics.

BOOKS RECOMMENDED:

1. Fitzgerald A.E., Kingsley C. and Umans S.D., *Electric Machinery*, 6th Edition, McGraw Hill
2. Langsdorff E.H., *Principles of A.C. Machines*, McGraw Hill
3. Nagrath I.J. and Kothari D.P., *Electrical Machines*, 4th Edition, Tata McGraw Hill,
4. Bimbhra P.S., *Electrical Machinery, Khanna Publishers*
5. Say M G, *Alternating Current Machines*, 5th edition, Sir Isaac pitman & Sons Ltd.

Note: *External question paper shall be set following guidelines to paper setter given at Page 61.*

Head
Department of Electrical Engineering
I K. Gujral Punjab Technical University
Kapurthala-144006

BTEE-402 LINEAR CONTROL SYSTEMS

Internal Marks: 40
External Marks: 60
Total Marks: 100

L	T	P
4	1	0

INTRODUCTORY CONCEPTS: Plant, Systems, Servomechanism, regulating systems, disturbances, Open loop control system, closed loop control systems, linear and non-linear systems, time variant and invariant, continuous and sampled-data control systems, Block diagrams, some illustrative examples.

MODELING: Formulation of equation of linear electrical, mechanical, thermal, pneumatic and hydraulic system, electrical, mechanical analogies. Use of Laplace transforms, Transfer function, concepts of state variable modeling. Block diagram representation, signal flow graphs and associated algebra, characteristics equation.

TIME DOMAIN ANALYSIS: Typical test – input signals, Transient response of the first and second order systems. Time domain specifications, Dominant closed loop poles of higher order systems. Steady state error and coefficients, pole-zero location and stability, Routh-Hurwitz Criterion.

ROOT LOCUS TECHNIQUE: The extreme points of the root loci for positive gain. Asymptotes to the loci, Breakaway points, intersection with imaginary axis, location of roots with given gain and sketch of the root locus plot.

FREQUENCY DOMAIN ANALYSIS: Closed loop frequency response, Bode plots, stability and loop transfer function. Frequency response specifications, Relative stability, Relation between time and frequency response for second order systems. Log. Magnitude versus Phase angle plot, Nyquist criterion for stability.

COMPENSATION: Necessity of compensation, series and parallel compensation, compensating networks, applications of lag and lead-compensation.

CONTROL COMPONENTS: Error detectors – potentiometers and synchros, servo motors, a.c. and d.c. techno generators, Magnetic amplifiers.

BOOKS RECOMMENDED

1. Dorf Richard C. and Bishop Robert H., *Modern Control System*, Addison –Wesley, Pearson New Delhi
2. Ogata K., *Modern Control Engineering*", Prentice Hall,
3. Kuo B. C., *Automatic Control System*", Prentice Hall
4. Nagrath I.J. and Gopal M., *Control System Engineering*, Wiley Eastern Ltd.

Note: *External question paper shall be set following guidelines to paper setter given at Page 61.*

BTEE-403 ELECTROMAGNETIC FIELDS

Internal Marks:	**40**		L	T	P
External Marks:	**60**		3	1	0
Total Marks:	**100**				

REVIEW OF VECTOR ANALYSIS: Vector analysis, Physical interpretation of gradient, divergence and curl; vector relations in other coordinate systems, integral theorems: divergence theorem, stoke's theorem, green's theorem and Helmholtz theorem.

ELECTROSTATICS: Introduction to fundamental relations of electrostatic field; Gauss's law and its applications; potential function; Field due to continuous distribution of charges; Equipotential surfaces; Divergence theorem; Poisson's equation and Laplace's equation, capacitance, electrostatic energy, Conditions at Boundary between dielectrics, Uniqueness theorem.

STEADY MAGNETIC FIELD: Magnetic induction and Faraday's laws; magnetic Flux Density; magnetic field strength and magnetomotive force; Ampere's work Law in the differential vector form; permeability; energy stored in a magnetic field ; ampere's force law; magnetic vector potential, Analogies between electric and magnetic fields.

MAXWELL'S EQUATIONS AND POYNTING VECTOR: Equation of continuity for time varying fields, Inconsistency of ampere's law, Maxwell's equations in integral and differential form for static and time varying fields, conditions at a Boundary surface, Concept of Poynting vector, Poynting Theorem, Interpretation of ExH

ELECTROMAGNETIC WAVES: Solutions for free-space conditions; Uniform plane Wave Propagation; Wave equations for a conducting medium; Sinusoidal time variations; Polarization; Conductors and Dielectrics; Direction Cosines; Reflection by Perfect Conductor -normal and oblique incidence, Perfect Dielectric-normal incidence, Perfect Insulator –Oblique incidence; Brewster angle, Reflection at a surface of Conductive medium, Surface impedance.

BOOKS RECOMMENDED

1. Edward C. Jordan and Keith G Balmain, *Electromagnetic Waves and Radiating Systems*, Prentice-Hall Inc.
2. Kraus John D. *Electromagnetics, McGraw-Hill Publishers*
3. Edminister Joseph A., *Schaum's Theory and Problems of Electromagnetics, McGraw-Hill*
4. Rao N. Narayana, *Elements of Engineering Electromagnetics, Pearson Education*

Note: *External question paper shall be set following guidelines to paper setter given at Page 61.*

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

BTEC-404 DIGITAL ELECTRONICS

Internal Marks:	**40**	**L**	**T**	**P**
External Marks:	**60**	**3**	**1**	**0**
Total Marks:	**100**			

NUMBER SYSTEM & CODES: Binary number system, octal number system, hexadecimal number system, BCD Code, Gray code, signed & unsigned binary numbers, 1's & 2's complement of a number, different types of codes, Binary operations- addition, subtraction, multiplication, division, Parity for error detection, Check sum and Hamming Code for error detection and correction.

COMBINATIONAL CIRCUITS: Concept of positive and negative logic, Introduction to Boolean variables, Boolean theorems and DeMorgan Theorem, Sum of product and Product of sum form of Logic expressions, Duality, Logical functions using Karnaugh map and Quine-McClusky methods, multiplexers, demultiplexers, encoders, decoders, adders, subtractors, parity generators, parity checkers, code converters.

SEQUENTIAL LOGIC CIRCUITS: Flip-flops, JK flip-flops, D flip-flops, T flip- flops, SR flip- flops, edge triggered and clocked flip-flops. Registers and Counters: Series and Parallel registers; Synchronous & Asynchronous counters, Up and Down counters, Ring counters & Mod- Counters.

INTRODUCTION TO VHDL: Overview of digital design with very-high-speed integrated circuits (VHSIC) hardware description language (VHDL), HDL format and Syntax, entity, Data representation in VHDL, Truth table using VHDL, Decision Control structure and Sequential Circuit using VHDL.

DIGITAL LOGIC FAMILIES: Introduction, characteristics of digital ICs, resistor-transistor logic, integrated-injection logic, direct-coupled transistor logic, diode-transistor logic & transistor-transistor logic, emitter-coupled logic and MOS logic

DIGITAL TO ANALOG (D/A) AND ANALOG TO DIGITAL (A/D) CONVERTERS: Introduction, weighted register *D/A* converter, binary ladder, *D/A* converter, specifications for *D/A* converters, parallel *A/D* converter, successive approximation *A/D* converter single & dual slope *A/D* converter, *AID* converter using voltage to frequency conversion, *A/D* converter using voltage to time conversion, countertype *AID* converters.

SEMICONDUCTOR MEMORIES: Introduction, memory organization, classification & characteristics of memories, sequential memories, read only memories, read & write memories, content addressable memories, Programmable array Logic, programmable logic arrays and Programmable Logic Device, Field Array Programmable Gate array

RECOMMENDED BOOKS:

1. Floyd Thomas S. *Digital Fundamentals*, Pearson Education
2. Jain R.P., *Modern digital Electronics*, Tata McGraw Hill
3. Kumar Anand, *Fundamentals of Digital Circuits*, Prentice Hall of india
4. Malvino Albert Paul, *Principles of Digital Electronics*, Tata McGraw Hill
5. Mano Morris, *Digital Logic and Computer Design*, Prentice Hall of India
6. Tocci Ronald J. Widmer Neal S. and Moss Gregory L., *Digital Systems: Principles and Applications*, Prentice Hall of India

Note: *External question paper shall be set following guidelines to paper setter given at Page 61.*

BTEE-405, POWER SYSTEMS – I (Transmission and Distribution)

Internal Marks:	**40**	L	T	P
External Marks:	**60**	3	1	0
Total Marks:	**100**			

SUPPLY SYSTEM: Introduction to Transmission and Distribution systems, Comparison between DC and AC systems for Transmission and Distribution, comparison of cost of conductors, choice of working voltage for transmission and distribution, economic size of conductors - Kelvin's law, Radial and mesh distribution networks, Voltage regulation.

CONDUCTORS AND TRANSMISSION LINE CONSTRUCTION: Conductor materials; solid, stranded, ACSR, hollow and bundle conductors. Different types of supporting structures for overhead lines. Elementary ideas about transmission line construction and erection. Stringing of conductors, spacing, sag and clearance from ground, overhead line insulators, concept of string efficiency.

TRANSMISSION LINE PARAMETERS: Introduction to line parameters, Resistance of transmission line, inductance of single phase two wire line, concept of G.M.D., Inductance of three phase line, Use of bundled conductor, transposition of power lines, capacitance of 1-phase and 3-phase lines. effect of earth on capacitance of conductors.

PERFORMANCE OF TRANSMISSION LINES: Representation of short transmission line, medium length line (nominal T & II circuits). long length line by hyperbolic equations and equivalent T & II circuits. Power flow through transmission lines, ABCD constants, Voltage regulation.

CIRCLE DIAGRAM AND LINE COMPENSATION: Receiving end circle diagram for long transmission lines based on ABCD constants, equivalent T circuits, power loci, surge impedance loading, reactive power requirement of system series and shunt compensation, Synchronous phase modifiers , rating of phase modifiers.

UNDERGROUND CABLES: Classification of cables based upon voltage and dielectric material, insulation resistance and capacitance of single core cable, dielectric stress, Capacitance of 3 core cables, methods of laying, heating effect, Maximum current carrying capacity, cause of failure, comparison with overhead transmission lines.

RECOMMENDED BOOKS

1. Elgerd O.L., *Electrical Energy System Theory - An introduction*, Tata McGraw-Hill Publication
2. Gupta B.R., Power System Analysis & Design, Wheeler Publishing.
3. Nagrath I.J. and Kothari D.P., Power System Analysis Tata McGraw-Hill Publication
4. Stevenson Jr. W.D., *Elements of Power System Analysis*, Tata McGraw-Hill Publication
5. Wadhwa C.L., *Course in Electrical Power*, New Age International (P)Ltd.

Note: *External question paper shall be set following guidelines to paper setter given at Page 61.*

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144603

BTEE-406 POWER PLANT ENGINEERING

Internal Marks:	**40**	**L**	**T**	**P**
External Marks:	**60**	**3**	**1**	**0**
Total Marks:	**100**			

STEAM GENERATORS, CONDENSERS AND TURBINES: Classification of steam generators, selection, operation of locomotive, Babcock Wilcox, Cochran boilers, Types of condensers, effect of air in condensers, Dalton's law of partial pressure, cooling water calculations, steam nozzles, types of steam turbine efficiencies, compounding, governing and control.

STEAM POWER PLANT: Classification, Operation, Description of Rankin cycle, Regenerative cycle, Reheat-Regenerative Cycle, Binary Vapour Cycle, Selection of plant site and its layout, coal handling system, combustion system, Fluidised bed combustion, Ash handling, Feed pumps, Heat exchangers, Economizers, Super heaters, Reheaters, Air preheaters, Feed water heaters, Evaporators.

HYDRO-ELECTRIC POWER PLANTS: Hydrological Cycle, Hydrograph, Flow duration curve, Selection of site, Essential features, Classification of hydro plants, Selection of water turbines for hydro power plant, Automatic and remote control of hydro-station, layout of hydro power plant.

NUCLEAR POWER PLANTS: Nuclear physics, Binding energy, Radioactive decay. Fertile material, Mass defect, Nuclear reactions type and application, Generation of nuclear energy by fission, Nuclear reactors. Site selections, safety measures, plant layout, Fusion reaction, Future of nuclear power.

GAS TURBINE: Elements of gas turbines, Open and closed cycles for gas turbines, Performance terms, Thermal refinement to gas turbines cycle, Plant layout, applications, gas turbines Cycle calculations.

DIESEL POWER PLANTS: Classifications of IC Engines and their performance, Four stroke and two stroke diesel engines, combustion phenomenon; Essential components, Celane number, knocking, super charging, operation and layout of diesel power plant.

COMBINED OPERATION OF DIFFERENT POWER PLANTS: Advantages of combined operation of plants, load division between power stations, coordination of different types of Power Plants.

POLLUTION CONTROL: Pollution from thermal & nuclear plants, Particulate emission and control, electrostatic precipitator, solid waste disposal.

RECOMMENDED BOOKS:

1. Chakrabarti A., Soni, M.L. Gupta P.V. and Bhatanagar U.S., *A Textbook on Power System Engineering*, Dhanpat Rai & Co.
2. El-Wakit M.M., *Power Plant Engineering*, McGraw Hill, USA
3. Rajput R.K., *Power Plant Engineering*, Luxmi Publications
4. Sharma P.C., *Power Plant Engineering*, Kataria & Sons
5. Skrotzki B.G.A. and Vapot W.A., *Power Station Engineering and Economy*, Tata McGraw-Hill

Note: *External question paper shall be set following guidelines to paper setter given at Page 61.*

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University

BTEE-407 Laboratory-IV (Instrumentation & Measuring Devices)

Internal Marks:	**30**	**L**	**T**	**P**
External Marks:	**20**	**0**	**0**	**2**
Total Marks:	**50**			

List of Experiments:

1. To study the input-output characteristics of a potentiometer and to use a potentiometer as an error detector.
2. To measure Insulation Resistance by Megger.
3. To measure earth resistance by Earth Tester.
4. To observe phase sequence of three phase circuit using Rotating type Phase Sequence Indicator.
5. To measure frequency of A.C. supply using Weston Frequency Meter.
6. To measure power factor of single phase and three phase load by PF Meter and verifying through current, voltage and power measurement.
7. To measure circuit parameters and three phase load by PF Meter by LCR Meter.
8. Measurement of displacement using LVDT.
9. Temperature measurement using temperature sensor (RTD).
10. Light measurement using LDR and photo cell censor.
11. Water level measurement using capacitance transducer of a Liquid in a Tank
12. Velocity measurement using air flow transducer.
13. RPM measurement using electromagnetic transducers.
14. Study of the characteristics of a Piezoresistive Sensor for Pressure Measurement of a Liquid in a Tank
15. Study of the characteristics of Resistance Temperature Detector(RTD)
16. Study of the characteristics of a Thermistor
17. Study of the characteristics of a Thermocouple
18. Study of the characteristics of an Electromagnetic Flowmeter
19. Study of the characteristics of a Tachometer
20. Study of the characteristics of a Photo reflective sensor for Speed Measurement

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

BTEE-408 Laboratory-V (Control System)

Internal Marks: 30
External Marks: 20
Total Marks: 50

L	T	P
0	0	2

List of Experiments:

1. To study the characteristics of potentiometers and to use 2- potentiometers as an error detector in a control system.
2. To study the synchro Transmitter-Receiver set and to use it as an error detector
3. To study the Speed – Torque characteristics of an AC Servo Motor and to explore its applications.
4. To study the Speed – Torque characteristics of an DC Servo Motor and explore its applications.
5. To study various electro-mechanical transducers i.e. resistive, capacitive and inductive transducers
6. To study a LVDT (AC-AC, DC-DC) as a transducer and its processing circuits
7. To study the characteristics of a thermocouple, a thermistor and a RTD
8. To study photo-conductive cell, semi-conductor photodiode and a silicon photo voltaic cell
9. To study a silicon phototransistor and obtain response of photo conductive cell
10. To study the variations of time lag by changing the time constant using control engineering trainer
11. To simulate a third order differential equations using an analog computer and calculate time response specifications
12. To obtain the transfer function of a D.C. motor – D.C. Generator set using Transfer Function Trainer
13. To study the speed control of an A.C. Servo Motor using a closed loop and an open loop systems
14. (i) To study the operation of a position sensor and study the conversion of position in to corresponding voltage
    (ii) To study an PI control action and show its usefulness for minimizing steady state error of time response.
15. To measure Force / Displacement using Strain Gauge in a wheat stone bridge
16. To design a Lag compensator and test its performance characteristics.
17. To design a Lead-compensator and test its performance characteristics.
18. To design a Lead-Lag compensator and test its performance characteristics.

Note: At least 10 Experiments, out of above list of experiments are to be performed in the semester.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

BTEC-409 Laboratory-VI (Electronic Circuits)

			L	T	P
Internal Marks:	**30**				
External Marks:	**20**		**0**	**0**	**2**
Total Marks:	**50**				

List of Experiments:

1. To design a voltage regulator using zener diode and also see the effect of line and load regulation
2. To design various clippers and clampers using diodes.
3. To obtain the frequency response of an amplifier and calculate the gain bandwidth of the amplifier.
4. To investigate the emitter follower (Buffer) amplifier and determine A_V,R_i,R_O
5. To study the characteristics of a class B amplifier and also calculate the overall efficiency.
6. To study the characteristics of a class AB amplifier.
7. To study the characteristics symmetry amplifier.
8. To design and study various type of oscillators and to determine the frequency of oscillations.
9. To design a transistor series voltage regulator with current limits and observes current feedback characteristics.
10. To study the characteristics of a complementary symmetry amplifier.
11. Application of Op-Amp(741) as inverting and non-inverting amplifier.
12. To use the OP-AMP as summing, scaling and averaging amplifier.
13. Design differentiator and integrator using OP-AMP and also determine the time constant and cut-off frequency.
14. Application of OP-AMP as Schmitt Trigger.
15. Design a delay circuit using 555 timer and study the monostable, bistable and astable operations using 555.
16. a) Verification of the truth tables of TTL gates viz; 7400,7402, 7404, 7408,7432,7486.
    b) Design and fabrication and realization of all gates using NAND/NOR gates.
17. Verification of truth table of Mutiplexer(74150)/Demultiplexer(74154)
18. Design and verification of truth tables of half-adder, full-adder and subtractor circuits using gates 7483 and 7486(controlled inverter).
19. To study the operation of Arithmetic Logic Unit IC 74181.
20. Design fabrication and testing of
    a) Monostable multivibrator of t = 0.1ms approx. using 74121/123.testing for both positive and negative edge triggering, variation in pulse width and retriggering.
    b) Free running mutivibrator at 1KHz and 1Hz using 555 with 50% duty cycle. Verify the timing from theoretical calculations.
21. Design and test S-R flip-flop using NOR/NAND gates.
22. Design, fabricate and test a switch debouncer using 7400.
23. Verify the truth table of a JK flip flop using IC 7476,
24. Verify the truth table of a D flip flop using IC 7474 and study its operation in the toggle and asynchronous mode.
25. Operate the counters 7490, 7493 and 74193(Up/Down counting mode). Verify the frequency division at each stage. Using a frequency clock (say 1 Hz) display the count of LED's.
26. Verify the truth table of decoder driver7447/7448. Hence operate a 7 segment LED display through a counter using a low frequency clock. Repeat the above with the BCD to Decimal decoder 7442.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144606

99

BTEE-501 SYNCHRONOUS MACHINES

Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**4**	**1**	**0**
Total Marks:	**100**				

GENERAL ASPECTS: Construction and working principle of synchronous machines, Excitation systems, production of sinusoidal electromotive force (EMF), flux and magnetomotive force (MMF) phasors in syn. machines; cylindrical and salient pole rotors.

WINDINGS: Classification of windings, pitch factor, distribution factor. Electromagnetic Force equation.

ALTERNATORS: Construction, Phasor diagram of cylindrical rotor alternator, ratings, nature of armature reaction, determination of synchronous reactance; open-circuit characteristics, short-circuit characteristics, short-circuit ratio, short-circuit loss. Effect of variation of power factor on voltage. Determination of voltage regulation: EMF method, MMF. method. Zero power factor (Z.P.F).method. Alternator on infinite bus bar, operation at constant load and variable excitation, power flow through inductive impedance. Power-angle characteristics of synchronous machines:- cylindrical and salient pole. Two reaction theory of salient pole machines, power factor control.

SYNCHRONOUS MOTORS: Operating characteristics, power-angle characteristics, conditions for maximum power developed. V-curves and inverted V-curves, methods of starting, synchronous motors applications, synchronous condensers. Hunting and damper windings.

PARALLEL OPERATION OF ALTERNATORS: Conditions for proper synchronizing for single phase and three phase alternators, conditions for parallel operation, synchronizing power, current and torque, effect of increasing excitation of one of the alternators, effect of change of speed of one of the alternators, effect of unequal voltages, load sharing.

TRANSIENTS: Transient reactances and time constants from equivalent circuits, synchronous machine reactances and their determination, Short circuit. Oscillogram, Synchronization with the grid system, Qualitative introduction to the transient stability of the synchronous machines.

SINGLE PHASE SYNCHRONOUS MOTORS: Reluctance and Hysteresis motors.

BOOKS RECOMMENDED:

6. Bimbhra P.S., *Electrical Machinery, Khanna Publishers*
7. Fitzgerald A.E., Kingsley C. and Umans S.D., *Electric Machinery*, 6th Edition, McGraw Hill
8. Langsdorff E.H., *Principles of D.C. machines*, McGraw Hill
9. Nagrath I.J. and Kothari D.P., *Electrical Machines*, 4th Edition, Tata McGraw Hill,
10. Say M G, *Alternating Current Machines*, 5th edition, Sir Isaac Pitman and Sons Ltd.

***Note:** External question paper shall be set following guidelines to paper setter given at Page 61.*

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

BTEE-502 ELECTRIC GENERATION AND ECONOMICS

Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**4**	**1**	**0**
Total Marks:	**100**				

Introduction: Electrical energy sources, organization of power sector in India, single line diagram of thermal, hydro and nuclear power stations. Classification of power plants in base load and peak load plants

Loads and Load curves: Types of load (fixed voltage loads, resistive loads, Inductive motor loads, Mechanical load), effect of load on supply voltage, Maximum demand, Group diversity factor, Peak diversity factor, Types of load, chronological load curves, load-duration Curve, mass curves, load factor, capacity factor, utilization factor, base load and peak load plants, load forecasting.

Power Plant Economics: Capital cost of plants, annual fixed cost, operating costs and effect of load factor on cost of energy, depreciation.

Tariffs and power factor improvement: Objectives of tariff making, different types of tariff (domestic, commercial, agricultural and industrial loads). Need for power factor (p.f.) improvement, power factor improvement using capacitors, determination of economic power factor.

Selection of plant: Plant location, plant size, number and size of units in plants, economic comparison of alternatives based on annual cost, rate of return, present worth and capitalized cost methods.

Economic operation of steam plants: Methods of loading turbo-generators, input- output curve, heat rate, incremental cost, method of Lagrangian multiplier, effect of transmission losses, co-ordination equations, and iterative procedure to solve co-ordination equations.

Hydro-thermal co-ordination: Advantages of combined working of Run-off River plant and steam plant, reservoir hydro plants and thermal plants, long-term operational aspects, scheduling methods.

Pollution and environmental problems: Energy and environment, Air pollution, Aquatic impacts, nuclear plant and hydro plant impacts.

Cogeneration: Definition and scope, Topping and Bottoming Cycles, Benefits, cogeneration technologies.

BOOKS RECOMMENDED:

6. Deshpande M.V., *Power Plant Engineering,* Tata McGraw Hill (2004).
7. EI-Wakit M.M., *Power Plant Engineering*, McGraw Hill, USA
8. Rajput R.K., *Power Plant Engineering*, Luxmi Publications
9. Sharma P.C., *Power Plant Engineering*, Kataria and Sons
10. Skrotzki B.G.A. and Vapot W.A., *Power Station Engineering and Economy*, Tata McGraw-Hill
11. Arora S.C. and Dom Kundwar S., A course in *Power Plant Engineering,* Dhanpat Rai.
12. Nag, P.K., *Power Plant Engineering,* Tata McGraw Hill
13. Gupta B.R., *Generation of Electrical Energy,* S. Chand (1998).
14. Nagrath I.J. and Kothari D.P., Power System Analysis Tata McGraw-Hill Publication
15. Chakrabarti A., Soni, M.L. Gupta P.V. and Bhatanagar U.S., *A Textbook on Power System Engineering,* Dhanpat Rai and Co.

Note: *External question paper shall be set following guidelines to paper setter given at Page 61.*

BTEE-503 MICROPROCESSORS

Internal Marks:	**40**	**L**	**T**	**P**
External Marks:	**60**	**4**	**1**	**0**
Total Marks:	**100**			

Introduction to Microprocessors: Types of computers, Microprocessor evolution and types, Central Processing Unit (CPU) operation and terminology, idea of 8- bit, 16-bit, 32-bit and 64- bit Microprocessors from Intel, Motorola and Zilog and their comparisons.

Introduction to 8-bit Microprocessor: 8085 Microprocessor architecture, classification of instructions, Instruction format, and overview of the 8085 instruction set.

Introduction to 16-bit Microprocessor: 8086 Internal Architecture, Addressing modes, program development steps, 8086 instruction set, Assembler directives, Assembly language, program development tools.

Programming of 8086: Simple sequence programs, jumps, flags, conditional Jumps, IF-THEN, IF-THEN-ELSE, Multiple IF-THEN-ELSE, WHILE-DO, REPEAT-UNTIL, Instruction Timing and delay loops, strings, procedures, Macros.

8086 System Connections, Timing, Troubleshooting: Pin-diagram, maximum/minimum. modes, timing diagrams, use of logic analyzer to observe Bus signals, troubleshooting a simple 8086 based system

8086 Interrupts and Applications: 8086 Interrupts, responses and applications, 8254 software-programmable timer/counter, 8259 a priority Interrupt Controller

Interfacing of 8086: Programmable parallel ports and handshake, Interfacing a Microprocessor to Keyboards and alphanumeric displays, Digital to Analog (D/A) converter operation, interfacing and applications, Analog-to Digital *(A/D)* converter specifications and Interfacing.

BOOKS RECOMMENDED:

1. Gaonkar, Ramesh S. *Microprocessor Architecture, Programming and Applications with the 8085*, Penram International
2. Ram B, *Fundamentals of Microprocessors and Microcomputers*, Dhanpat Rai and Sons,
3. Hall, Douglas V. *Microprocessors and interfacing: Programming and Hardware*, Tata McGraw Hill
4. Brey, Barry B.Bray, *The INTEL Microprocessors 8086/88, 80186, 286, 386, 486, Pentium Pro Processors, Architecture, Programming and Interfacing*, 4th Edition, Prentice Hall (India)
5. Ray A.K. and Bhurchandi K.M., *Advanced Microprocessors and Peripherals*, Tata McGraw Hill.

Note: *External question paper shall be set following guidelines to paper setter given at Page 61.*

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

BTEE-504 POWER ELECTRONICS

Internal Marks:	**40**	**L**	**T**	**P**
External Marks:	**60**	**4**	**1**	**0**
Total Marks:	**100**			

Thyristors and their characteristics: Introduction to Thyristor family, V-I characteristics of silicon-controlled rectifier (SCR), gate turn-off thyristor (GTO), Bidirectional diode for alternating current (DIAC) and Bidirectional, Triode for Alternating Current (TRIAC). Principle of operation of silicon-controlled rectifier (SCR). Two transistor analogy. Turn on methods of a thyristor Switching characteristics of thyristors during tum-on and turn-off. Gate characteristics. Firing of thyristors. Gate triggering circuits. Series and parallel operation of silicon-controlled rectifiers (SCR) and their triggering circuits. Thyristor specifications; such as latching current and holding current, critical rate of rise of off-state voltage (dv/dt) and critical rate of rise of on-state current (di/dt) etc. Protection of SCR from over voltage and over current. Snubber circuits. Power dissipation.

Thyristor commutation techniques: Self commutation by resonating the load (Class A), Self commutation by LC circuit (class B), Complementary commutation (class C), Auxiliary commutation (class D), External pulse commutation (class E), AC Line commutation (class F).

Phase controlled techniques: Introduction to phase angle control. Single phase half wave controlled rectifiers. Single phase half controlled and full controlled bridge rectifiers. Three phase full controlled bridge rectifiers. Effect of resistive, inductive and resistive cum inductive loads. Basic circuit and principle of operation of Dual Converter, circulating current mode and non-circulating current mode of operation. Applications of rectifiers and dual converters to speed control of DC motor drives.

Choppers: Introduction of chopper, Basic chopper classification, Basic chopper operations. Control strategies, Chopper configuration, voltage commutated chopper, Current commutated chopper, Load commutated chopper.

Cycloconverters: Basic principle of operation, Single phase to. single phase cycloconverter. Three phase half wave cycloconverter. Advantages disadvantages of cycloconverters.

Inverters: Introduction & Classification of inverter. Operating principle, Single phase half bridge voltage source inverters, Single phase full bridge inverter. Modified McMurray half-bridge and full-bridge inverter. Three-phase bridge inverter. Voltage control (Pulse-width modulation (PWM) control etc.) and reduction of harmonics in the inverter output voltage. Series inverter.

Symbols and V-I characteristics of Silicon Unilateral Switch (SUS), Silicon Controlled Switch (SCS), Silicon Bilateral Switch (SBS), Unijunction Transistor (UJT), Programmable Unijunction Transistor (PUT), Light-activated silicon-controlled rectifier (LASCR), Reverse conducting Thyristors (RCT), Static Induction Thyristor (SITH), N- Metal Oxide Semiconductor Controlled Thyristor (N-MCT), Field Controlled Thyristors (FCT).

BOOKS RECOMMENDED:

1. Bimbhra, P.S., *Power Electronics*, Khanna Publishers.
2. Singh M.D. and Khanchandani K.B., *Power Electronics*, Tata Mc Graw Hill Publishing company limited.
3. Rashid M.H., *Power Electronics*, Circuits Devices and Applications, Prentice Hall (India)
4. Sen, P.C., *Power Electronics*, Tata McGraw Hill Publishing Company limited.
5. Bhattacharya S.K. and Chatterji, S. *Industrial Electronics and Control,* by New Age international Publications(P) Ltd, New Delhi.

Note: *External question paper shall be set following guidelines to paper setter given at Page 61.*

BTEE-505 NUMERICAL AND STATISTICAL METHODS

Internal Marks:	**40**	**L**	**T**	**P**
External Marks:	**60**	**4**	**1**	**0**
Total Marks:	**100**			

Floating-Point Numbers: Floating-point representation, Rounding, Chopping, Error analysis, Condition and instability.

Non-Linear Equations: Bisection, Fixed-point iteration and Newton-Raphson methods, Order of convergence.

Linear Systems and Eigen-Values: Gauss-elimination method (using Pivoting strategies) and Gauss-Seidel Iteration method. Rayleigh's power method for Eigen-values and Eigen-vectors

Interpolation: Lagrange's formula with error, divided difference, Newton's divided difference formula

Numerical Integration: Newton-Cote's quadrature formula (with error) and Gauss-Legendre quadrature formula.

Differential Equations: Solution of initial value problem using Taylor Series, Euler's and Runge-Kutta (up to fourth order) methods Statistical Methods

Random Variables: Definition, Probability distribution, Distribution functions, probability distribution function (pdf) and cumulative distribution function (cdf), Expectation and Variance.

Special Probability Distributions: Binomial, Poisson, Geometric, Uniform, Normal and Exponential distributions.

Sampling Distributions: Population and samples, Concept of sampling distributions, Sampling distribution of mean, Chi-square, t and F distributions (pdf only). Tests of Hypotheses: Basic ideas, Important tests based on normal, Chi-square, t and F distribution.

Curve Fitting: Method of least squares, Fitting of simple curves using this method, Regression and Correlation: (Two variables case only)

BOOKS RECOMMENDED:

1. Jain M.K., Iyengar, S.R.K., and Jain R.K., *Numerical Methods for Scientific and Engineering Computation,* New Age International (2008) 5th ed.
2. Conte, S.D and Carl D. Boor, *Elementry Numerical Analysis: An Algorithmic approach,* Tata McGraw Hill, New York (2005).
3. Johnson, R., Miller, I. and Freunds, J., *Probability and Statistics for Engineers,* Pearson Education(2005) 7th ed.
4. Gerald C.F and Wheatley P.O., *Applied Numerical Analysis,* Pearson Education (2008) 7th ed.
5. Mathew, J.H., *Numerical Methods for Mathematics, Science and Engineering,* Prentice Hall Inc.J (2002).
6. Meyer, P.L., *Introductory Probability and Statistical Applications,* Oxford (1970) 2nd ed.
7. Walpole, Ronald E., Myers, Raymond H., Myers, Sharon L. and, Keying Ye, *Probability and Statistics for Engineers and Scientists,* Pearson Education (2007) 8th ed
8. Sastry S.S., *Introductory Methods of Numerical Analysis*, Prentice Hall (India), (2002), 3rd ed.

Note: *External question paper shall be set following guidelines to paper setter given at Page 61.*

BTEE-506 Laboratory-VII (Electrical Machines-II)

Internal Marks:	**30**	**L**	**T**	**P**
External Marks:	**20**	**0**	**0**	**2**
Total Marks:	**50**			

Note: Atleast TEN experiments are to be performed in a semester. list of experiments is given below:

List of Experiments:

1. To perform load-test on three-phase Induction motor and to plot torque versus speed characteristics.
2. To perform no-load and blocked–rotor tests on three-phase Induction motor to obtain equivalent circuit. Parameters and to draw circle diagram.
3. To study the speed control of three-phase Induction motor by Kramer's Concept.
4. To study the speed control of three-phase Induction motor by cascading of two induction motors, i.e. by feeding the slip power of one motor into the other motor.
5. To study star- delta starters physically and
   a) to draw electrical connection diagram
   b) to start the three-phase Induction motor using it.
   c) to reverse the direction of three-phase Induction motor
6. To start a three-phase slip –ring induction motor by inserting different levels of resistance in the rotor ckt. And to plot torque –speed characteristics.
7. To perform no-load and blocked–rotor test on single-phase Induction motor and to determine the parameters of equivalent ckt. Drawn on the basis of double revolving field theory.
8. To perform load –test on single-phase. Induction motor and plot torque –speed characteristics.
9. To perform no load and short circuit. Test on three-phase alternator and draw open and short circuit characteristics.
10. To find voltage regulation of an alternator by zero power factor (ZPF.) method.
11. To study effect of variation of field current upon the stator current and power factor with synchronous motor running at no load and draw Voltage and inverted Voltage curves of motor.
12. To measure negative sequence and zero sequence reactance of Synchronous Machines.
13. Parallel operation of three phase alternators using
    - Dark lamp method
    - Two-Bright and one dark lamp method
14. To study synchroscope physically and parallel operation of three-phase alternators using synchroscope.
15. Starting of synchronous motors using
    - Auxiliary motor
    - Using Damper windings

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

BTEE-507 Laboratory-VIII (Numerical Analysis)

Internal Marks:	**30**		**L**	**T**	**P**
External Marks:	**20**		**0**	**0**	**2**
Total Marks:	**50**				

Note: Atleast TEN experiments are to be performed in a semester. list of experiments is given below:

List of Experiments:

To Develop algorithms/programs in C or C++ or FORTRAN-77/90/95 or MatLab language for the following methods

1. Lagrange's formula with error, divided difference for interpolation,
2. Newton's divided difference method for interpolation and extrapolation.
3. Bisection method for finding a real root of an equation.
4. Newton Raphson method for finding a real root of an equation.
5. Iteration method for finding a real root of an equation.
6. Gauss elimination method for solving simultaneous linear algebraic equations.
7. Gauss Jordan method for solving simultaneous linear algebraic equations.
8. Simpson's 1/3rd rule for numerical integration.
9. Newton's forward interpolation formula.
10. Lagrange's method for interpolation.
11. Euler's method for solving ordinary differential equations.
12. Runge-Kutta (up to fourth order) method for solving ordinary differential equations.
13. Curve fitting (linear and polynomial)

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

BTEE-508 Laboratory-IX (Electrical: Estimation and Costing)

Internal Marks:	**30**	**L**	**T**	**P**
External Marks:	**20**	**0**	**0**	**2**
Total Marks:	**50**			

Note: Atleast TEN experiments are to be performed in a semester. list of experiments is given below:

List of Experiments:

1. To study Indian electricity rules
2. To carryout wiring diagram of residential building, Educational institute and Industry. Giving selection of appropriate wiring, list materials and accessories for given project.
3. To study the design consideration of Panel Boards.
4. To study the design consideration of various electrical systems:
   a. 3 phase four wire distribution systems
   b. Earthing
5. To estimate the cost of a domestic installation (Residential building, laboratory room or Drawing hall etc) with concept of illumination design. TERI (The Energy Research Institute) recommendations on lighting schemes
6. To estimate the cost of industrial installation (Work shop, agriculture, flour mill etc).
7. To estimate the cost of overhead service connection (Single phase and three phase).
8. To estimate the cost of underground service connection (single phase and three phase).
9. To estimate the cost of overhead, 440 V, 3-phase, 4 wire or 3 wire distribution line.
10. To estimate the cost of underground, distribution line.
11. To estimate the cost of any one electrical appliance.
12. To estimate the cost of repairs and maintenance of any one domestic appliance.
13. To study various types of light sources and lighting schemes.
14. To make wiring diagrams of motor control circuits for starting of
    a. 3 phase induction motor
    b. Wound Motor
    c. Synchronous motor

RECOMMENDED BOOKS

1. Raina K.B. and Bhattacharya S.K., *Electrical Design, Estimating and Costing*, Tata McGraw Hill, New Delhi
2. Gupta J.B., *A course in Electrical Installation, Estimating and Costing*, SK Kataria and Sons, N.Delhi
3. Sharma B.R. and Rai H.M., *Electrical Estimating and Costing*
4. Uppal S.L., *Electrical Wiring, Estimating and Costing*
5. Singh Surjeet, *Estimating and Costing*, Dhanpat Rai and Co., New Delhi

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

BTEE-601 ELECTRIC POWER UTILIZATION

Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**	**1**	**0**
Total Marks:	**100**				

Electric Drives: Electrical drives & Mechanical drives, Concept of electrical drives, Basic features of industrial drives, review of operating and starting characteristics of different types of electric motors for various drives (AC and DC motors). Estimation of rating and heating of motors, Load equalization (Fly wheel effect), Drives for particular services.

Electric Traction: Introduction to Indian railways system , Electric Locomotive Classes, Various types of Traction system, single phase feeding arrangement prevalent in India. Substation. arrangements, Different Types of Catenary construction and line insulation, Span and dropper design Calculations.

Electric Heating and Welding: Methods of electric heating, types of electric heating, constructional details and performance of resistance heating furnace. Dielectric heating, Alternating current (AC).and Direct current (DC) Welding, Resistance and Arc Welding. Electric Beam Welding, Laser Welding. Typical construction of electrical welding AC and DC set.

Illumination: Production of light by different methods, terms used, laws of illumination, Different Artificial light sources, their construction and operating principles, Design of lighting schemes and equipment used for indoor, industrial and flood lighting.

Refrigeration and Air conditioning: Refrigeration system, Domestic refrigeration, Air conditioner, Comfort Air conditioning, Effective temperature.

Electrolysis: Laws of Electrolysis, Process voltage, current, energy, efficiency, Applications of electrolysis.

BOOKS RECOMMENDED:

1. Partab H., *Modern Electric Traction,* Dhanpat Rai
2. De N.K. and Sen P.K., *Electric Drives*, PHI publication
3. Berde M.S., *Electric Motor Drives*, Khanna Publishers
4. Gupta J.B., *Utilization of Electric Power and Electric Traction*, S.K. Kataria and Sons
5. Tripathy S. C., *Electric Energy Utilization and Conservation*, Tata McGraw Hill
6. Taylor E.O., *Utilization of Electric Energy,* Orient Blackswan
7. Hughes Austin, *Electric Motors and Drives: Fundamentals, Types and Applications*, Newnes, (2005)

Note: *External question paper shall be set following guidelines to paper setter given at Page 61.*

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

BTEE-602 POWER SYSTEM-II (SWITCH GEAR AND PROTECTION)

Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**	**1**	**0**
Total Marks:	**100**				

Sub-Station: Types, Main equipment in Substation, substation layout, Busbar-arrangements.

Isolators and Fuses: Isolating switches functions, Types, Rating and operation. Fuse-types, Rating, Selection, theory and characteristics, applications.

Circuit Breakers: Need for Circuit Breakers, Arc phenomenon, Theory of Arc Interruption, Recovery Voltage and Restriking Voltage, Various Types of Circuit Breakers. Principles and Constructional Details of Air Blast, Minimum Oil, SF6, Vacuum Circuit Breakers etc.

Protective Relays: Introduction, classification, constructional features; and Characteristics of Electromagnetic, Induction, Thermal, Overcurrent relays, Directional relays, Distance relays, Differential, Translay, Negative sequence relay, introduction to static and up-based relays.

Protection of Feeders: Time graded protection, Differential and Distance protection of feeders, choice between Impedance, Reactance and Mho relays, Elementary idea about carrier current protection of lines.

Protection of Generators and Transformers: Types of faults on alternator, Stator and rotor protection, Negative sequence protection, Loss of excitation and overload protection. Types of fault on transformers, percentage differential protection, Gas relays.

Protection against over voltage and earthing: Ground wires, Rod gap, Impulse gap, Valve type and Metal Oxide Arresters, Line Arrester/Surge Absorber. Ungrounded neutral system, Grounded neutral system and Selection of Neutral Grounding.

BOOKS RECOMMENDED

1. Rao S., *Switchgear and Protection,* Khanna Publishers
2. Chakrabarti A., Soni, M.L. Gupta P.V. and Bhatanagar U.S., *A Textbook on Power System Engineering,* Dhanpat Rai and Co.
3. Wadhawa C.L. , *A Course in Electrical Power*, New Age international Pvt. Ltd
4. Badri Ram and Vishwakarma D.N., *Power system Protection and Switchgear*, Tata McGraw Hill
5. Deshpande M.V., *Switchgears and Protection*, Tata McGraw Hill

Note: *External question paper shall be set following guidelines to paper setter given at Page 61.*

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

BTEE-603 NON-LINEAR AND DIGITAL CONTROL SYSTEMS

			L	T	P
Internal Marks:	**40**		**4**	**1**	**0**
External Marks:	**60**				
Total Marks:	**100**				

STATE VARIABLE TECHNIQUES: State variable representation of systems by various methods, solution of state variable model. Controllability and observability.

PHASE PLANE ANALYSIS: Singular points, Method of isoclines, delta method , phase portrait of second order nonlinear systems, limit cycle.

DESCRIBING FUNCTION ANALYSIS: Definition, limitations, use of describing function for stability analysis, describing function of ideal relay, relay with hystersis, dead zone, saturation, coulomb friction and backlash.

LYAPUNOV'S STABILITY METHOD: Lyapunov's direct method, generation of Lyapunov's function by Krasovskii's and Variable Gradient methods

SAMPLED DATA SYSTEMS: Sampling process, mathematical analysis of sampling process, application of Laplace transform. Reconstruction of sampled signal, zero order, first order hold. Z-transform definition, evaluation of Z-transform, inverse Z-transform, pulse transfer function, limitations of Z-transform, State variable formulation of discrete time systems, solution of discrete time state equations. Stability definition, Jury's test of stability, extension of Routh-Hurwitz criterion to discrete time systems.

BOOKS RECOMMENDED:

1. Ogata K., *Modern control engineering*. Prentice Hall (India)
2. Nagrath I.J., Gopal M., *Control system engineering*, New Age Publications
3. Hsu J.C. and Meyer A.U., *Modern control principles and application*
4. Gopal M., *Digital Control and State Variable Methods*, Tata McGraw Hill
5. Kuo B.C. and Golnaraghi F., *Automatic Control System, Wiley* Publications
6. Dorf R.V. and Bishop R.H., *Modern Control Systems*, Adison Wesley

Note: *External question paper shall be set following guidelines to paper setter given at Page 61.*

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

BTEE-804C DIGITAL SIGNAL PROCESSING

Internal Marks: 40
External Marks: 60
Total Marks: 100

L	T	P
3	1	0

Introduction: Signals, Systems and Signal processing, Classification of Signals, Concept of frequency in continuous time and discrete time signals.

Discrete Time Signals and Systems: Discrete time signals, Discrete time systems, Analysis of discrete time linear time-invariant systems, Discrete time systems described by difference equations, Implementation of discrete system, Correlation of discrete time signals.

Z-Transform: The Z-transformation, properties of Z-transformation, Rational Z-transformation, Inversion of Z-transform, Analysis of linear time invariant systems in Zdomain.

Frequency Analysis of Signals and Systems: Frequency analysis of continuous time signals, Frequency analysis of discrete time signals, Properties of Fourier Transform for discrete time signals, Frequency domain characteristics of linear time invariant systems, linear invariant systems as frequency selective filters, Inverse systems and de-convolution.

The Discrete Fourier Transform: Frequency domain sampling, Properties of Discrete Fourier Transform (DFT), Linear filtering methods based on DFT, Frequency analysis of signals using the DFT.

Design of Digital Filters: General considerations, Design of Finite Impulse Response (FIR) filters, Design of Infinite Impulse Response (IIR) filters from analog filters, Frequency transformations, Design of digital filters based on least-square method and window method, Comparison of IIR and FIR filters.

BOOKS RECOMMENDED:

1. Oppenheim A.V. and Schafer, R.W., *Digital Signal Processing*, Prentice Hall (India)
2. Kuo, Sen-Maw and Gan, Woon-Seng, *Digital Signal Processing* architectures, Implementations, and Applications McGraw Hill
3. Proakais John G., *Digital Signal Processing: Principles, Algorithms, and Applications,* Pearson Education 4th Ed. (2007)
4. Richard G Lyons, *Understanding Digital Signal Processing,* Pearson Education Publications.
5. Mitra K. Sanjit, Digital Signal Processing, 3rd ed. Tata McGraw Hill
6. Hayes Mansen, *Schaum's Outline of Digital Signal Processing*, Tata MGraw Hill, (2001)

Note: *External question paper shall be set following guidelines to paper setter given at Page 61.*

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144603

120

BTEE-804D INDUSTRIAL PROCESS CONTROL

Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**	**1**	**0**
Total Marks:	**100**				

Description And Modeling of Various Industrial Processes: Model Classification, Mathematical Models, Physical Models, Analog Models, Estimation of Model Parameters, System Identification, Experimental Nature of Simulation, Steps Involved in Simulation Studies, Validation of Simulation Models, Computer Simulation of Continuous and Discrete Systems, Examples

Process Control: Types and Description of Processes, Blending, batch processes, compressor and chiller controls, distillation control, steam turbine and water treatment controls, boiler controls, reactor controls

Conventional Controllers: On-off Controllers, Cascade and Feed forward Controllers, Split Range Controllers, ratio controls, Single loop, multi loop and self tuning controllers, set point control (SPC), discrete digital control (DDC)

Intelligent Controllers: Fuzzy logic control, programmable logic controllers, PC based system, conventional and Widows-NT based distributed control system (DCS) systems, artificial intelligence and neural networks, smart and intelligent transmitters.

BOOKS RECOMMENDED:

1. Padmanabhan, Tattamangalam R, *Industrial Process Instrumentation and control* Springer Publishing
2. Andrew W.G. and Williams H.B., *Applied Instrumentation in the Process Industries,* Gulf Publishing,Houston
3. Nolting B.E., *Instrumentation Reference Book,* Elsevier India Pvt, New Delhi
4. Liptak B.G., *Instrument Engineer's Handbook (Process Control),* Elsevier India Pvt ,New Delhi.

Note: *External question paper shall be set following guidelines to paper setter given at Page 61.*

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

121

BTEE-804E NETWORKS AND DATA COMMUNICATION

Internal Marks: 40
External Marks: 60
Total Marks: 100

L	T	P
3	1	0

Introduction: Basic Concepts of analog and digital signals, data transmission concepts, Analog and digital transmission, transmission impairments

Transmission Media: Guided and Un-guided media, Performance, Shannon Capacity, Media Computerization

Encoding and Modulating: Digital–to-Digital conversion, Analog and digital conversion, Digital to Analog conversion, Analog to Analog conversion

Digital Data Communication: Digital data transmission, Data terminal equipment (DTE) - data circuit-terminating equipment (DCE) Interface, Electronic Industries Alliance (EIA)-449, EIA- 530, X.21 (Communication standard), Modems, Cable Modems

Multiplexing And Switching: Frequency-division multiplexing (FDM), wavelength-division multiplexing (WDM), Time-division Multiplexing (TDM) application- telephone systems, Digital subscriber line (DSL), Par Circuit switching , Packet Switching and Message switching virtual circuits

Spread Spectrum: Concept, Frequency hoping spread spectrum, direct sequence spread spectrum, code division Multiple Access

Error Detection and Correction: Types of Errors, Detection, Vertical Redundancy Check (VRC), longitudinal redundancy check (LRC), cyclic redundancy check (CRC), Checksum, Error Correction

Protocol Architecture: Protocols, Standards, OSI (Open Systems Interconnection) model, TCP (Transmission Control Protocol)/ IP (Internet Protocol) Protocol Architecture

BOOKS RECOMMENDED:

1. Ulylers D Balck, *Data Communication and Distributed Networks*, Prentice Hall (India)
2. Andrew S. Teanebaum, *Computer Networks*, Prentice Hall (India)
3. William Stallings, *Data and Computer Communication*, Pearson Education
4. Behrouz A Ferouzan *Data Communications and Networking*, Tata McGraw Hill.

Note: *External question paper shall be set following guidelines to paper setter given at Page 61.*

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

122

BTEE-804F DATA MINING AND PATTERN RECOGNITION

Internal Marks:	**40**	**L**	**T**	**P**
External Marks:	**60**	**3**	**1**	**0**
Total Marks:	**100**			

Data Mining: What is data mining, on what kind of data, Data Mining Functionalities

Data Warehouse: Difference Between operational database systems and data warehouses, A multidimensional data model, Data Warehouse architecture, data warehouse architecture, Data Warehouse implementation.

Data preprocessing: Data cleaning, data integration and transformation, data reduction.

Data Mining Query Language: Characterization and Comparison, Generalization, Mining association rules in large databases, constraint based association Mining Classification and prediction Classification by decision Tree Induction, Bayesian classification, classification by Back propagation Cluster analysis Partitioning Methods, Hierarchical methods, and Density and Grid based methods, Mining complex types of data, applications and trends in data mining, Social impacts of data mining.

Pattern recognition: Its importance and applications, applications in Bioinformatics, recognizing important bio-informatics sequences, other applications of pattern discovery.

BOOKS RECOMMENDED:.

1. Pal. Sankar K. and Mitra P., *Pattern Recognition Algorithms for Data Mining*, Chapman and Hall/CRC
2. Elden L. *Matrix Methods in Data Mining and Pattern Recognition*. SIAM, 2007.

Note: *External question paper shall be set following guidelines to paper setter given at Page 61.*

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

123

BTEE-805A POWER QUALITY MONITORING AND CONDITIONING

			L	T	P
Internal Marks:	**40**				
External Marks:	**60**		**3**	**1**	**0**
Total Marks:	**100**				

Overview and definition of power quality (PQ): Sources of pollution, and regulations, Power quality problems rapid voltage fluctuations voltage unbalance, Voltage dips and voltage swells, Short duration outages,

Definitions Voltage sag analysis and mitigation: Sag caused by motor starting, Sag caused by utility fault clearing, Sag mitigation, Sag magnitude and duration calculations in single-phase systems, Equipment performance in presence of sag, Computers, Alternating current (AC) and direct current (DC) drives.

Harmonics: Effects-within the power system, Interference with communication Harmonic measurements. Harmonic elimination.

Harmonic distortion: Power system harmonics: harmonic analysis, Harmonic sources-the static converters, Transformer magnetization and non-linearities, Rotating machines, arc furnaces, Fluorescent lighting. Introduction to power converters, Fourier analysis, Total harmonic distortion, rms and average value calculations, Arcing and saturable devices, Effects of harmonic distortion, System response characteristics.

Principles for controlling harmonics: Locating sources of harmonics, Passive and active filters, Harmonic filter design.

Monitoring power quality: Monitoring essentials, Power quality measuring equipment, Current industry trends.

Power Conditioning: Electric power conditioning, Active and passive filters, IEEE, IEC, ANSI standards, Power Acceptability Curves, Various standards

BOOKS RECOMMENDED:

1. Beaty, H. and Santoso,S., *Electrical Power System Quality*, McGraw Hill (2002).
2. Kennedy, B., *Power Quality Primer*, McGraw Hill (2000).
3. Bollen, M.H.J., *Power Quality Problems: Voltage Sag and Interruptions*, IEEE Press (2007).
4. Mohan, N., *Power Electronics*, New Age International (P) Limited, Publishers (2007).

Note: *External question paper shall be set following guidelines to paper setter given at Page 61.*

124

BTEE-805B HIGH VOLTAGE DIRECT CURRENT TRANSMISSION

Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**	**1**	**0**
Total Marks:	**100**				

Direct Current (DC) power transmission technology: Introduction, comparison of Alternating Current (AC) and Direct Current (DC) transmission, application of DC transmission, application of DC transmission, description of DC transmission system, Configurations, planning for High Voltage Direct Current (HVDC) transmission, modern trends in DC transmission. Introduction to Device: Thyristor valve, valve tests, recent trends.

Analysis of High Voltage Direct Current (HVDC) converters: Pulse number, choice of converter configuration, simplified analysis of Graetz circuit, converter bridge characteristics, characteristics of a twelve-pulse converter, detailed analysis of converters with and without overlap.

Converter and HVDC system control: General, principles of DC link control, converter control characteristics, system control hierarchy, firing angle control, current and extinction angle control, starting and stopping of DC link, power control, higher level controllers, telecommunication requirements.

Converter faults and protection: Introduction, converter faults, protection against over-currents, over-voltages in a converter station, surge arresters, protection against over-voltages.

Smoothing reactor and DC line: Introduction, smoothing reactors, DC line, transient over voltages in DC line, protection of DC line, DC breakers, Monopolar operation, effects of proximity of AC and DC transmission lines.

Component models for the analysis of AC/DC systems: General, converter model, converter control, modelling of DC network, modelling of AC networks.

RECOMMENDED BOOKS:

1. Bagamudre, Rakesh Das *Extra High Voltage A.C. Transmission Engineering*, New Age International Publishers.
2. Kimbark E.W., *High Voltage DC Transmission*, Wiley-Interscience
3. Kamaraju V. and Naidu M.S., *High Voltage Engineering,* Tata McGraw-Hill Education
4. Jha R.S., *High Voltage Engineering, Dhanpat Rai*
5. Kuffel, E. and Abdullah, M. High Voltage Engineering, Pergamon Press
6. Wadhwa C. L., *High Voltage Engineering,* New Age Publications.
7. Padiyar, K.R. HVDC Power Transmission Systems: Technology and System Interactions, New Age International

Note: *External question paper shall be set following guidelines to paper setter given at Page 61.*

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

125

128

BTEE-805C VIRTUAL INSTRUMENTATION

Internal Marks:	**40**			
External Marks:	**60**	**L**	**T**	**P**
Total Marks:	**100**	**3**	**1**	**0**

Introduction: Virtual Instrumentation - Definition, flexibility, Block diagram and Architecture of Virtual Instruments, Virtual Instruments versus Traditional Instruments, Review of LABVIEW software in virtual Instrumentation and programming techniques.

Data Acquisition In Virtual Instrumentation: Analog-to-Digital, Digital-to-Analog converters, plug-in Analog input/output cards, Digital Input/ Output cards, Organization of the Data acquisition (DAQ)-VI system, Opto-isolation, Performing analog input and analog output, Scanning multiple analog channels, Issues involved in selection of data acquisition cards, Data acquisition modules with serial communication.

Communication Networked Modules: Introduction to Personal Computer (PC) Busses, Local busses: Industry Standard Architecture (ISA), Peripheral Component Interconnect (PCI), RS232, RS422, RS485, Interface Busses, Universal Serial Bus (USB), Personal Computer Memory Card International Association (PCMCIA), Virtualization eXperience Infrastructure (VXI), Signal Conditioning eXtensions for Instrumentation (SCXI), PCI eXtensions for Instrumentation (PXI). Instrumentation Buses: Modbus, General Purpose Interface Bus (GPIB) Networked busses, ISO (International Organization for Standardization)/OSI (Open Systems Interconnection) Reference model, Ethernet TCP (Transmission Control Protocol)/ IP (Internet Protocol) protocols.

Real Time Control in Virtual Instrumentation and Applications: Design of ON/OFF controller, simulation of industrial instruments and systems, Virtual Instrumentation functions and objects including signal processing and analysis. Typical instruments and systems -digital storage oscilloscope, spectrum analyzer, waveform generator, Data visualization from multiple locations; Distributed monitoring and control devices.

BOOKS RECOMMENDED:

1. Wells L. K. and Travis J., *Labview for everyone*, Prentice Hall
2. Gupta S. and Gupta J.P., *PC interfacing for data acquisition and process control*, ISA
3. Rahman Jamal and Herbert Picklik, *Labview — Applications and solutions*, National Instruments Release
4. Gary Jhonson, *Labview Graphical programming*, McGraw Hill

Note: *External question paper shall be set following guidelines to paper setter given at Page 61.*

BTEE-805D ENERGY EFFICIENT MACHINES

Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**	**1**	**0**
Total Marks:	**100**				

INTRODUCTION: Need for energy efficient machines, energy cost and two part tariff, energy conservation in industries and farms -a necessity, introduction to energy management and energy audit system. Review of induction motor characteristics.

ENERGY EFFICIENT MOTORS: Standard motor efficiency, why more efficient motors? An energy efficient motor, efficiency determination methods, Direct Measurement method, Loss segregation method, Comparison, motor efficiency labelling, energy efficient motor standards. Motor life cycle

POWER FACTOR: The power factor in sinusoidal systems, power factor improvement, power factor with nonlinear loads, Harmonics and the power factor

INDUCTION MOTORS AND ADJUSTABLE DRIVE SYSTEMS: Energy Conservation, adjustable speed systems, Application of adjustable speed systems to fans, pumps and constant torque loads.

BOOKS RECOMMENDED:

1. Andreas John C., *Energy efficient electric motors*, Marcel Dekker Inc. 1992.
2. Thuman Albert, *Introduction to Efficient Electric System Design*, The Fairmount Press Prentice Hall.
3. Tripathi S.C. , *Electric Energy Utilization and Conservation*, Tata McGraw-Hill 1991.
4. Belove Charles, *Handbook of Modem Electronics and Electrical Engineering*, John Wiley & Sons.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

127

BTEE-805E EMBEDDED SYSTEMS

Internal Marks:	**40**	**L**	**T**	**P**
External Marks:	**60**	**3**	**1**	**0**
Total Marks:	**100**			

Introduction: Review of Embedded Hardware: Terminology, Gates, Timing Diagram, Memory, Microprocessor Buses, Direct Memory Access, Interrupts, Built instructions on the Microprocessor. Conventions used on Schematic, Interrupts, Microprocessor Architecture, Interrupt Basic, Shared Data Problem,Interrupt Latency.

PIC Micro controller and Interfacing: Introduction, CPU Architecture, Registers, Instruction Sets, Addressing Modes, Programs, Interfacing Methods, Parallel I/O Interface, Parallel Port Interface, Memory Interfacing, High Speed I/O Interfacing, Interrupt, Interrupt Service Routine, features of Interrupts, Interrupt vector and Priority, Timing Generation and Measurements, Input Capture, Output Compare, Frequency Measurement, Serial I/O Device RS232, RS845, Analog Interfacing, Applications.

Software Development and Tools: Embedded System Evolution Trends, Round – Robin, Robin with Interrupts, Function Scheduling architecture, Algorithms, Introduction to assembler, Compiler and Cross compilers and Integrated Development Environment (IDE), Object Oriented Interfacing, Recursion, Debugging Strategies, Simulators.

Real Time Operating Systems (RTOS): Task And Task States, Tasks and Data, Semaphores and shared data, operating system services, Message queues, Timer Function, Events, Memory Management, Interrupt Routines in an RTOS Environment, Basic Design Using RTOS.

BOOKS RECOMMENDED:

1. Gajski D.D., Vahid F., Gong J., Narayan S., *Specification and Design of Embedded Systems*, Prentice Hall.
2. Steve Heath, Newnes *Embedded systems Design*, Prentice Hall.
3. Balarin F., Chiodo, *Hardware Software Co-design of Embedded Systems*, Academic Publishers.

Note: *External question paper shall be set following guidelines to paper setter given at Page 61.*

128

BTEE-805F VISUAL PROGRAMMING

Internal Marks:	**40**		**L**	**T**	**P**
External Marks:	**60**		**3**	**1**	**0**
Total Marks:	**100**				

Introduction: Visual programming basics, Application framework fundamental, windows programming (Win32 programming), and Visual C++.memory management, Dynamic-link library (DLLs),Win32, Application programming interface (API).

Visual C++ components: Resource compiler, Microsoft Foundation Classes (MFC), modal Dialog, Windows Common Control, the Modeless Dialog and Windows Common Dialogs, ActiveX Control, Bitmap, Reading and Writing Documents, Serial digital interface (SDI), multiple document interface (MDI) applications.

Socket Programming using Win Sock, TCP/IP (TCP (Transmission Control Protocol/Internet Protocol), Document-View Structure, Microsoft Foundation Class (MFC) Libraries viz Cview, Cfile, Cpoint, Cdialog.

WIN32 Programming: WIN32 programming, Difference between a Windows program and a typical DOS program, Windows Programming modal, Windows Memory management, A skeletal Windows Application: WinMain function, Window Function, Componants of a Skeletal Application, Windows style, Device context, Creation of LISTBOX class, Dialog Boxes and SCROLLBAR class.

BOOKS RECOMMENDED:

1. David J. Kruglenski *VISUAL C++ programming,* Microsoft Press
2. Newcomer, Addison, *WIN32 Programming,* Wesley
3. Petzold , Charles, *Programming Windows 3.1*, Microsoft press.

Note: *External question paper shall be set following guidelines to paper setter given at Page 61.*

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

129

BTEE-806 Laboratory-XIII (Power System Analysis)

Internal Marks: 30
External Marks: 20
Total Marks: 50

L	T	P
0	0	2

Note: Atleast TEN experiments are to be performed in a semester. List of experiments is given below:

List of Experiments:

1. Design of transmission systems for given power and distance.
2. Short circuit calculations and calculations of circuit breaker ratings for a power system network.
3. Design of substations
4. Design of distribution systems
5. Y-bus formation
6. Z-bus formulation
7. Load flow analysis by Gauss Seidal method
8. Load flow analysis by Newto Raphson method
9. Fault analysis for line-to-line (L-L), Line-to-Ground (L-G) etc
10. Design of underground cabling system for substation.
11. To obtain power system stability on High Voltage Alternating current (HVAC) system with the help of Flexible Alternating Current Transmission Systems (FACTS) devices.
12. Optimal Capacitor placement on a system having variable reactive power and low voltage profile.
13. To obtain relay co-ordination on a power system.
14. To obtain optimal generator pricing on hydro-thermal and renewable energy systems.
15. To find synchronous reactances (Transient, sub-transient) during fault analysis.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

BTEE-807 PROJECT WORK

Internal Marks:	**60**	**L**	**T**	**P**
External Marks:	**40**	**0**	**0**	**6**
Total Marks:	**100**			

Design, Fabrication, Simulation, Evaluation, Testing etc. related to Electrical Engineering is to be carried out under the supervision of guide(s).

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

131

BTEE-808 SEMINAR

Internal Marks:	**100**	**L**	**T**	**P**
External Marks:		**0**	**0**	**2**
Total Marks:	**100**			

Students will be required to prepare a report on a given topic related to latest developments in electrical engineering and deliver a seminar on that topic along with seminar report.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala 144006

BTEE-701 SOFTWARE TRAINING

Internal Marks:	**150**	**L**	**T**	**P**
External Marks:	**100**	**0**	**0**	**2**
Total Marks:	**200**			

Students will be provided training on any of three of the programming language/ application softwares. All the applications shall be related to the Electrical components and systems.

- Any high level procedure oriented or object oriented programming language. Such language should be covered under regular or elective subject(s).
- MatLab
- LabView
- PSpice
- PSCAD

Students will undertake one project related to the Electrical components and systems based on the software training imparted during the semester in a group of three students. The entire group will select different projects. Students will be required to prepare a report on the Project undertaken and deliver a seminar on the project undertaken. The students will be evaluated based on Project undertaken, project report, seminar and viva-voce examination.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

133

GUIDELINES TO PAPER SETTERS

1. The question paper shall have three sections:
   Section A of 20 marks
   Section B of 20 marks
   Section C of 20 marks.
2. **Section A** is compulsory shall contain only **ONE** question with TEN sub-question carrying **two marks** each distributed from the entire syllabus. These questions shall be of conceptual nature and of short answer type to test the basic grasp of the subject matter by the students.
3. **Section B** shall contain **FIVE** questions and students shall be asked to answer any **FOUR** questions. Each question will carry **five marks**. These questions are to be set from different parts of syllabus with not more than one question from one part.
4. **Section C** shall contain **THREE** questions students shall be asked to answer any **TWO** questions. Each question shall carry **ten marks**. These questions are to be set from those parts of syllabus, which are not covered in Section B and restricted to not more than one question from each part.
5. At least 40% of the question should be numerical wherever applicable.
6. The paper setter shall provide detailed marking instructions and solution to numerical problems for evaluation purpose in the separate envelopes provided for solution.
7. The two different question papers should not contain more than 15% same/similar questions.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

134

Study Scheme & Syllabus of

Bachelor of Technology

(Electrical Engineering)

Batch 2018 onwards

Board of Study (Electrical Engineering)

IK Gujral Punjab Technical University, Main Campus and Constituent Campuses

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

By

Department of Academics

IK Gujral Punjab Technical University

Vision

To create globally competent technical professionals, researchers and entrepreneurs through outcome-based learning for the emerging challenges of industry, academia, social, cultural and environment for global prosperity.

Mission

1. To be a department of higher learning that offers state-of-the-art technical education and training.
2. To promote techno-innovations and entrepreneurship in the field of Electrical Engineering and interdisciplinary areas.
3. To inculcate lifelong learning ability, technical expertise, ethical standards, teamwork and leadership qualities and skills.
4. To create excellence in research and consultancy in the field of Electrical Engineering.
5. To develop an aptitude for the use of modern engineering tools and technology, software and equipment to serve the industry, profession, and be responsible citizens of the world.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144603

136

127

Programme Outcomes

The graduates from the Department of Electrical Engineering will have the following abilities, knowledge, characteristics and skills:

a.	Graduate will have knowledge of applied mathematics, sciences, and engineering.
b.	Graduate will have knowledge of professional and ethical responsibilities.
c.	Graduate will have ability to understand so as to identify, formulate, and solve complex engineering problems.
d.	Graduate will have ability to understand the impact of engineering solutions on the society and also will be aware of contemporary issues and environmental issues.
e.	Graduate will have ability to apply engineering so as to create and produce solutions that meet societal needs.
f.	Graduates will have the ability to analyze analog and digital systems/components.
g.	Graduates will have the ability to analyze using modern engineering tools, software and equipment.
h.	Graduates will have an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
i.	Graduate will have an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
j.	Graduate will be able to communicate effectively in both verbal and written form.
k.	Graduate will develop confidence for self-education and ability for life-long learning.
l.	Graduate will be able to participate and succeed in competitive examinations or entrepreneurial endeavors.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144003

137
128

Programme Educational Objectives

I.	**Preparation:** To prepare students to be successful in industry/ technical profession through outcome-based education.
II.	**Core Competence:** To provide students with a solid foundation in mathematical, scientific and engineering fundamentals required to solve engineering problems and also to pursue higher studies.
III.	**Breadth:** To train students with good scientific and engineering breadth so as to understand, analyze, design, and create novel products and solutions for the real-life problems.
IV.	**Professionalism:** To inculcate in students professional and ethical attitude, effective communication skills, teamwork skills, interdisciplinary approach, and an ability to relate engineering issues to broader social context.
V.	**Learning Environment:** To provide students with an academic environment aware of excellence, leadership, ethical code and guidelines, and the life-long learning needed for a successful professional career.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

138
129

Study Scheme & Syllabus of

Bachelor of Technology

(1st and 2nd semester)

Batch 2018 onwards

KAPURTHALA

By

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

Department of Academics

IK Gujral Punjab Technical University

139

IK Gujral Punjab Technical University
Bachelor of Technology (B. Tech. 1st Year)

Bachelors of Technology 1st and 2nd semester

It is an Under Graduate (UG) Programme of 4 years duration (8 semesters)

Eligibility for Admission: *As per AICTE norms.*

First Semester **Group-A** **Contact Hrs. : 24**

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L	T	P	Internal	External		
BTPHXX-18	Basic Science Course	Physics	3	1	0	40	60	100	4
BTPHXX-18	Basic Science Course	Physics (Lab)	0	0	3	30	20	50	1.5
BTAMXX-18	Basic Science Course	Maths-I	3*	1	0	40	60	100	4
BTEE101-18	Engineering Science Course	Basic Electrical Engineering	3	1	0	40	60	100	4
BTEE102-18	Engineering Science Course	Basic Electrical Engineering (Lab)	0	0	2	30	20	50	1
BTME101-18	Engineering Science Courses	Engineering Graphics & Design	1	0	4	60	40	100	3
BMPD101-18		Mentoring and Professional Development	0	0	2	Satisfactory / Un-Satisfactory			Non-Credit
TOTAL			10	3	11	220	280	500	17.5

*These are the minimum contact hrs. allocated. The contact hrs. may be increased by institute as per the need based on the content of subject.

First Semester **Group-B** **Contact Hrs. : 29**

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L	T	P	Internal	External		
BTCH101-18	Basic Science Course	Chemistry-I	3	1	0	40	60	100	4
BTCH102-18	Basic Science Course	Chemistry-I (Lab)	0	0	3	30	20	50	1.5
BTAMXX-18	Basic Science Course	Maths-I	3*	1	0	40	60	100	4
BTPS101-18	Engineering Science Course	Programming for Problem Solving	3	0	0	40	60	100	3
BTPS102-18	Engineering Science Course	Programming for Problem Solving (Lab)	0	0	4	30	20	50	2
BTMP101-18	Engineering Science Courses	Workshop / Manufacturing Practices	1	0	4	60	40	100	3
BTHU101-18	Humanities and Social Sciences including Management courses	English	2	0	0	40	60	100	2
BTHU102-18	Humanities and Social Sciences including Management courses	English (Lab)	0	0	2	30	20	50	1
BMPD101-18		Mentoring and Professional Development	0	0	2	Satisfactory / Un-Satisfactory			Non-Credit
TOTAL			12	2	15	290	360	650	20.5

*These are the minimum contact hrs. allocated. The contact hrs. may be increased by institute as per the need based on the content of subject.

140

IK Gujral Punjab Technical University
Bachelor of Technology (B. Tech. 1st Year)

Second Semester **Group-A** **Contact Hrs. : 29**

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L	T	P	Internal	External		
BTCH101-18	Basic Science Course	Chemistry-I	3	1	0	40	60	100	4
BTCH102-18	Basic Science Course	Chemistry-I (Lab)	0	0	3	30	20	50	1.5
BTAMXX-18	Basic Science Course	Maths-II	3*	1	0	40	60	100	4
BTPS101-18	Engineering Science Course	Programming for Problem Solving	3	0	0	40	60	100	3
BTPS102-18	Engineering Science Course	Programming for Problem Solving (Lab)	0	0	4	30	20	50	2
BTMP101-18	Engineering Science Courses	Workshop / Manufacturing Practices	1	0	4	60	40	100	3
BTHU101-18	Humanities and Social Sciences including Management courses	English	2	0	0	40	60	100	2
BTHU102-18	Humanities and Social Sciences including Management courses	English (Lab)	0	0	2	30	20	50	1
BMPD201-18		Mentoring and Professional Development	0	0	2	Satisfactory / Un-Satisfactory			Non-Credit
	TOTAL		**12**	**2**	**15**	**290**	**360**	**650**	**20.5**

***These are the minimum contact hrs. allocated. The contact hrs. may be increased by institute as per the need based on the content of subject.**

Second Semester **Group-B** **Contact Hrs.: 24**

Course Code	Course Type	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L	T	P	Internal	External		
BTPHXX-18	Basic Science Course	Physics	3	1	0	40	60	100	4
BTPHXX-18	Basic Science Course	Physics (Lab)	0	0	3	30	20	50	1.5
BTAMXX-18	Basic Science Course	Maths-II	3*	1	0	40	60	100	4
BTEE101-18	Engineering Science Course	Basic Electrical Engineering	3	1	0	40	60	100	4
BTEE102-18	Engineering Science Course	Basic Electrical Engineering (Lab)	0	0	2	30	20	50	1
BTME101-18	Engineering Science Courses	Engineering Graphics & Design	1	0	4	60	40	100	3
BMPD201-18		Mentoring and Professional Development	0	0	2	Satisfactory / Un-Satisfactory			Non-Credit
	TOTAL		**10**	**3**	**11**	**220**	**280**	**500**	**17.5**

***These are the minimum contact hrs. allocated. The contact hrs. may be increased by institute as per the need based on the content of subject.**

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University

Note : 1. Mentoring and Professional Development will be offered as mandatory Non-Credit course. Mentoring and Professional Development course will have internal evaluation only.

2. This study scheme & syllabus is not applicable for B. Tech Chemical Engineering and B. Tech Petrochem & Petroleum Refinery Engineering. The study scheme and syllabus of B. Tech Chemical Engineering and B. Tech Petrochem & Petroleum Refinery Engineering is separately uploaded on University website.

L41

131

3. There will be no external theory exam for subject code BTME101-18 (Engineering Graphics & Design) For detail evaluation scheme refer detailed syllabus (page no. 84)
4. The Institutional Summer Vacation Training (4 Weeks) as per IKGPTU/DA/792 dated 21.05.2019.

A. Definition of Credit:

1 Hr. Lecture (L) per week	1 credit
1 Hr. Tutorial (T) per week	1 credit
1 Hr. Practical (P) per week 2 Hours Practical(Lab)/week	0.5 credits 1 credit

B. Range of credits –

A range of credits from 150 to 160 for a student to be eligible to get Under Graduate degree in Engineering. A student will be eligible to get Under Graduate degree with Honours or additional Minor Engineering, if he/she completes an additional 20 credits. These could be acquired through MOOCs.

C. Structure of Undergraduate Engineering program:

S. No.	Category	Suggested Breakup of Credits(Total 160)
1	Humanities and Social Sciences including Management courses	12
2	Basic Science courses	25
3	Engineering Science courses including workshop, drawing, basics of electrical/mechanical/computer etc	24
4	Professional core courses	48
5	Professional Elective courses relevant to chosen specialization/branch	18
6	Open subjects – Electives from other technical and /or emerging subjects	18
7	Project work, seminar and internship in industry or elsewhere	15
8	Mandatory Courses [Environmental Sciences, Induction training, Indian Constitution, Essence of Indian Traditional Knowledge]	(non-credit)
	Total	160

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

Guidelines regarding Mentoring and Professional Development

The objective of mentoring will be development of:

- Overall Personality
- Aptitude (Technical and General)
- General Awareness (Current Affairs and GK)
- Communication Skills
- Presentation Skills

The course shall be split in two sections i.e. outdoor activities and class activities.
For achieving the above, suggestive list of activities to be conducted are:

Part – A
(Class Activities)

1. Expert and video lectures
2. Aptitude Test
3. Group Discussion
4. Quiz (General/Technical)
5. Presentations by the students
6. Team building Exercises

Part – B
(Outdoor Activities)

1. Sports/NSS/NCC
2. Society Activities of various students chapter i.e. ISTE, SCIE, SAE, CSI, Cultural Club, etc.

Evaluation shall be based on rubrics for Part – A & B
Mentors/Faculty incharges shall maintain proper record student wise of each activity conducted and the same shall be submitted to the department.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

143

Induction Programs

A Guide to Induction Program

Introduction

(Induction Program was discussed and approved for all colleges by AICTE in March 2017. It was discussed and accepted by the Council of IITs for all IITs in August 2016. It was originally proposed by a Committee of IIT Directors and accepted at the meeting of all IIT Directors in March 2016.[1] This guide has been prepared based on the Report of the Committee of IIT Directors and the experience gained through its pilot implementation in July 2016 as accepted by the Council of IITs. Purpose of this document is to help insti-tutions in understanding the spirit of the accepted Induction Program and implementing it.)

Engineering colleges were established to train graduates well in the branch/department of admission, have a holistic outlook, and have a desire to work for national needs and beyond.

The graduating student must have knowledge and skills in the area of his study. However, he must also have broad understanding of society and relationships. Character needs to be nurtured as an essential quality by which he would understand and fulfill his responsibility as an engineer, a citizen and a human being. Besides the above, several meta-skills and underlying values are needed.

There is a mad rush for engineering today, without the student determining for himself his interests and his goals. This is a major factor in the current state of demotivation towards studies that exists among UG students.

The success of gaining admission into a desired institution but failure in getting the desired branch, with peer pressure generating its own problems, leads to a peer envi-ronment that is demotivating and corrosive. Start of hostel life without close parental supervision at the same time, further worsens it with also a poor daily routine.

To come out of this situation, a multi-pronged approach is needed. One will have to work closely with the newly joined students in making them feel comfortable, allow them to explore their academic interests and activities, reduce competition and make them

[1]A Committee of IIT Directors was setup in the 152nd Meeting of IIT Directors on 6th September 2015 at IIT Patna, on how to motivate undergraduate students at IITs towards studies, and to develop verbal ability. The Committee submitted its report on 19th January 2016. It was considered at the 153rd Meeting of all IIT Directors at IIT Mandi on 26 March 2016, and the accepted report came out on 31 March 2016. The Induction Program was an important recommendation, and its pilot was implemented by three IITs, namely, IIT(BHU), IIT Mandi and IIT Patna in July 2016. At the 50th meeting of the Council of IITs on 23 August 2016, recommendation on the Induction Program and the report of its pilot implementation were discussed and the program was accepted for all IITs.

work for excellence, promote bonding within them, build relations between teachers and students, give a broader view of life, and build character.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

144

Induction Program

When new students enter an institution, they come with diverse thoughts, backgrounds and preparations. It is important to help them adjust to the new environment and inculcate in them the ethos of the institution with a sense of larger purpose. Precious little is done by most of the institutions, except for an orientation program lasting a couple of days.

We propose a 3-week long induction program for the UG students entering the insti-tution, right at the start. Normal classes start only after the induction program is over. Its purpose is to make the students feel comfortable in their new environment, open them up, set a healthy daily routine, create bonding in the batch as well as between faculty and students, develop awarness, sensitivity and understanding of the self, people around them, society at large, and nature.[2]

The time during the Induction Program is also used to rectify some critical lacunas, for example, English background, for those students who have deficiency in it.

The following are the activities under the induction program in which the student would be fully engaged throughout the day for the entire duration of the program.

Induction Program as described here borrows from three programs running earlier at different insti-tutions: (1) Foundation Program running at IIT Gadhinagar since July 2011, (2) Human Values course running at IIIT Hyderabad since July 2005, and (3) Counselling Service or mentorship running at several IITs for many decades. Contribution of each one is described next.

(1) IIT Gandhinagar was the first IIT to recognize and implement a special 5-week Foundation Program for the incoming 1st year UG students. It took a bold step that the normal classes would start only after the five week period. It involved activities such as games, art, etc., and also science and other creative workshops and lectures by resource persons from outside.

(2) IIIT Hyderabad was the first one to implement a compulsary course on Human Values. Under it, classes were held by faculty through discussions in small groups of students, rather than in lecture mode. Moreover, faculty from all departments got involved in conducting the group discussions under the course. The content is non-sectarian, and the mode is dialogical rather than sermonising or lecturing. Faculty were trained beforehand, to conduct these discussions and to guide students on issues of life.

(3) Counselling at some of the IITs involves setting up mentor-mentee network under which 1st year students would be divided into small groups, each assigned a senior student as a student guide, and a faculty member as a mentor. Thus, a new student gets connected to a faculty member as well as a senior student, to whom he/she could go to in case of any difficulty whether psychological, financial, academic, or otherwise.

The Induction Program defined here amalgamates all the three into an integrated whole, which leads to its high effectiveness in terms of building physical activity, creativity, bonding, and character. It develops sensitivity towards self and one's relationships, builds awareness about others and society beyond the individual, and also in bonding with their own batch-mates and a senior student besides a faculty member.

Scaling up the above amalgamation to an intake batch of 1000 plus students was done at IIT(BHU), Varanasi starting from July 2016.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

1495

2.1 Physical Activity

This would involve a daily routine of physical activity with games and sports. It would start with all students coming to the field at 6 am for light physical exercise or yoga. There would also be games in the evening or at other suitable times according to the local climate. These would help develop team work. Each student should pick one game and learn it for three weeks. There could also be gardening or other suitably designed activity where labour yields fruits from nature.

2.2 Creative Arts

Every student would chose one skill related to the arts whether visual arts or performing arts. Examples are painting, sculpture, pottery, music, dance etc. The student would pursue it everyday for the duration of the program.

These would allow for creative expression. It would develop a sense of aesthetics and also enhance creativity which would, hopefully, flow into engineering design later.

2.3 Universal Human Values

It gets the student to explore oneself and allows one to experience the joy of learning, stand up to peer pressure, take decisions with courage, be aware of relationships with colleagues and supporting staff in the hostel and department, be sensitive to others, etc. Need for character building has been underlined earlier. A module in Universal Human Values provides the base.

Methodology of teaching this content is extremely important. It must not be through do's and dont's, but get students to explore and think by engaging them in a dialogue. It is best taught through group discussions and real life activities rather than lecturing. The role of group discussions, however, with clarity of thought of the teachers cannot be over emphasized. It is essential for giving exposure, guiding thoughts, and realizing values.

The teachers must come from all the departments rather than only one department like HSS or from outside of the Institute. Experiments in this direction at IIT(BHU) are noteworthy and one can learn from them.[3]

Discussions would be conducted in small groups of about 20 students with a faculty mentor each. It is to open thinking towards the self. Universal Human Values discussions could even continue for rest of the semester as a normal course, and not stop with the induction program.

Besides drawing the attention of the student to larger issues of life, it would build relationships between teachers and students which last for their entire 4-year stay and possibly beyond.

---

[3]The Universal Human Values Course is a result of a long series of experiments at educational institutes starting from IIT-Delhi and IIT Kanpur in the 1980s and 1990s as an elective course, NIT Raipur in late 1990s as a compulsory one-week off campus program. The courses at IIT(BHU) which started from July 2014, are taken and developed from two compulsory courses at IIIT Hyderabad first introduced in July 2005.

2.4 Literary

Literary activity would encompass reading, writing and possibly, debating, enacting a play etc.

2.5 Proficiency Modules

This period can be used to overcome some critical lacunas that students might have, for example, English, computer familiarity etc. These should run like crash courses, so that when normal courses start after the induction program, the student has overcome the lacunas substantially. We hope that problems arising due to lack of English skills, wherein students start lagging behind or failing in several subjects, for no fault of theirs, would, hopefully, become a thing of the past.

2.6 Lectures by Eminent People

This period can be utilized for lectures by eminent people, say, once a week. It would give the students exposure to people who are socially active or in public life.

2.7 Visits to Local Area

A couple of visits to the landmarks of the city, or a hospital or orphanage could be organized. This would familiarize them with the area as well as expose them to the under privileged.

2.8 Familiarization to Dept./Branch & Innovations

The students should be told about different method of study compared to coaching that is needed at IITs. They should be told about what getting into a branch or department means what role it plays in society, through its technology. They should also be shown the laboratories, workshops & other facilties.

3.Schedule

The activities during the Induction Program would have an Initial Phase, a Regular Phase and a Closing Phase. The Initial and Closing Phases would be two days each.

Time	Activity
Day 0 Whole Day	Student arrive – Hostel allotment. (Preferably do pre-allotment)
Day-1 09:00 am- 03:00 pm 04:30 pm - 06:00 pm	Academic Registration Orientation
Day-2 09:00 am - 10:00 am	Diagnostic Test (for English etc.)
10:15am - 12:25 pm	Visit to respective depts..
12:30 pm - 01:55 pm	Lunch
02:00 pm -02:55 pm	Director's address
03:00 pm – 05:00 pm	Interaction with parents
03:30 pm – 05:00 pm	Mentor-mentee groups – introduction within group (Same as Universal Human Values groups)

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144603

3.2 Regular Phase

After two days is the start of the Regular Phase of induction. With this phase there would be regular program to be followed every day.

147

3.2.1 Daily Schedule

Some of the activities are on a daily basis, while some others are at specified periods within the Induction Program. We first show a typical daily timetable.

Sessn.	Time	Activity	Remarks
	Day 3 onwards		
	06:00 am	*Wake up call*	
I	06:30 am - 07:10 am	Physical activity (mild exercise/yoga)	
	07:15 am - 08:55 am	*Bath, Breakfast, etc.*	
II	09:00 am - 10:55 am	Creative Arts / Universal Human Values	Half the groups do Creative Arts
III	11:00 am - 12:55 pm	Universal Human Values / Creative Arts	Complementary alternate
	01:00 pm - 02:25 pm	*Lunch*	
IV	02:30 pm - 03:55 pm	Afternoon Session	See below.
V	04:00 pm - 05:00 pm	Afternoon Session	See below.
	05:00 pm - 05:25 pm	*Break / light tea*	
VI	05:30 pm - 06:45 pm	Games / Special Lectures	
	06:50 pm - 08:25 pm	*Rest and Dinner*	
VII	08:30 pm - 09:25 pm	Informal interactions (in hostels)	

Sundays are off . Saturdays have the same schedule as above or have outings.

3.2.2 Afternoon Activities (Non-Daily)

The following five activities are scheduled at diff erent times of the Induction Program, and are not held daily for everyone:

1. Familiarization to Dept. / Branch & Innovations
2. Visits to Local Area
3. Lectures by Eminent People
4. Literary
5. Proficiency Modules

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

N98

Here is the approximate activity schedule for the afternoons (may be changed to suit local needs):

Activity	*Session*	*Remarks*
Familiarization with Dept/Branch & Innovations	IV	For 3 days (Day 3 to 5)
Visits to Local Area	IV, V and VI	For 3 days - interspersed (e.g., 3 Saturdays)
Lectures by Eminent People	IV	As scheduled - 3-5 lectures
Literary (Play / Book Reading / Lecture)	IV	For 3-5 days
Proficiency Modules	V	Daily, but only for those who need it

3.3 Closing Phase

Time	*Activity*
Last But One Day	
08:30 am - 12 noon	Discussions and finalization of presentation within each group
02:00 am - 05:00 pm	Presentation by each group in front of 4 other groups besides their own (about 100 students)
Last Day	
Whole day	Examinations (if any). May be expanded to last 2 days, in case needed.

3.4 Follow Up after Closure

A question comes up as to what would be the follow up program after the formal 3-week Induction Program is over? The groups which are formed should function as mentor-mentee network. A student should feel free to approach his faculty mentor or the student guide, when facing any kind of problem, whether academic or financial or psychological etc. (For every 10 undergraduate first year students, there would be a senior student as a *student guide*, and for every 20 students, there would be a *faculty mentor*.) Such a group should remain for the entire 4-5 year duration of the stay of the student. Therefore, it would be good to have groups with the students as well as teachers from the same department/discipline[4].

Here we list some important suggestions which have come up and which have been experimented with.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144603

3.4.1 Follow Up after Closure – Same Semester

It is suggested that the groups meet with their faculty mentors once a month, within the semester after the 3-week Induction Program is over. This should be a scheduled meeting shown in the timetable. (The groups are of course free to meet together on their own more often, for the student groups to be invited to their faculty mentor's home for dinner or tea, nature walk, etc.)

3.4.2 Follow Up – Subsequent Semesters

It is extremely important that continuity be maintained in subsequent semesters.

It is suggested that at the start of the subsequent semesters (upto fourth semester), three days be set aside for three full days of activities related to follow up to Induction Program. The students be shown inspiring films, do collective art work, and group discussions be conducted. Subsequently, the groups should meet at least once a month.

Summary

Engineering institutions were set up to generate well trained manpower in engineering with a feeling of responsibility towards oneself, one's family, and society. The incoming undergraduate students are driven by their parents and society to join engineering without understanding their own interests and talents. As a result, most students fail to link up with the goals of their own institution.

The graduating student must have values as a human being, and knowledge and meta-skills related to his/her profession as an engineer and as a citizen. Most students who get demotivated to study engineering or their branch, also lose interest in learning.

The *Induction Program* is designed to make the newly joined students feel comfortable, sensitize them towards exploring their academic interests and activities, reducing compe-tition and making them work for excellence, promote bonding within them, build relations between teachers and students, give a broader view of life, and building of character.

The *Universal Human Values* component, which acts as an anchor, develops awareness and sensitivity, feeling of equality, compassion and oneness, draw attention to society and

[4]We are aware that there are advantages in mixing the students from different depts. However, in mixing, it is our experience that the continuity of the group together with the faculty mentor breaks down soon after. Therefore, the groups be from the same dept. but hostel wings have the mixed students from different depts. For example, the hostel room allotment should be in alphabetical order irrespective of dept.

nature, and character to follow through. It also makes them reflect on their relationship with their families and extended family in the college (with hostel staff and others). It

Head
Department of Electrical Engineering
... Technical University

also connects students with each other and with teachers, so that they can share any difficulty they might be facing and seek help.

References:

Motivating UG Students Towards Studies,

Rajeev Sangal, IITBHU Varanasi, Gautam Biswas, IIT Guwahati, Timothy Gonsalves, IIT Mandi, Pushpak Bhattacharya, IIT Patna, (Committee of IIT Directors), 31 March 2016, IIT Directors' Secretariat, IIT Delhi.

Contact: *Prof. Rajeev Sangal* Director, IIT(BHU), Varanasi, (director@iitbhu.ac.in)

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144603

Semester 1st

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

Sr. No.	Branch	Related Branches	Course codes	Course title	Credits
1	Civil Engineering	1. Civil Engineering 2.Construction Engineering & Management	BTPH101-18 BTPH111-18	Mechanics of solids Mechanics of solids Lab	4 1.5
2	Electrical Engineering	1.Electrical Engineering 2.Automation & Robotics 3.Electrical & Electronics Engineering 4.Electronics & Electrical Engineering 5.Electrical Engineering & Industrial Control 6.Instrumentation & Control Engineering	BTPH102-18 BTPH112-18	Optics and Modern Physics Optics and Modern Physics Lab	4 1.5
3	Mechanical Engineering	1.Mechanical Engineering 2.Marine Engineering 3.Production Engineering 4.Industrial Engineering 5.Tool Engineering 6.Automobile Engineering 7.Aerospace Engineering 8.Aeronautical Engineering	BTPH103-18 BTPH113-18	Electromagnetism Electromagnetism Lab	4 1.5

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

4	Computer Science Engineering	1.Computer Engineering	BTPH104-18	Semiconductor Physics	4
		2.Computer Science Engineering			
		3.Information Technology	BTPH114-18	Semiconductor Physics Lab	1.5
		4.3D Animation Engineering			
		5 CSE (Artificial Intelligence & Machine Learning			
		6 CSE (Data Science)			
		7 CSE(IoT & Cyber Security including Block Chain Technology)			
		8 CSE (Internet of Things)			
		9 Artificial Intelligence & Data Science			
5	Electronics and communication Engineering	1.Electronics & Communication Engineering	BTPH105-18	Semiconductor and Optoelectronics Physics	4
		2.Electronics & Computer Engineering			
		3.Electronics & Instrumentation Engineering	BTPH115-18	Semiconductor and Optoelectronics Physics Lab	1.5
		4.Electronics & Telecomm Engineering			
		5.Electronics Engineering			
6	Chemical Sciences	1.Chemical Engineering	BTPH106-18	Optics and Electromagnetism	4
		2.Petrochem & Petroleum Refinery Engineering	BTPH116-18	Optics and Electromagnetism Lab	1.5
		3.Textile Engineering			
		4.Food Technology			

Head
Department of Electrical Engineering
I.K.Gujral Punjab Technical University
Kapurthala-144006

154

7	Bio-Technology	1 Bio-Technology 2 Agricultural Engineering	BTPH107-18	Introduction to Physics: Biotechnology	4
			BTPH117-18	Physics Lab	1.5

155

BTPH101-18	Mechanics of Solids	L-3, T-1, P-0	4 Credits

Pre-requisites (if any): High-school education with Physics as one of the subject.

Course Objectives: The aim and objective of the course on **Mechanics of Solids** is to introduce the students of B. Tech. to the formal structure of vector mechanics, harmonic oscillators, and mechanics of solids so that they can use these in Engineering as per their requirement.

Course Outcomes: At the end of the course, the student will be able to

CO1	Understand the vector mechanics for a classical system.
CO2	Identify various types of forces in nature, frames of references, and conservation laws.
CO3	Know the simple harmonic, damped, and forced simple harmonic oscillator for a mechanical system.
CO4	Analyze the planar rigid body dynamics for a mechanical system.
CO5	Apply the knowledge obtained in this course to the related problems.

Detailed Syllabus:

PART-A

UNIT I: Vector mechanics *(10 lectures)*

Physical significance of gradient, Divergence and curl. Potential energy function, F = - Grad V, equipotential surfaces, Forces in Nature, Newton's laws and its completeness in describing particle motion, Conservative and non-conservative forces, curl of a force field; Central forces; Conservation of Angular Momentum and Energy, Introduction to Cartesian, spherical and cylindrical coordinate system, Inertial and Non-inertial frames of reference; Rotating coordinate system :- Centripetal and Coriolis accelerations.

UNIT II: Simple harmonic motion, damped and forced simple harmonic oscillator *(10 lectures)*

Mechanical simple harmonic oscillators, damped oscillations, damped harmonic oscillator – heavy, critical and light damping, energy decay in a damped harmonic oscillator, quality factor, forced mechanical oscillators, resonance.

PART-B

UNIT III: Planar rigid body mechanics *(10 lectures)*

Definition and motion of a rigid body in plane; Rotation in the plane, Angular momentum about a point of a rigid body in planar motion; center of mass, moment of inertia, theorems of moment of inertia, inertia of plane lamina, circular ring, moment of force, couple, Euler's laws of motion.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

156

UNIT IV: Mechanics of solids *(10 lectures)*

Friction: Definitions: Types of friction, Laws of static friction, Limiting friction, Angle of friction, angle of repose; motion on horizontal and inclined planes. Methods of reducing friction, Concept of stress and strain at a point; Concepts of elasticity, plasticity, strain hardening, failure (fracture/yielding), one dimensional stress-strain curve; Generalized Hooke's law. Force analysis — axial force, shear force, bending moment and twisting moment. Bending stress; Shear stress; Concept of strain energy; Yield criteria.

Reference books and suggested reading:

1. Engineering Mechanics, 2nd ed. - MK Harbola, Cengage Learning India, 2013.
2. Introduction to Mechanics - MK Verma, CRC Press Book, 2009.
3. Mechanics- DS Mathur, S Chand Publishing, 1981.
4. An Introduction to Mechanics - D Kleppner & R Kolenkow, Tata McGraw Hill 2009.
5. Principles of Mechanics - JL Synge & BA Griffiths, Nabu Press, 2011.
6. Mechanics - JP Den Hartog, Dover Publications Inc, 1961.
7. Engineering Mechanics- Dynamics, 7th ed. - JL Meriam, Wiley.
8. Theory of Vibrations with Applications -WT Thomson, Pearson.
9. An Introduction to the Mechanics of Solids, 2nd ed. with SI Units-SH Crandall, NC Dahl & TJ Lardner
10. Classical Mechanics- H. Goldstein, Pearson Education, Asia.
11. Classical mechanics of particles and rigid bodies-K.C Gupta, Wiley eastern, New Delhi.
12. Engineering Physics-Malik and Singh, Tata McGraw Hill.
13. Engineering Mechanics: Statics- 7th ed.-JL Meriam, Wiley, 2011.
14. Analytical Mechanics-Satish K Gupta, Modern Publishers.
15. https://nptel.ac.in/courses/122102004/

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

IK Gujral Punjab Technical University
Bachelor of Technology (B. Tech. 1st Year)

BTPH111-18	**Mechanics of Solids Lab**	**L-0, T-0, P-3**	**1.5 Credits**

Pre-requisites (if any): High-school education with Physics lab as one of the subject.

Course Objectives: The aim and objective of the Lab course on **Mechanics of Solids** is to introduce the students of B. Tech to the formal structure of Mechanics of solids so that they can use these in Engineering as per their requirement.

Course Outcomes: At the end of the course, the student will be

CO1	Able to understand the concepts learned in the mechanics of solids.
CO2	Learning the skills needed to verify some of the concepts of theory courses.
CO3	Trained in carrying out precise measurements and handling sensitive equipment.
CO4	Able to understand the principles of error analysis and develop skills in experimental design.
CO5	Able to document a technical report which communicates scientific information in a clear and concise manner.

Detailed syllabus:

Note: Students are expected to perform about 10-12 experiments from the following list, selecting minimum of 7-8 from the Section-A and 3-4 from the Section-B.

Section -A

1. Measurements of length (or diameter) using vernier caliper, screw gauge, and travelling microscope. Use of Plumb line and Spirit level.
2. To determine the horizontal distance between two points using a Sextant.
3. To determine the vertical distance between two points using a Sextant.
4. To determine the height of an inaccessible object using a Sextant.
5. To determine the angular diameter of the sun using the sextant.
6. To determine the angular acceleration α, torque τ, and Moment of Inertia of flywheel.
7. To study the Motion of a Spring and calculate (a) Spring Constant (b) Value of **g** and (c) Modulus of rigidity.
8. To determine the time period of a simple pendulum for different length and acceleration due to gravity.
9. To study the variation of time period with distance between centre of suspension and centre of gravity for a compound pendulum and to determine: (i) Radius of gyration of the bar about an axis through its C.G. and perpendicular to its length. (ii) The value of g in the laboratory.
10. To determine the Young's Modulus of a Wire by Optical Lever Method.
11. To determine the Elastic Constants/Young's Modulus of a Wire by Searle's method.
12. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.
13. To determine the Modulus of Rigidity of brass using Searle's method.
14. To find the moment of inertia of an irregular body about an axis through its C.G with the torsional pendulum.
15. To determine **g** by Kater's Pendulum.
16. To determine **g** and velocity for a freely falling body using Digital Timing Technique.
17. To find out the frequency of AC mains using electric-vibrator.

158

Section-B

Virtual lab:

1. To determine the angular acceleration α and torque τ of flywheel.
2. To determine the moment of inertia of a flywheel.
3. To find the acceleration of the cart in the simulator.
4. To find the distance covered by the cart in the simulator in the given time interval.
5. To verify that energy conservation and momentum conservation can be used with a ballistic pendulum to determine the initial velocity of a projectile, its momentum and kinetic energy.
6. To verify the momentum and kinetic energy conservation using collision balls.
7. To understand the torsional oscillation of pendulum in different liquid. and determine the rigidity modulus of the suspension wire using torsion pendulum.
8. To find the Time of flight, Horizontal range and maximum height of a projectile for different velocity, angle of projection, cannon height and environment.
9. The Elastic and Inelastic collision simulation will help to analyse the collision variations for different situations.
10. Demonstration of collision behaviour for elastic and inelastic type.
11. Variation of collision behavior in elastic and inelastic type.
12. Study of variation of Momentum, Kinetic energy, Velocity of collision of the objects and the Center of Mass with different velocity and mass.
13. Calculation of the Momentum, Kinetic energy, and Velocity after collision.

Reference book and suggested readings:

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
3. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11th Edn, 2011, Kitab Mahal.
4. Engineering Practical Physics, S. Panigrahi & B. Mallick, 2015, Cengage Learning India Pvt. Ltd.
5. Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press.
6. Laboratory Experiments in College Physics, C.H. Bernard and C.D. Epp, John Wiley and Sons, Inc., New York, 1995.
7. Practical Physics, G.L. Squires, Cambridge University Press, Cambridge, 1985.
8. Experiments in Modern Physics, A.C. Melissinos, Academic Press, N.Y., 1966.
9. Practical Physics, C L Arora. S. Chand & Company Ltd.
10. http://www.vlab.co.in
11. http://vlab.amrita.edu/index.php?sub=1

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

IK Gujral Punjab Technical University
Bachelor of Technology (B. Tech. 1st Year)

BTPH102-18	**Optics and Modern Physics**	**L-3, T-1, P-0**	**4 Credits**

Pre-requisite (if any):

1. High-school education with physics as one of the subject.
2. Mathematical course on differential equations.

Course Objectives: The aim and objective of the course on **Optics and Modern Physics** is to introduce the students of B.Tech. to the subjects of wave optics, Quantum Mechanics, Solids, and Semiconductors so that they can use these in Engineering as per their requirement.

Course Outcomes: At the end of the course, the student will be able to

CO1	Identify and illustrate physical concepts and terminology used in optics and other wave phenomena.
CO2	Understand optical phenomenon, such as, interference, diffraction etc. in terms of wave model.
CO3	Understand the importance of wave equation in nature and appreciate the mathematical formulation of the same.
CO4	Appreciate the need for quantum mechanics, wave particle duality, uncertainty principle etc. and their applications.
CO5	Understand some of the basic concepts in the physics of solids and semiconductors.

Detailed Syllabus:

PART-A

UNIT I: Waves and Oscillations *(10 lectures)*

Mechanical simple harmonic oscillators, damped harmonic oscillator, forced mechanical oscillators, impedance, steady state motion of forced damped harmonic oscillator, Transverse wave on a string, wave equation on a string, reflection and transmission of waves at a boundary, impedance matching, standing waves, longitudinal waves and their wave equation, reflection and transmission of waves at a boundary.

UNIT II: Optics and LASERS *(10 lectures)*

Optics: Light as an electromagnetic wave, reflectance and transmittance, Fresnel equations (Qualitative idea), Brewster's angle, total internal reflection: Interference: Huygens' principle, superposition of waves and interference of light by wavefront splitting and amplitude splitting; Young's double slit experiment, Michelson interferometer. Diffraction: Farunhofer diffraction from a single slit and a circular aperture, Diffraction gratings and their resolving power; LASERS: Spontaneous and stimulated emission, Einstein's theory of matter radiation interaction and A and B coefficients; population inversion, pumping, various modes, properties of laser beams, types of lasers: gas lasers (He-Ne), solid-state lasers (ruby), and its applications.

160

PART-B

UNIT III: Introduction to Quantum Mechanics *(10 lectures)*

Wave nature of Particles, Free-particle wave function and wave-packets, probability densities, Expectation values, Uncertainty principle, Time-dependent and time-independent Schrodinger equation for wave function, Born interpretation, Solution of stationary-state Schrodinger equation for one dimensional problems: particle in a box, linear harmonic oscillator.

UNIT IV: Introduction to Solids and Semiconductors *(10 lectures)*

Free electron theory of metals, Fermi level, density of states in 1, 2 and 3 dimensions, Bloch's theorem for particles in a periodic potential, Origin of energy bands (Qualitative idea); Types of electronic materials: metals, semiconductors, and insulators, Intrinsic and extrinsic semiconductors, Dependence of Fermi level on carrier-concentration and temperature (equilibrium carrier statistics), Carrier generation and recombination, Carrier transport: diffusion and drift, p-n junction.

Reference books and suggested reading:

1. I. G. Main, "Vibrations and waves in physics", Cambridge University Press, 1993.
2. H. J. Pain, "The physics of vibrations and waves", Wiley, 2006.
3. E. Hecht, "Optics", Pearson Education, 2008.
4. A. Ghatak, "Optics", McGraw Hill Education, 2012.
5. O. Svelto, "Principles of Lasers", Springer Science & Business Media, 2010.
6. D. J. Griffiths, "Quantum mechanics", Pearson Education, 2014.
7. R. Robinett, "Quantum Mechanics", OUP Oxford, 2006.
8. D.A. Neamen, "Semiconductor Physics and Devices", Times Mirror High Education Group, Chicago, 1997.
9. E.S. Yang, "Microelectronic Devices", McGraw Hill, Singapore, 1988.
10. B.G. Streetman, "Solid State Electronic Devices", Prentice Hall of India, 1995.
11. HK Malik and AK Singh, Engineering Physics, 2nd ed., Tata McGraw Hill, 2018.
12. S. Sharma and J. Sharma, Engineering Physics, Pearson, 2018.
13. https://nptel.ac.in/courses/117108037/3
14. https://nptel.ac.in/courses/115102023/

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

IK Gujral Punjab Technical University
Bachelor of Technology (B. Tech. 1st Year)

BTPH112-18	Optics and Modern Physics Lab	L-0, T-0, P-3	1.5 Credits

Pre-requisite (If any): High-school education with physics as one of the subject.

Course Objectives: The aim and objective of the lab on **Optic and Modern Physics** is to introduce the students of B.Tech. class to the formal structure of wave and optics, Quantum Mechanics and semiconductor physics so that they can use these in Engineering branch as per their requirement.

Course Outcomes: At the end of the course, the student will be able to

CO1	Verify some of the theoretical concepts learnt in the theory courses.
CO2	Trained in carrying out precise measurements and handling sensitive equipment.
CO3	Introduced to the methods used for estimating and dealing with experimental uncertainties and systematic errors.
CO4	Learn to draw conclusions from data and develop skills in experimental design.
CO5	Write a technical report which communicates scientific information in a clear and concise manner.

Detailed Syllabus:

Note: Students are expected to perform about 10-12 experiments from the following list, selecting minimum of 7-8 from the Section-A and 3-4 from the Section-B.

Section-A

1. To study the laser beam characteristics like; wave length using diffraction grating aperture & divergence.
2. Study of diffraction using laser beam and thus to determine the grating element.
3. To study laser interference using Michelson's Interferometer.
4. To determine the numerical aperture of a given optic fibre and hence to find its acceptance angle.
5. To determine attenuation & propagation losses in optical fibres.
6. To determine the grain size of a material using optical microscope.
7. To find the refractive index of a material/glass using spectrometer.
8. To find the refractive index of a liquid using spectrometer.
9. To find the velocity of ultrasound in liquid.
10. To determine the specific rotation of sugar using Laurent's half-shade polarimeter.
11. To study the characteristic of different p-n junction diode - Ge and Si.
12. To analyze the suitability of a given Zener diode as voltage regulator.
13. To find out the intensity response of a solar cell/Photo diode.
14. To find out the intensity response of a LED.
15. To find out the frequency of AC mains using electric-vibrator.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

162

Section-B

Virtual lab:

1. To find the resolving power of the prism.
2. To determine the angle of the given prism.
3. To determine the refractive index of the material of a prism
4. To determine the numerical aperture of a given optic fibre and hence to find its acceptance angle.
5. To calculate the beam divergence and spot size of the given laser beam.
6. To determine the wavelength of a laser using the Michelson interferometer.
7. To revise the concept of interference of light waves in general and thin-film interference in particular.
8. To set up and observe Newton's rings.
9. To determine the wavelength of the given source.
10. To understand the phenomenon Photoelectric effect.
11. To draw kinetic energy of photoelectrons as a function of frequency of incident radiation.
12. To determine the Planck's constant from kinetic energy versus frequency graph.
13. To plot a graph connecting photocurrent and applied potential.
14. To determine the stopping potential from the photocurrent versus applied potential graph.

Reference books and suggested reading:

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
3. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11th Edn, 2011, Kitab Mahal.
4. Engineering Practical Physics, S. Panigrahi & B. Mallick, 2015, Cengage Learning India Pvt. Ltd.
5. Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press.
6. Laboratory Experiments in College Physics, C.H. Bernard and C.D. Epp, John Wiley and Sons, Inc., New York, 1995.
7. Practical Physics, G.L. Squires, Cambridge University Press, Cambridge, 1985.
8. Experiments in Modern Physics, A.C. Melissinos, Academic Press, N.Y., 1966.
9. Practical Physics, C L Arora. S. Chand & Company Ltd.
10. http://www.vlab.co.in
11. http://vlab.amrita.edu/index.php?sub=1

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

BTPH103-18	**Electromagnetism**	**L-3, T-1, P-0**	**4 Credits**

Pre-requisites (if any):

1. High-school education with physics as one of the subject.
2. Mathematical course on vector calculus.

Course Objectives: The aim and objective of the course is to expose the students to the formal structure of electromagnetism so that they can use these in Engineering as per their requirement.

Course Outcomes: At the end of the course, the student will be able to

CO1	Specify the constitutive relationships for fields and understand their important.
CO2	Describe the static and dynamic electric and magnetic fields for technologically important structures.
CO3	Measure the voltage induced by time varying magnetic flux.
CO4	acquire the knowledge of Maxwell equation and electromagnetic field theory and propagation and reception of electro-magnetic wave systems.
CO5	have a solid foundation in engineering fundamentals required to solve problems and also to pursue higher studies.

Detailed Syllabus:

PART-A

UNIT I: Electrostatics in vacuum and linear dielectric medium *(10 lectures)*

Calculation of electric field and electrostatic potential for a charge distribution; Divergence and curl of electrostatic field; Laplace's and Poisson's equations for electrostatic potential; Uniqueness theorem (Definition); examples: Faraday's cage; Boundary conditions of electric field; Energy of a charge distribution and its expression in terms of electric field. Electrostatic field and potential of a dipole. Bound charges due to electric polarization in Dielectrics; Electric displacement; Solving simple electrostatics problems in presence of dielectrics – Point charge at the centre of a dielectric sphere, charge in front of a dielectric slab.

UNIT II: Magnetostatics in linear magnetic medium *(10 lectures)*

Bio-Savart law, Divergence and curl of static magnetic field; Concept of vector potential, Magnetization and associated bound currents; auxiliary magnetic field $\vec{H}$; Boundary conditions on $\vec{B}$ and $\vec{H}$. Solving for magnetic field due to bar magnet; magnetic susceptibility and ferromagnetic, paramagnetic and diamagnetic materials; magnetic domains, hysteresis and B-H curve.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

164

PART-B

UNIT III: Faraday's law and Maxwell's equations *(10 lectures)*

Faraday's law; equivalence of Faraday's law and motional EMF; Lenz's law; Electromagnetic breaking and its applications; Differential form of Faraday's law; energy stored in a magnetic field. Continuity equation for current densities; Modifying equation for the curl of magnetic field to satisfy continuity equation; displacement current and magnetic field arising from time-dependent electric field; Maxwell's equation in vacuum and non-conducting medium; Flow of energy and Poynting vector and Poynting theorem.

UNIT IV: Electromagnetic waves *(10 lectures)*

Wave equation for electromagnetic waves in free space and conducting medium, Uniform plane waves and general solution of uniform plane waves, relation between electric and magnetic fields of an electromagnetic wave their transverse nature.; Linear, circular and elliptical polarization, Reflection and transmission of electromagnetic waves from a non-conducting medium-vacuum interface for normal incidence.

Text and Reference Books:

1. D. Griffiths, Introduction to Electrodynamics, Pearson Education India; 4th ed. (2015).
2. J D Jackson, Classical Electrodynamics, John Wiley and Sons (1999).
3. Halliday and Resnick, Fundamentals of Physics, Wiley (2011).
4. W. Saslow, Electricity, Magnetism and Light, Academic Press (2002).
5. HK Malik and AK Singh, Engineering Physics, 2nd ed., Tata McGraw Hill (2018).

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

IK Gujral Punjab Technical University
Bachelor of Technology (B. Tech. 1st Year)

BTPH113-18	**Electromagnetism Lab**	**L-0, T-0, P-3**	**1.5 Credits**

Pre-requisite (If any): High-school education

Course Objectives: The aim and objective of the lab course on **Electromagnetism** is to introduce the students of B. Tech. class to the formal structure of electromagnetism so that they can use these in various branches of engineering as per their requirement.

Course Outcomes: At the end of the course, the student will be able to

CO1	Able to verify some of the theoretical concepts learnt in the theory courses.
CO2	Trained in carrying out precise measurements and handling sensitive equipment.
CO3	understand the methods used for estimating and dealing with experimental uncertainties and systematic "errors."
CO4	Learn to draw conclusions from data and develop skills in experimental design.
CO5	Write a technical report which communicates scientific information in a clear and concise manner.

Detailed Syllabus:

Note: Students are expected to perform about 10-12 experiments from the following list, selecting minimum of 7-8 from the Section-A and 3-4 from the Section-B.

Section-A

1. Use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, (d) Capacitances, and (e) Checking electrical fuses.
2. To study the magnetic field of a circular coil carrying current.
3. To study B-H curve for a ferromagnetic material using CRO.
4. To find out the frequency of AC mains using electric-vibrator.
5. To find out polarizability of a dielectric substance.
6. Determine a high resistance by leakage method using Ballistic Galvanometer.
7. To study the characteristics of a Series RC Circuit.
8. To study the series LCR circuit and determine its (a) Resonant Frequency, (b) Quality.
9. To study a parallel LCR circuit and determine its (a) Anti-resonant frequency (b) Quality factor Q.
10. To determine the value of self-inductance by Maxwell Inductance Bridge.
11. To determine the value of self-inductance by Maxwell Inductance Capacitance Bridge.
12. To determine the mutual inductance of two coils by Absolute method.
13. To study the induced emf as a function of the velocity of magnet and to study the phenomenon of electromagnetic damping.
14. To determine unknown capacitance by flashing and quenching method.
15. To study the field pattern of various modes inside a rectangular waveguide.
16. To determine charge to mass ratio (e/m) of an electron by helical method.
17. To determine charge to mass ratio (e/m) of an electron by Thomson method.
18. To find out the horizontal component of earth's magnetic field (B_h).

166

Section-B

Virtual lab:

1. To find out the horizontal component of earth's magnetic field (B_h).
2. An experiment to study the variation of magnetic field with distance along the axis of a circular coil carrying current.
3. Aim is to find the horizontal intensity of earth's magnetic field at a place and moment of the bar magnet.
4. To determine the self-inductance of the coil (L) using Anderson's bridge.
5. To calculate the value of inductive reactance (X_L) of the coil at a particular frequency.
6. The temperature coefficient of resistor simulation will help the user to easily identify the change in resistivity of the resistor according to the change in temperature.

Reference books and suggested reading:

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
3. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11th Edn, 2011, Kitab Mahal.
4. Engineering Practical Physics, S. Panigrahi & B. Mallick, 2015, Cengage Learning India Pvt. Ltd.
5. Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press.
6. Laboratory Experiments in College Physics, C.H. Bernard and C.D. Epp, John Wiley and Sons, Inc., New York, 1995.
7. Practical Physics, G.L. Squires, Cambridge University Press, Cambridge, 1985.
8. Experiments in Modern Physics, A.C. Melissinos, Academic Press, N.Y., 1966.
9. Practical Physics, C L Arora, S. Chand & Company Ltd.
10. http://www.vlab.co.in
11. http://vlab.amrita.edu/index.php?sub=1

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

IK Gujral Punjab Technical University
Bachelor of Technology (B. Tech. 1st Year)

BTPH104-18	**Semiconductor Physics**	**L-3, T-1, P-0**	**4 Credits**

Prerequisite (if any): Introduction to Quantum Mechanics desirable

Course Objectives: The aim and objective of the course on **Semiconductor Physics** is to introduce the students of B. Tech. class to the formal structure of semiconductor physics so that they can use these in Engineering as per their requirement.

Course Outcomes: At the end of the course, the student will be able to

CO1	Understand and explain the fundamental principles and properties of electronic materials and semiconductors
CO2	Understand and describe the interaction of light with semiconductors in terms of fermi golden rule.
CO3	Understand and describe the impact of solid-state device capabilities and limitations on electronic circuit performance.
CO4	Understand the design, fabrication, and characterization techniques of Engineered semiconductor materials.
CO5	Develop the basic tools with which they can study and test the newly developed devices and other semiconductor applications.

Detailed Syllabus:

PART-A

UNIT 1: Electronic materials *(10 lectures)*

Free electron theory of metals, Density of states in 1D, 2D, and 3D, Bloch's theorem for particles in a periodic potential, Energy band diagrams, Kronig-Penny model (to introduce origin of band gap), Energy bands in solids, E-k diagram, Direct and indirect bandgaps, Types of electronic materials: metals, semiconductors, and insulators, Occupation probability, Fermi level, Effective mass.

UNIT II: Semiconductors *(10 lectures)*

Intrinsic and extrinsic semiconductors, Dependence of Fermi level on carrier-concentration and temperature (equilibrium carrier statistics), Carrier generation and recombination, Carrier transport: diffusion and drift, p-n junction, Metal-semiconductor junction (Ohmic and Schottky), Semiconductor materials of interest for optoelectronic devices.

PART-B

UNIT III: Light-semiconductor interaction *(10 lectures)*

Optical transitions in bulk semiconductors: absorption, spontaneous emission, and stimulated emission; Einstein coefficients, Population inversion, application in semiconductor Lasers; Joint density of states, Density of states for phonons, Transition rates (Fermi's golden rule), Optical loss and gain; Photovoltaic effect, Exciton, Drude model.

Head
Department of Electrical Engineering
I.K.Gujral Punjab Technical University
Kapurthala-144006

UNIT IV: Measurement Techniques ***(10 lectures)***

Measurement for divergence and wavelength using a semiconductor laser, Measurements for carrier density, resistivity, hall mobility using Four-point probe and van der Pauw method, Hot-point probe measurement, capacitance-voltage measurements, parameter extraction from diode I-V characteristics.

Reference books and suggested reading:

1. J. Singh: Semiconductor Optoelectronics: Physics and Technology, McGraw-Hill Inc. (1995).
2. B. E. A. Saleh and M. C. Teich: Fundamentals of Photonics, John Wiley & Sons, Inc., (2007).
3. S. M. Sze: Semiconductor Devices: Physics and Technology, Wiley (2008).
4. A. Yariv and P. Yeh, Photonics: Optical Electronics in Modern Communications, Oxford University Press, New York (2007).
5. P. Bhattacharya: Semiconductor Optoelectronic Devices, Prentice Hall of India (1997).
6. Ben G. Streetman: Solid State Electronics Devices, Pearson Prentice Hall.
7. D.A. Neamen, "Semiconductor Physics and Devices", Times Mirror High Education Group, Chicago, 1997.
8. E.S. Yang, "Microelectronic Devices", McGraw Hill, Singapore, 1988.
9. Online course: "Semiconductor Optoelectronics" by M R Shenoy on NPTEL.
10. Online course: "Optoelectronic Materials and Devices" by Monica Katiyar and Deepak Gupta on NPTEL.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

IK Gujral Punjab Technical University
Bachelor of Technology (B. Tech. 1st Year)

BTPH114-18	Semiconductor Physics Lab	L-0, T-0, P-3	1.5 Credits

Pre-requisite (if any): (i) High-school education

Course Objectives: The aim and objective of the Lab course on **Semiconductor Physics** is to introduce the students of B.Tech. class to the formal structure of semiconductor physics so that they can use these in Engineering as per their requirement.

Course Outcomes: At the end of the course, the student will be able to

CO1	Able to verify some of the theoretical concepts learnt in the theory courses.
CO2	Trained in carrying out precise measurements and handling sensitive equipment.
CO3	Introduced to the methods used for estimating and dealing with experimental uncertainties and systematic "errors."
CO4	Learn to draw conclusions from data and develop skills in experimental design.
CO5	Write a technical report which communicates scientific information in a clear and concise manner.

Detailed Syllabus:

Note: Students are expected to perform about 10-12 experiments from the following list, selecting minimum of 7-8 from the Section-A and 3-4 from the Section-B.

Section-A

1. To study the characteristic of different PN junction diode-Ge and Si.
2. To analyze the suitability of a given Zener diode as a power regulator.
3. To find out the intensity response of a solar cell/Photo diode.
4. To find out the intensity response of a LED.
5. To determine the band gap of a semiconductor.
6. To determine the resistivity of a semiconductor by four probe method.
7. To confirm the de Broglie equation for electrons.
8. To study voltage regulation and ripple factor for a half-wave and a full-wave rectifier without and with different filters.
9. To study the magnetic field of a circular coil carrying current.
10. To find out polarizability of a dielectric substance.
11. To study B-H curve of a ferro-magnetic material using CRO.
12. To find out the frequency of AC mains using electric-vibrator.
13. To find the velocity of ultrasound in liquid.
14. To study the Hall effect for the determination of charge current densities.
15. Distinguish between Diamagnetic material, Paramagnetic and ferromagnetic material.
16. Measurement of susceptibility of a liquid or a solution by Quincke's method.
17. To study the sample with the nano-scale objects and measure surface topography with different scales, width and height of nano objects, and force-distance curves using AFM.
18. To study the temperature coefficient of Resistance of copper.
19. To determine the ratio k/e Using a transistor.
20. To compare various capacitance and verify the law of addition of capacitance.
21. To determine dipole moment of an organic molecule acetone.
22. To measure the temperature dependence of a ceramic capacitor.
23. Verification of the curie Weiss law for the electrical susceptibility of a ferromagnetic material.
24. To study the laser beam characteristics like; wave length using diffraction grating aperture & divergence.

25. To study laser interference using Michelson's Interferometer.
26. Study of diffraction using laser beam and thus to determine the grating element.

Section-B

Virtual lab:

1. To draw the static current-voltage (I-V) characteristics of a junction diode.
2. To plot the characteristics of thermistor and hence find the temperature coefficient of resistance.
3. To determine the resistivity of semiconductors by Four Probe Method.
4. To study Zener diode voltage as regulator and measure its line and load regulation.
5. To study the B-H Curve for a ferromagnetic material.
6. To study the Hall effect experiment to determine the charge carrier density.
7. To determine the magnetic susceptibilities of paramagnetic liquids by Quincke's Method.
8. To study the phenomena of magnetic hysteresis and calculate the retentivity, coercivity and saturation magnetization of a material using a hysteresis loop tracer.
9. Verification and design of combinational logic using AND, OR, NOT, NAND and XOR gates.

Reference books and suggested reading:

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
3. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11th Edn, 2011, Kitab Mahal.
4. Engineering Practical Physics, S. Panigrahi & B. Mallick, 2015, Cengage Learning India Pvt. Ltd.
5. Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press.
6. Laboratory Experiments in College Physics, C.H. Bernard and C.D. Epp, John Wiley and Sons, Inc., New York, 1995.
7. Practical Physics, G.L. Squires, Cambridge University Press, Cambridge, 1985.
8. Experiments in Modern Physics, A.C. Melissinos, Academic Press, N.Y., 1966.
9. Practical Physics, C L Arora, S. Chand & Company Ltd.
10. http://www.vlab.co.in
11. http://vlab.amrita.edu/index.php?sub=1

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

171

BTPH105-18	**Semiconductor and Optoelectronics Physics**	**L-3, T-1, P-0**	**4 Credits**

Prerequisite (if any): "Introduction to Quantum Mechanics" Desirable

Course Objectives: The aim and objective of the course on **Semiconductor and Optoelectronics Physics** is to introduce the students of B. Tech. class to the formal structure of semiconductor physics and Optoelectronics so that they can use these in Engineering as per their requirement.

Course Outcomes: At the end of the course, the student will be able to

CO1	Understand and explain the fundamental principles and properties of electronic materials and semiconductors.
CO2	Understand and describe the interaction of light with semiconductors in terms of fermi golden rule.
CO3	Understand and describe the impact of solid-state device capabilities and limitations on electronic circuit performance.
CO4	Understand the design, fabrication, characterization techniques, and measurements of Engineered semiconductor materials.
CO5	Learn the basics of the optoelectronic devices, LEDs, semiconductor lasers, and photo detectors.

Detailed Syllabus:

PART-A

UNIT -I: Electronic materials *(10 lectures)*

Free electron theory of metals, Density of states in 1D, 2D, and 3D, Bloch's theorem for particles in a periodic potential, energy band diagrams, Kronig-Penny model (to introduce origin of band gap), Energy bands in solids, E-k diagram, Direct and indirect band gaps, Types of electronic materials: metals, semiconductors and insulators, Occupation probability, Fermi level, Effective mass of electron and hole.

UNIT -II: Semiconductors *(10 lectures)*

Intrinsic and extrinsic semiconductors, Dependence of Fermi level on carrier-concentration and temperature (equilibrium carrier statistics), Carrier generation and recombination, Carrier transport: diffusion and drift, p-n junction, Metal-semiconductor junction (Ohmic and Schottky).

172

PART-B

UNIT -III: Optoelectronic devices *(10 lectures)*

Radiative and non-radiative recombination mechanisms in semiconductors, Semiconductor materials of interest for optoelectronic devices; Semiconductor light emitting diodes (LEDs): light emitting materials, device structure, characteristics; Optical transitions in bulk semiconductors: absorption, spontaneous emission, and stimulated emission, Semiconductor laser: population inversion at a junction, structure, materials, device characteristics, Photovoltaics: Types of semiconductor photo detectors-p-n junction, PIN, and Avalanche-and their structure, materials, working principle, and characteristics, Noise limits on performance.

UNIT-IV: Measurement techniques *(10 lectures)*

Measurement for divergence and wavelength using a semiconductor laser, Measurements for carrier density, resistivity, and hall mobility using Four-point probe and van der Pauw method, Hot-point probe measurement, capacitance-voltage measurements, parameter extraction from diode I-V characteristics.

Reference books and suggested reading:

1. J. Singh, Semiconductor Optoelectronics: Physics and Technology, McGraw-Hill Inc. (1995).
2. B. E. A. Saleh and M. C. Teich, Fundamentals of Photonics, John Wiley & Sons, Inc. (2007).
3. S. M. Sze, Semiconductor Devices: Physics and Technology, Wiley (2008).
4. A. Yariv and P. Yeh, Photonics: Optical Electronics in Modern Communications, Oxford University Press, New York (2007).
5. P. Bhattacharya: Semiconductor Optoelectronic Devices, Prentice Hall of India (1997).
6. Solid state electronics devices: Ben. G. Streetman Pearson Prentice Hall.
7. D.A. Neamen: "Semiconductor Physics and Devices", Times Mirror High Education Group, Chicago, 1997.
8. E.S. Yang: "Microelectronic Devices", McGraw Hill, Singapore, 1988.
9. Online course: "Semiconductor Optoelectronics" by M R Shenoy on NPTEL.
10. Online course: "Optoelectronic Materials and Devices" by Monica Katiyar and Deepak Gupta on NPTEL.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

BTPH115-18	**Semiconductor and Optoelectronics Physics Lab**	**L-0, T-0, P-3**	**1.5 Credits**

Pre-requisite (if any): High-school education

Course Objectives: The aim and objective of the Lab course on **Semiconductor and Optoelectronics Physics** is to introduce the students of B.Tech. class to the formal lab structure of semiconductor physics so that they can use these in Engineering as per their requirement.

Course Outcomes: At the end of the course, the student will be able to

CO1	Able to verify some of the theoretical concepts learnt in the theory courses.
CO2	Trained in carrying out precise measurements and handling sensitive equipment.
CO3	Introduced to the methods used for estimating and dealing with experimental uncertainties and systematic "errors."
CO4	Learn to draw conclusions from data and develop skills in experimental design.
CO5	Write a technical report which communicates scientific information in a clear and concise manner.

Detailed Syllabus:

Note: Students are expected to perform about 10-12 experiments from the following list, selecting minimum of 7-8 from the Section-A and 3-4 from the Section-B.

Section-A

1. To study the characteristic of different PN junction diode-Ge and Si.
2. To analyze the suitability of a given Zener diode as a power regulator.
3. To find out the intensity response of a solar cell/Photo diode.
4. To find out the intensity response of a LED.
5. To determine the band gap of a semiconductor.
6. To determine the resistivity of a semiconductor by four probe method.
7. To confirm the de Broglie equation for electrons.
8. To study voltage regulation and ripple factor for a half-wave and a full-wave rectifier without and with different filters.
9. To study the magnetic field of a circular coil carrying current.
10. To find out polarizability of a dielectric substance.
11. To study B-H curve of a ferro-magnetic material using CRO.
12. To find out the frequency of AC mains using electric-vibrator.
13. To find the velocity of ultrasound in liquid.
14. To study the Hall effect for the determination of charge current densities.
15. Distinguish between diamagnetic material, paramagnetic and ferromagnetic material.
16. Measurement of susceptibility of a liquid or a solution by Quincke's method.
17. To study the sample with the nano-scale objects and measure surface topography with different scales, width and height of nano objects, and force-distance curves using AFM.
18. To study the temperature coefficient of Resistance of copper.
19. To determine the ratio k/e using a transistor.
20. To compare various capacitance and verify the law of addition of capacitance.
21. To measure the temperature dependence of a ceramic capacitor.
22. Verification of the curie Weiss law for the electrical susceptibility of a ferromagnetic material.

179

23. To study the laser beam characteristics like; wave length using diffraction grating aperture & divergence.
24. To study laser interference using Michelson's Interferometer.
25. Study of diffraction using laser beam and thus to determine the grating element.

Section-B

Virtual lab:

1. To draw the static current-voltage (I-V) characteristics of a junction diode.
2. To plot the characteristics of thermistor and hence find the temperature coefficient of resistance.
3. To determine the resistivity of semiconductors by Four Probe Method.
4. To study Zener diode voltage as regulator and measure its line and load regulation.
5. To study the B-H Curve for a ferromagnetic material.
6. To study the Hall effect experiment to determine the charge carrier density.
7. To determine the magnetic susceptibilities of paramagnetic liquids by Quincke's Method.
8. To study the phenomena of magnetic hysteresis and calculate the retentivity, coercivity and saturation magnetization of a material using a hysteresis loop tracer.
9. Verification and design of combinational logic using AND, OR, NOT, NAND and XOR gates.

Reference books and suggested reading:

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
3. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11th Edn, 2011, Kitab Mahal.
4. Engineering Practical Physics, S. Panigrahi & B. Mallick, 2015, Cengage Learning India Pvt. Ltd.
5. Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press.
6. Laboratory Experiments in College Physics, C.H. Bernard and C.D. Epp, John Wiley and Sons, Inc., New York, 1995.
7. Practical Physics, G.L. Squires, Cambridge University Press, Cambridge, 1985.
8. Experiments in Modern Physics, A.C. Melissinos, Academic Press, N.Y., 1966.
9. Practical Physics, C L Arora, S. Chand & Company LTD.
10. http://www.vlab.co.in
11. http://vlab.amrita.edu/index.php?sub=1

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

BTPH106-18	Optics and Electromagnetism	L-3, T-1, P-0	4 Credits

Prerequisite (if any): Introduction to Quantum Mechanics desirable

Course Objectives: The aim and objective of the course on **Optics and Electromagnetism** is to introduce the students of B.Tech. class to the basic concepts of optics and its applications, electricity and magnetism, and quantum physics, so that they can use these in Engineering as per their requirement.

Course Outcomes: At the end of the course, the student will be able to understand

CO1	Identify and illustrate physical concepts and terminology used in optics and other wave phenomena.
CO2	Understand optical phenomena such as polarization, birefringence, interference, and diffraction in terms of the wave model.
CO3	Understand the importance of wave equation in nature and appreciate the mathematical formulation of the same
CO4	Acquire knowledge about the Maxwell equation and magnetic properties of materials.
CO5	Appreciate the need for quantum mechanics, wave particle duality, uncertainty principle etc.

Detailed syllabus:

PART-A

Unit I: Wave Optics (*8 lectures*)

Diffraction: Introduction to interference and example; concept of diffraction, Fraunhofer and Fresnel diffraction, Fraunhofer diffraction at single slit, double slit, and multiple slits; diffraction grating, characteristics of diffraction grating and its applications; Polarization: Introduction to polarization, polarisation by reflection, polarisation by double refraction, scattering of light, circular and elliptical polarisation, optical activity.

UNIT-II: Fibre Optics and LASERS (*12 lectures*)

Fibre Optics: Introduction, optical fibre as a dielectric wave guide: total internal reflection, numerical aperture and various fibre parameters, losses associated with optical fibres, step and graded index fibres, application of optical fibres; LASERS: Spontaneous and stimulated emission, Einstein's theory of matter radiation interaction and A and B coefficients; population inversion, pumping, various modes, properties of laser beams, types of lasers: gas lasers (He-Ne), solid-state lasers (ruby), applications.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

176

PART-B

UNIT-III: Electromagnetism and Magnetic Properties of Materials *(10 lectures)*

Laws of electrostatics: Coulomb and Gauss Law, electric current and the continuity equation, laws of magnetism: Ampere's and Faraday's laws. Maxwell's equations (derivation and physical significance), Dielectric polarisation, permeability and dielectric constant, polar and non-polar dielectrics, internal fields in a solid, Clausius-Mossotti equation, applications of dielectrics; Magnetisation, permeability and susceptibility, classification of magnetic materials, ferromagnetism, magnetic domains and hysteresis, applications.

Unit IV: Quantum Mechanics *(10 lectures)*

Introduction to quantum physics, black body radiation, explanation using the photon concept, photoelectric effect, Compton effect, de Broglie hypothesis, wave-particle duality, Born's interpretation of the wave function, Davisson and Germer experiment: verification of matter waves, uncertainty principle, Schrodinger wave equation: particle in 1-dimensional box.

Reference books and suggested reading:

1. "Fundamentals of Physics", 6th Ed., D. Halliday, R. Resnick and J. Walker, John Wiley and Sons, Inc., New York, 2001.
2. "Physics", M. Alonso and E.J. Finn, Addison Wesley, .1992.
3. "Fundamentals of Optics", 4th Ed., F.A. Jenkins and H.E. White, McGraw-Hill Book Co., 1981.
4. "Optics", A Ghatak, Tata-McGraw Hill, New Delhi, 1992.
5. "Vibration and Waves", A.P. French, Arnold-Heinemann, New Delhi, 1972.
6. "Vibrations and waves in physics", I. G. Main, Cambridge University Press, 1993.
7. "The physics of vibrations and waves", H. J. Pain, Wiley, 2006.
8. "Optics", E. Hecht, Pearson Education, 2008.
9. "Optics", A. Ghatak, McGraw Hill Education, 2012.
10. "Principles of Lasers", O. Svelto, Springer Science & Business Media, 2010.
11. "Quantum mechanics", D. J. Griffiths, Pearson Education, 2014.
12. "Quantum Mechanics", R. Robinett, OUP Oxford, 2006.
13. "Semiconductor Physics and Devices", D.A. Neamen, Times Mirror High Education Group, Chicago, 1997.
14. "Microelectronic Devices", E.S. Yang, McGraw Hill, Singapore, 1988.
15. "Solid State Electronic Devices", B.G. Streetman, Prentice Hall of India, 1995.
16. HK Malik and AK Singh, Engineering Physics, 2nd ed., Tata McGraw Hill (2018).
17. https://nptel.ac.in/courses/117108037/3
18. https://nptel.ac.in/courses/115102023/

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144008

BTPH116-18	**Optics and Electromagnetism Lab**	**L-0, T-0, P-3**	**1.5 Credits**

Pre-requisite (if any): High-school education

Course Objectives: The aim and objective of the lab on Optics and Electromagnetism is to provide students the firsthand experience of verifying various theoretical concepts learnt in theory courses so that they can use these in their branch of Engineering as per their requirement.

Laboratory Outcomes: At the end of the course, students will be

CO1	Able to verify some of the theoretical concepts learnt in the theory courses.
CO2	Trained in carrying out precise measurements and handling sensitive equipment.
CO3	Introduced to the methods used for estimating and dealing with experimental uncertainties and systematic "errors."
CO4	Learn to draw conclusions from data and develop skills in experimental design.
CO5	Write a technical report which communicates scientific information in a clear and concise manner.

Detailed Syllabus:

Note: Students are expected to perform about 10-12 experiments from the following list, selecting minimum of 7-8 from the Section-A and 3-4 from the Section-B.

Section-A

1. To study the magnetic field of a circular coil carrying current.
2. To find out polarizability of a dielectric substance.
3. To study the laser beam characteristics like; wave length using diffraction grating aperture & divergence.
4. To study laser interference using Michelson's Interferometer.
5. Study of diffraction using laser beam and thus to determine the grating element.
6. To determine numerical aperture of an optical fibre.
7. To determine attenuation & propagation losses in optical fibres.
8. To find out the frequency of AC mains using electric-vibrator.
9. To find the refractive index of a material using spectrometer.
10. To find the refractive index of a liquid using spectrometer.
11. To study B-H curve for a ferromagnetic material using CRO.
12. To find the velocity of ultrasound in liquid.
13. To determine the grain size of a material using optical microscope.
14. To study the characteristics of solar cell.
15. To study the Characteristics of Light Emitting Diode (LED).
16. To determine the energy gap of a given semi-conductor.
17. To determine the specific rotation of sugar using Laurent's half-shade polarimeter.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

F78

Section-B

Virtual lab:

1. To find the resolving power of the prism.
2. To determine the angle of the given prism.
3. To determine the refractive index of the material of a prism.
4. To find the numerical aperture of a given optic fibre and hence to find its acceptance angle.
5. To calculate the beam divergence and spot size of the given laser beam.
6. To determine the wavelength of a laser using the Michelson interferometer.
7. To revise the concept of interference of light waves in general and thin-film interference in particular.
8. To set up and observe Newton's rings.
9. To determine the wavelength of the given source.
10. To understand the phenomenon Photoelectric effect as a whole.
11. To draw kinetic energy of photoelectrons as a function of frequency of incident radiation.
12. To determine the Planck's constant from kinetic energy versus frequency graph.
13. To plot a graph connecting photocurrent and applied potential
14. To determine the stopping potential from the photocurrent versus applied potential graph.

Reference books and suggested reading:

1. "Fundamentals of Physics", 6th Ed., D. Halliday, R. Resnick and J. Walker, John Wiley and Sons, Inc., New York, 2001.
2. "Physics", M. Alonso and E.J. Finn, Addison Wesley, .1992.
3. "Fundamentals of Optics", 4th Ed., F.A. Jenkins and H.E. White, McGraw-Hill Book Co., 1981.
4. "Optics", A Ghatak, Tata-McGraw Hill, New Delhi, 1992
5. "Vibration and Waves", A.P. French, Arnold-Heinemann, New Delhi, 1972.
6. "Students Reference Manual for Electronic Instrumentation Laboratories",
7. "Laboratory Experiments in College Physics", C.H. Bernard and C.D. Epp, John Wiley and Sons, Inc., New York, 1995.
8. "Practical Physics", G.L. Squires, Cambridge University Press, Cambridge, 1985.
9. "Experiments in Modern Physics", A.C. Melissinos, Academic Press, N.Y., 1966.
10. "Practical Physics", C L Arora. S. Chand & Company LTD.
11. http://www.vlab.co.in
12. http://vlab.amrita.edu/index.php?sub=1

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

IK Gujral Punjab Technical University
Bachelor of Technology (B. Tech. 1st Year)

BTPH107-18	**Introduction to Physics in Biotechnology**	**L-3, T-1, P-0**	**4 Credits**

Prerequisite (if any): High School knowledge

Course Objectives: The aim and objective of the course on Introduction to Physics in Biotechnology is to introduce the students of B. Tech. class to the basic concepts and applications of Lasers, fibre optics, X-rays, magnetic material, superconductivity and a brief introduction to quantum physics, so that they can use these in Engineering as per their requirement.

Course Outcomes: At the end of the course, the student will be able to

CO1	Identify and illustrate physical concepts and terminology used in Lasers, fibre optics and other wave phenomena.
CO2	Understand the X-Rays and their applications to the ultrasounds.
CO3	Understand the importance of wave equation in nature and appreciate the mathematical formulation of the same
CO4	Appreciate the need for quantum mechanics, wave particle duality, uncertainty principle etc.
CO5	Understand the properties of magnetic materials and superconductivity.

Detailed Syllabus:

PART-A

UNIT I: LASERS and Fibre Optics *(10 lectures)*

Principles and working of laser: population inversion, pumping, threshold population inversion, types of laser: solid state (Ruby), gas (He-Ne); application of lasers (Medical/Industrial Applications); Fibre Optics: Introduction, optical fibre as a dielectric wave guide, total internal reflection, step and graded index fibres, numerical aperture and various fibre parameters, losses associated with optical fibres, application of optical fibres.

UNIT II: Magnetic Materials and Superconductivity *(10 lectures)*

Origin of magnetism, Basic idea of Diamagnetic, Paramagnetic, Ferromagnetic, Ferrimagnetic and Ferrite materials, Soft and Hard Magnetic materials, magnetostriction, magnetic anisotropy, applications of magnetic materials; Superconductivity, properties of superconducting state, Meissner Effect, Type-I and Type-II superconductors, Introduction to BCS theory (Qualitative idea), applications in medical industry.

PART-B

UNIT III: X-rays and Ultrasounds *(10 lectures)*

X-rays, Production of X-rays, Continuous and Characteristic X-Rays, Absorption of X-rays, Bragg's law, Adverse effects of X-rays, X-ray radiography; Ultrasounds: Ultra sound generators, properties of ultrasound-waves and its propagation in biological tissues, Pulse echo techniques, Doppler principle, involvement in design of medical instruments, Adverse effects of ultrasound waves.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

180

UNIT IV: Quantum Theory and Nano-Materials (*(10 lectures)*

Photoelectric effect, Compton effect and de-Broglie waves; Wave-particle duality, concept of Electron microscopy; Nano-materials, surface to volume ratio, electron confinement (qualitative description), top-down and bottom-up method of synthesis, qualitative idea of quantum well, quantum wire and quantum dot. Carbon nanotubes: types, properties and applications.

Text and Reference Books:

1. Engineering Physics, Malik; HK, Singh; AK, Tata McGraw Hill.
2. Concepts of Modern Physics, Beiser; A., Tata McGraw Hill.
3. Introduction to Solids, Azaroff LV, Tata Mc Graw Hill.
4. Engineering Physics, D.K. Bhattacharya, Poonam Tondon, Oxford University Press.
5. Optical Fibre system, Technology, Design & Applications, Kao; CK, McGraw Hill.
6. Laser Theory & Applications, Thygrajan; K, Ghatak; AK, Mc Millan India Ltd.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

181

IK Gujral Punjab Technical University
Bachelor of Technology (B. Tech. 1st Year)

BTPH117-18	**Physics lab**	**L-0, T-0, P-3**	**1.5 Credits**

Pre-requisite (if any): High-school education

Course Objectives: The aim and objective of the Physics lab is to provide students the firsthand experience of verifying various theoretical concepts learnt in theory courses so that they can use these in Engineering as per their requirement.

Laboratory Outcomes: At the end of the course, students will be

CO1	Able to verify some of the theoretical concepts learnt in the theory courses.
CO2	Trained in carrying out precise measurements and handling sensitive equipment.
CO3	Introduced to the methods used for estimating and dealing with experimental uncertainties and systematic errors.
CO4	Learn to draw conclusions from data and develop skills in experimental design.
CO5	Write a technical report which communicates scientific information in a clear and concise manner.

Detailed Syllabus:

Note: Students are expected to perform about 10-12 experiments from the following list, selecting minimum of 7-8 from the Section-A and 3-4 from the Section-B.

Section-A

1. To study the magnetic field of a circular coil carrying current.
2. To find out polarizability of a dielectric substance.
3. To study the laser beam characteristics like; wave length using diffraction grating aperture & divergence.
4. To study laser interference using Michelson's Interferometer.
5. Study of diffraction using laser beam and thus to determine the grating element.
6. To determine numerical aperture of an optical fibre.
7. To determine attenuation & propagation losses in optical fibres.
8. To find out the frequency of AC mains using electric-vibrator.
9. To determine the energy gap of a given semi-conductor.
10. To study B-H curve of a ferromagnetic material using CRO.
11. To find the velocity of ultrasound in liquid.
12. To determine the grain size of a material using optical microscope.
13. To study the characteristics of solar cell.
14. To study the Characteristics of Light Emitting Diode (LED).
15. To determine the specific rotation of sugar using Laurent's half-shade polarimeter.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical Uni
Kapurthala-144006

182

Section-B

Virtual lab:

1. To find the numerical aperture of a given optic fibre and hence to find its acceptance angle.
2. To calculate the beam divergence and spot size of the given laser beam.
3. To determine the wavelength of a laser using the Michelson interferometer.
4. To revise the concept of interference of light waves in general and thin-film interference in particular.
5. To set up and observe Newton's rings.
6. To determine the wavelength of the given source.
7. To understand the phenomenon Photoelectric effect.
8. To draw kinetic energy of photoelectrons as a function of frequency of incident radiation.
9. To determine the Planck's constant from kinetic energy versus frequency graph.
10. To plot a graph connecting photocurrent and applied potential
11. To determine the stopping potential from the photocurrent versus applied potential graph.

Reference books and suggested reading:

1. "Fundamentals of Physics", 6th Ed., D. Halliday, R. Resnick and J. Walker, John Wiley and Sons, Inc., New York, 2001.
2. "Physics", M. Alonso and E.J. Finn, Addison Wesley, 1992.
3. "Fundamentals of Optics", 4th Ed., F.A. Jenkins and H.E. White, McGraw-Hill Book Co., 1981.
4. "Optics", A Ghatak, Tata-McGraw Hill, New Delhi, 1992
5. "Vibration and Waves", A.P. French, Arnold-Heinemann, New Delhi, 1972.
6. "Students Reference Manual for Electronic Instrumentation Laboratories",
7. "Laboratory Experiments in College Physics", C.H. Bernard and C.D. Epp, John Wiley and Sons, Inc., New York, 1995.
8. "Practical Physics", G.L. Squires, Cambridge University Press, Cambridge, 1985.
9. "Experiments in Modern Physics", A.C. Melissinos, Academic Press, N.Y., 1966.
10. "Practical Physics", C L Arora. S. Chand & Company LTD
11. http://www.vlab.co.in
12. http://vlab.amrita.edu/index.php?sub=1

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144606

IK Gujral Punjab Technical University
Bachelor of Technology (B. Tech. 1st Year)

S.No.	Branch	Related Branches	Course codes	Course title	Credits
1	Civil Engineering-I Sem	1. Civil Engineering 2.Construction Engineering & Management	BTAM101-18	Mathematics-I	5
	Civil Engineering-II Sem	1. Civil Engineering 2.Construction Engineering & Management	BTAM201-18	Mathematics-II	5
2	Electrical Engineering-I Sem	1.Electrical Engineering 2.Automation & Robotics 3.Electrical & Electronics Engineering 4.Electronics & Electrical Engineering 5.Electrical Engineering & Industrial Control 6.Instrumentation & Control Engineering	BTAM101-18	Mathematics-I	5
	Electrical Engineering-II Sem	1.Electrical Engineering 2.Automation & Robotics 3.Electrical & Electronics Engineering 4.Electronics & Electrical Engineering 5.Electrical Engineering & Industrial Control 6.Instrumentation & Control Engineering	BTAM202-18	Mathematics-II	5

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical Univ
Kapurthala-144006

184

3	Mechanical Engineering-I Sem	1.Mechanical Engineering 2.Marine Engineering 3.Production Engineering 4.Industrial Engineering 5.Tool Engineering 6.Automobile Engineering 7.Aerospace Engineering 8.Aeronautical Engineering	BTAM101-18	Mathematics-I	5
	Mechanical Engineering-II Sem	1.Mechanical Engineering 2.Marine Engineering 3.Production Engineering 4.Industrial Engineering 5.Tool Engineering 6.Automobile Engineering 7.Aerospace Engineering 8.Aeronautical Engineering	BTAM203-18	Mathematics-II	5
4	Computer Science Engineering-I Sem	1.Computer Engineering 2.Computer Science Engineering 3.Information Technology 4.3D Animation Engineering 5 CSE (Artificial Intelligence & Machine Learning 6 CSE (Data Science) 7 CSE(IoT & Cyber Security including Block Chain Technology) 8 CSE (Internet of Things) 9 Artificial Intelligence & Data Science	BTAM104-18	Mathematics Paper-I	5

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

185

	Computer Science Engineering-II Sem	1.Computer Engineering 2.Computer Science Engineering 3.Information Technology 4.3D Animation Engineering 5 CSE (Artificial Intelligence & Machine Learning 6 CSE (Data Science) 7 CSE(IoT & Cyber Security including Block Chain Technology) 8 CSE (Internet of Things) 9 Artificial Intelligence & Data Science	BTAM204-18	Mathematics Paper-II	5
5	Electronics and communication Engineering-I Sem	1.Electronics & Communication Engineering 2.Electronics & Computer Engineering 3.Electronics & Instrumentation Engineering 4.Electronics & Telecomm Engineering 5.Electronics Engineering	BTAM101-18	Mathematics-I	5
	Electronics and communication Engineering-II Sem	1.Electronics & Communication Engineering 2.Electronics & Computer Engineering 3.Electronics & Instrumentation Engineering 4.Electronics & Telecomm Engineering 5.Electronics Engineering	BTAM202-18	Mathematics-II	5

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144603

186

6	Chemical Sciences-I Sem	1.Chemical Engineering 2.Petrochem & Petroleum Refinery Engineering 3.Textile Engineering 4.Food Technology	BTAM106-18	Mathematics-I	5
	Chemical Sciences-II Sem	1.Chemical Engineering 2.Petrochem & Petroleum Refinery Engineering 3.Textile Engineering 4.Food Technology	BTAM206-18	Mathematics-II	5
7	Bio-Technology-I Sem	1. Bio-Technology 2. Agricultural Engineering	BTAM107-18	Basic Mathematics-I	5
	Bio-Technology-II Sem	1. Bio-Technology 2. Agricultural Engineering	BTAM207-18	Basic Mathematics-II	5

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144603

187

IK Gujral Punjab Technical University
Bachelor of Technology (B. Tech. 1st Year)
Branch/Course: CIVIL ENGINEERING

BTAM101-18	Mathematics-I (Calculus & LinearAlgebra)	4L:1T:0P	4 credits

Course Objective:

The objective of this course is to familiarize the prospective engineers with techniques in calculus, multivariate analysis and linear algebra. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

Detailed Contents:

Section-A

Unit-I: Calculus (10 hours)

Rolle's theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; Indeterminate forms and L' Hôpital's rule; Maxima and minima; Evaluation of definite and Improper integrals; Applications of definite integrals to evaluate surface areas and volumes of revolutions.

Unit-II: Multivariable Calculus (15 hours)

Limit, continuity and partial derivatives, Total derivative; Tangent plane and normal line; Maxima, minima and saddle points; Method of Lagrange multipliers; Multiple Integration: double and triple integrals (Cartesian and polar), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volumes by (double integration), Center of mass and Gravity (constant and variable densities).

Section-B

Unit-III: Sequences and Series (12 hours)

Convergence of sequence and series, tests for convergence of positive term series: root test, ratio test, p-test, comparison test; Alternate series and Lebinitz's test; Power series, Taylor's series, series for exponential, trigonometric and logarithmic functions.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144606

188

Unit-IV: Matrices (13 hours)

Algebra of matrices, Inverse and rank of a matrix, introduction of null space and kernel, statement of rank-nullity theorem; System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Determinants; Eigenvalues and eigenvectors; Similar matrices; Diagonalization of matrices; Cayley-Hamilton Theorem.

Suggested Text/Reference Books

G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.

Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.

T. Veerarajan, Engineering Mathematics for first year, Tata McGraw-Hill, NewDelhi, 2008.

B.V. Ramana, Higher Engineering Mathematics, Tata McGraw Hill New Delhi,11thReprint, 2010.

D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.

N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, LaxmiPublications, Reprint, 2008.

B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

Course Outcomes: The students will learn:

- The fallouts of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.
- To apply differential and integral calculus to evaluate definite, improper integrals and its applications.
- The convergence of sequence and series and to apply different tests of convergence
- To deal with functions of several variables that are essential in most branches of engineering.
- The essential tool of matrices and linear algebra in a comprehensive manner.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

189

IK Gujral Punjab Technical University
Bachelor of Technology (B. Tech. 1st Year)

BTAM201-18	Mathematics-II (Differential equations)	4L:1T:0P	4 credits

Course Objectives:

The objective of this course is to familiarize the prospective engineers with techniques in multivariate integration, ordinary and partial differential equations. It aims to equip the students to deal with advanced level of mathematics and applications that would be essential for their disciplines.

Detailed Contents:

Section A

Unit-I: Ordinary differential equations: First and Higher order (15 hours)

Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

Second order linear differential equations with variable coefficients, method of variation of parameters, Cauchy-Euler equation; Power series solutions.

Unit-II: Partial Differential Equations: First order (10 hours)

First order partial differential equations, solutions of first order linear and non-linear PDEs. Solution to homogenous and non-homogenous linear partial differential equations second and higher order by complimentary function and particular integral method.

Section B

Unit-III: Partial Differential Equations: higher order (12 hours)

Second-order linear equations and their classification, Initial and boundary conditions (with an informal description of well-posed problems), D'Alembert's solution of the wave equation. Separation of variables method to simple problems in Cartesian coordinates.

Unit-IV: Partial Differential Equations: higher order (contd.) (13 hours)

The Laplacian in plane, cylindrical and spherical polar coordinates. One dimensional diffusion equation and its solution by separation of variables. Boundary-value problems: Solution of boundary-value problems for various linear PDEs.

190

Textbooks/References:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary Value Problems, 9th Edition, Wiley India, 2009.
3. S. L. Ross, Differential Equations, 3rd Ed., Wiley India, 1984.
4. E. A. Coddington, An Introduction to Ordinary Differential Equations, Prentice Hall India, 1995.
5. E. L. Ince, Ordinary Differential Equations, Dover Publications, 1958.
6. G.F. Simmons and S.G. Krantz, Differential Equations, Tata McGraw Hill, 2007.
7. S. J. Farlow, Partial Differential Equations for Scientists and Engineers, Dover Publications, 1993.
8. R. Haberman, Elementary Applied Partial Differential equations with Fourier Series and Boundary Value Problem, 4th Ed., Prentice Hall, 1998.
9. Ian Sneddon, Elements of Partial Differential Equations, McGraw Hill, 1964.
10. Manish Goyal and N.P. Bali, Transforms and Partial Differential Equations, University Science Press, Second Edition, 2010.

Course Outcomes: The students will learn:

- The mathematical tools needed in evaluating multiple integrals and their usage.
- The effective mathematical tools for the solutions of differential equations that model physical processes.
- The tools of differentiation and integration of functions that are used in various techniques dealing engineering problems.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

IK Gujral Punjab Technical University
Bachelor of Technology (B. Tech. 1st Year)

Branch/Course: ELECTRICAL ENGINEERING

BTAM101-18	**Mathematics-I** **(Calculus & Linear Algebra)**	**4L:1T:0P**	**4 credits**

Course Objective:

The objective of this course is to familiarize the prospective engineers with techniques in calculus, multivariate analysis and differential equations. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

Detailed Contents:

Section-A

Unit-I: Calculus (10 hours)

Rolle's theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; Indeterminate forms and L' Hôpital's rule; Maxima and minima; Evaluation of definite and Improper integrals; Applications of definite integrals to evaluate surface areas and volumes of revolutions.

Unit-II: Multivariable Calculus (15 hours)

Limit, continuity and partial derivatives, Total derivative; Tangent plane and normal line; Maxima, minima and saddle points; Method of Lagrange multipliers; Multiple Integration: double and triple integrals (Cartesian and polar), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volumes by (double integration), Center of mass and Gravity (constant and variable densities).

Section-B

Unit-III: Sequences and Series (12 hours)

Convergence of sequence and series, tests for convergence of positive term series: root test, ratio test, p-test, comparison test; Alternate series and Lebinitz's test; Power series, Taylor's series, series for exponential, trigonometric and logarithmic functions.

192

Head
Department of Electrical Engineering

Unit-IV: Matrices (13 hours)

Algebra of matrices, Inverse and rank of a matrix, introduction of null space and kernel, statement of rank-nullity theorem; System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Determinants; Eigenvalues and eigenvectors; Similar matrices; Diagonalization of matrices; Cayley-Hamilton Theorem.

Text / References:

G.B. Thomas and R.L. Finney, "Calculus and Analytic geometry", Pearson, 2002.

T. Veerarajan, "Engineering Mathematics", McGraw-Hill, New Delhi, 2008.

B. V. Ramana, "Higher Engineering Mathematics", McGraw Hill, New Delhi, 2010.

N.P. Bali and M. Goyal, "A text book of Engineering Mathematics", Laxmi Publications, 2010.

B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 2010.
E. Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, 2006.
D. Poole, "Linear Algebra: A Modern Introduction", Brooks/Cole, 2005.

V. Krishnamurthy, V. P. Mainra and J. L. Arora, "An introduction to Linear Algebra", Affiliated East-West press, 2005.

Course Outcomes: The students will learn:

- The differential and integral calculus for applications of definite integrals to evaluate surface areas and volumes of revolutions.
- The fallouts of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.
- The tool of matrices and convergence of sequence and series for learning advanced Engineering Mathematics.
- The tools of differentiation and integration of functions of multiple variables which are used in various techniques dealing engineering problems.

193

IK Gujral Punjab Technical University
Bachelor of Technology (B. Tech. 1st Year)

BTAM202-18	**Mathematics-II** **(Differential Equations & Numerical Methods)**	**4L:1T:0P**	**4 credits**

Course Objective:

The objective of this course is to familiarize the prospective engineers with techniques in linear algebra, transform calculus and numerical methods. It aims to equip the students with standard concepts and tools of integral transforms, matrices and numerical techniques that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

Detailed Contents:

Section-A

Unit-I: Ordinary Differential Equations: First and higher order (13 hours)

Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type. Second order linear differential equations with variable coefficients, method of variation of parameters, Cauchy-Euler equation, Power series solutions.

Unit-II: Partial Differential Equations: First order (12 hours)

First order partial differential equations, solutions of first order linear and non-linear PDEs; Solution to homogenous and non-homogenous linear partial differential equations of second order by complimentary function and particular integral method. Second-order linear equations and their classification, Separation of variables method to simple problems.

Section-B

Unit-III: Numerical Methods-I (12 hours)

Solution of polynomial and transcendental equations – Bisection method, Regula-Falsi method, Newton-Raphson method. Finite differences, Interpolation using Newton's forward and backward difference formulae. Central difference interpolation: Gauss's forward and backward formulae. Numerical integration: Trapezoidal rule and Simpson's 1/3rd and 3/8 rules.

194

Head
Department of Electrical Engineering

Unit-IV: Numerical Methods-II (13 hours)

Ordinary differential equations: Taylor's series, Euler and modified Euler's methods; Runge-Kutta method of fourth order for solving first and second order equations. Milne's and Adam's predicator-corrector methods. Partial differential equations: Finite difference solution of two-dimensional Laplace equation and Poisson equation, Implicit and explicit methods for one dimensional heat equation (Bender-Schmidt and Crank-Nicholson methods), Finite difference explicit method for wave equation.

Text / References:

W. E. Boyce and R. C. DiPrima, "Elementary Differential Equations and Boundary Value Problems", Wiley India, 2009.

S. L. Ross, "Differential Equations", Wiley India, 1984.

E. A. Coddington, "An Introduction to Ordinary Differential Equations", Prentice Hall India, 1995.

E. L. Ince, "Ordinary Differential Equations", Dover Publications, 1958.
G.F. Simmons and S.G. Krantz, "Differential Equations", McGraw Hill, 2007.

N.P. Bali and M. Goyal, "A text book of Engineering Mathematics", Laxmi Publications, 2008.

B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 2010.

Course Outcomes: Students will be able to:

- understand the methods which can be used to solve a variety of ordinary and partial differential equations
- demonstrate knowledge of a range of applications of analytical and numerical methods
- develop their attitude towards problem solving.
- Understand how to apply numerical methods to solve the mathematical models.

Head
Department of Electrical Engineering

195

IK Gujral Punjab Technical University
Bachelor of Technology (B. Tech. 1st Year)

Branch/Course: MECHANICAL ENGINEERING

BTAM101-18	**Mathematics-I** **(Calculus & Linear Algebra)**	**4L:1T:0P**	**4 credits**

Course Objective:

The objective of this course is to familiarize the prospective engineers with techniques in calculus, multivariate analysis and linear algebra. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

Detailed Contents:

Section-A

Unit-I: Calculus (10 hours)

Rolle's theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; Indeterminate forms and L' Hôpital's rule; Maxima and minima; Evaluation of definite and Improper integrals; Applications of definite integrals to evaluate surface areas and volumes of revolutions.

Unit-II: Multivariable Calculus (15 hours)

Limit, continuity and partial derivatives, Total derivative; Tangent plane and normal line; Maxima, minima and saddle points; Method of Lagrange multipliers; Multiple Integration: double and triple integrals (Cartesian and polar), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volumes by (double integration), Center of mass and Gravity (constant and variable densities).

Section-B

Unit-III: Sequences and Series (12 hours)

196

Convergence of sequence and series, tests for convergence of positive term series: root test, ratio test, p-test, comparison test; Alternate series and Lebinitz's test; Power series, Taylor's series, series for exponential, trigonometric and logarithmic functions.

Unit-IV: Matrices (13 hours)

Algebra of matrices, Inverse and rank of a matrix, introduction of null space and kernel, statement of rank-nullity theorem; System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Determinants; Eigenvalues and eigenvectors; Similar matrices; Diagonalization of matrices; Cayley-Hamilton Theorem.

Suggested Text/Reference Books

G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.

Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.

T. Veerarajan, Engineering Mathematics for first year, Tata McGraw-Hill, NewDelhi, 2008.

B.V. Ramana, Higher Engineering Mathematics, Tata McGraw Hill New Delhi,11th Reprint, 2010.

D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.

N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, LaxmiPublications, Reprint, 2008.

B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

Course Outcomes: The students will learn:

- The fallouts of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.
- To apply differential and integral calculus to evaluate definite, improper integrals and its applications.
- The convergence of sequence and series and to apply different tests of convergence
- To deal with functions of several variables that are essential in most branches of engineering.
- The essential tool of matrices and linear algebra in a comprehensive manner.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

197

IK Gujral Punjab Technical University
Bachelor of Technology (B. Tech. 1st Year)

BTAM203-18	**MATHEMATICS II (Ordinary Differential Equations and Complex Variable)**	**4L:1T:0P**	**5 credits**

Course Objective:

The objective of this course is to familiarize the prospective engineers with techniques in calculus, Ordinary differential equations and Complex analysis. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

Detailed Contents:

Section-A

Unit-I: Ordinary differential equations: First Order (12 lectures)

Exact, linear and Bernoulli's equations, Euler's equation, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

Unit-II: Ordinary differential equations: Higher orders (13 lectures)

Second order linear differential equations with variable coefficients, method of variation of parameters, Cauchy-Euler equation; Power series solutions.

Section-B

Unit-III: Complex Variable – Differentiation (10 lectures)

Elementary functions of complex variables, limit, continuity and differentiability; Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) and their properties; Conformal mappings, Mobius transformation and its properties.

Unit-IV: Complex Variable – Integration (15 lectures)

Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula (without proof), Liouville's theorem and Maximum-Modulus theorem (without proof); Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral involving sine and cosine,

IK Gujral Punjab Technical University
Bachelor of Technology (B. Tech. 1st Year)

Branch/Course: COMPUTER SCIENCE AND ENGINEERING

BTAM104-18	**Mathematics Paper-I** **(Calculus & Linear Algebra)**	**4L:1T:0P**	**4 credits**

Course Objective:

The objective of this course is to familiarize the prospective engineers with techniques in basic calculus and linear algebra. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

Detailed Contents:

Section-A

Unit-I: Calculus (13 hours)

Rolle's theorem, Mean value theorems, Statements of Taylor's and Maclaurin theorems with remainders; Indeterminate forms and L' Hôpital's rule; Maxima and minima.

Evaluation of definite and improper integrals; Applications of definite integrals to evaluate surface areas and volumes of revolutions; Beta and Gamma functions and their properties.

Unit-II: Matrix Algebra (12 hours)

Matrices, vectors addition and scalar multiplication, matrix multiplication; Linear systems of equations, linear Independence, rank of a matrix, determinants, Cramer's Rule, inverse of a matrix, Gauss elimination and Gauss-Jordan elimination.

Section-B

Unit-III: Linear Algebra (13 hours)

Vector Space, linear dependence of vectors, basis, dimension; Linear transformations (maps), range and kernel of a linear map, rank and nullity, statement of rank-nullity theorem, Matrix associated with a linear map.

Unit-IV: Linear Algebra (Contd.) (12 hours)

Eigenvalues, eigenvectors, symmetric, skew-symmetric, and orthogonal Matrices, eigen bases; Similar matrices, diagonalization.

199

Suggested Text/Reference Books

G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition,Pearson, Reprint, 2002.

Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.

W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary Value Problems, 9th Edn., Wiley India, 2009.

S. L. Ross, Differential Equations, 3rd Ed., Wiley India, 1984.

E. A. Coddington, An Introduction to Ordinary Differential Equations, Prentice Hall India, 1995.

E. L. Ince, Ordinary Differential Equations, Dover Publications, 1958.

J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7thEd., Mc-Graw Hill, 2004.

N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, LaxmiPublications, Reprint, 2008.

B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36thEdition, 2010.

Course Outcomes: The students will learn:

- The effective mathematical tools for the solutions of differential equations that model physical processes.
- The tools of differentiation and integration of functions of a complex variable that are used in various techniques dealing engineering problems.

Suggested Text/Reference Books

G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.

Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.

D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.

Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.

B.V. Ramana, Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.

N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.

B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.

V. Krishnamurthy, V.P. Mainra and J.L. Arora, An introduction to Linear Algebra, Affiliated East–West press, Reprint 2005.

Course Outcomes: The students will be able

- To apply differential and integral calculus to notions of curvature and to improper integrals. Apart from various applications, they will have a basic understanding of Beta and Gamma functions. The essential tools of matrices and linear algebra including linear transformations, eigenvalues, diagonalization and orthogonalization.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

IK Gujral Punjab Technical University
Bachelor of Technology (B. Tech. 1st Year)

BTA204-18	Mathematics Paper-II (Probability & Statistics)	4L:1T:0P	4 credits

Course Objective:

The objective of this course is to familiarize the students with statistical techniques. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling various problems in the discipline.

Detailed Content:

Section-A

Unit I: (10 hours)

Measures of Central tendency: Moments, skewness and kurtosis, Variance, Correlation coefficient, Probability, conditional probability, independence; Discrete random variables, Independent random variables, expectation of Discrete random variables.

Unit II: (15 hours)

Probability distributions: Binomial, Poisson and Normal, Poisson approximation to the binomial distribution, evaluation of statistical parameters for these three distributions, Correlation and regression – Rank correlation.

Section-B

Unit III: (10 hours)

Continuous random variables and their properties, distribution functions and densities, normal and exponential densities. Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas.

Unit IV; (15 hours)

Test of significance: Large sample test for single proportion, difference of proportions, single mean, difference of means, and difference of standard deviations.

Test for single mean, difference of means and correlation coefficients, test for ratio of variances - Chi-square test for goodness of fit and independence of attributes.

202

Head
Department of Electrical Engineering
IK Gujral Punjab Technical University
Kapurthala-144006

Suggested Text/Reference Books

Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.

P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall, 2003 (Reprint).

S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.

W. Feller, An Introduction to Probability Theory and its Applications, Vol. 1, 3rd Ed., Wiley, 1968.

N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.

B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.

T. Veerarajan, Engineering Mathematics (for semester III), Tata McGraw-Hill, New Delhi, 2010.

Course Outcomes: The students will learn:

- The ideas of probability and random variables and various discrete and continuous probability distributions and their properties. The basic ideas of statistics including measures of central tendency, correlation and regression and the statistical methods of studying data samples.

IK Gujral Punjab Technical University
Bachelor of Technology (B. Tech. 1st Year)

Branch/Course: ELECTRONICS & COMMUNICATION ENGINEERING

BTAM101-18	**Mathematics-I** **(Calculus & Linear Algebra)**	**4L:1T:0P**	**4 credits**

Course Objective:

The objective of this course is to familiarize the prospective engineers with techniques in calculus, multivariate analysis and linear algebra. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

Detailed Contents:

Section-A

Unit-I: Calculus (10 hours)

Rolle's theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; Indeterminate forms and L' Hôpital's rule; Maxima and minima; Evaluation of definite and Improper integrals; Applications of definite integrals to evaluate surface areas and volumes of revolutions.

Unit-II: Multivariable Calculus (15 hours)

Limit, continuity and partial derivatives, Total derivative; Tangent plane and normal line; Maxima, minima and saddle points; Method of Lagrange multipliers; Multiple Integration: double and triple integrals (Cartesian and polar), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volumes by (double integration), Center of mass and Gravity (constant and variable densities).

Section-B

Unit-III: Sequences and Series (12 hours)

Convergence of sequence and series, tests for convergence of positive term series: root test, ratio test, p-test, comparison test; Alternate series and Lebinitz's test; Power series, Taylor's series, series for exponential, trigonometric and logarithmic functions.

204
195

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University

Unit-IV: Matrices (13 hours)

Algebra of matrices, Inverse and rank of a matrix, introduction of null space and kernel, statement of rank-nullity theorem; System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Determinants; Eigenvalues and eigenvectors; Similar matrices; Diagonalization of matrices; Cayley-Hamilton Theorem.

Suggested Text/Reference Books

G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.

Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.

T. Veerarajan, Engineering Mathematics for first year, Tata McGraw-Hill, NewDelhi, 2008.

B.V. Ramana, Higher Engineering Mathematics, Tata McGraw Hill New Delhi,11thReprint, 2010.

D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.

N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, LaxmiPublications, Reprint, 2008.

B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

Course Outcomes: The students will learn:

- The fallouts of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.
- To apply differential and integral calculus to evaluate definite, improper integrals and its applications.
- The convergence of sequence and series and to apply different tests of convergence
- To deal with functions of several variables that are essential in most branches of engineering.
- The essential tool of matrices and linear algebra in a comprehensive manner.

96
205

IK Gujral Punjab Technical University
Bachelor of Technology (B. Tech. 1st Year)

BTAM202-18	**Mathematics-II** **(Differential Equations & Numerical Methods)**	**4L:1T:0P**	**4 credits**

Course Objective:

The objective of this course is to familiarize the prospective engineers with techniques in linear algebra, transform calculus and numerical methods. It aims to equip the students with standard concepts and tools of integral transforms, matrices and numerical techniques that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

Detailed Contents:

Section-A

Unit-I: Ordinary Differential Equations: First and higher order (13 hours)

Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type. Second order linear differential equations with variable coefficients, method of variation of parameters, Cauchy-Euler equation, Power series solutions.

Unit-II: Partial Differential Equations: First Order (12 hours)

First order partial differential equations, solutions of first order linear and non-linear PDEs; Solution to homogenous and non-homogenous linear partial differential equations of second order by complimentary function and particular integral method. Second-order linear equations and their classification, Separation of variables method to simple problems.

Section-B

Unit-III: Numerical Methods-I (12 hours)

Solution of polynomial and transcendental equations – Bisection method, Regula-Falsi method, Newton-Raphson method. Finite differences, Interpolation using Newton's forward and backward difference formulae. Central difference interpolation: Gauss's forward and backward formulae. Numerical integration: Trapezoidal rule and Simpson's 1/3rd and 3/8 rules.

197

206

Unit-IV: Numerical Methods-II (13 hours)

Ordinary differential equations: Taylor's series, Euler and modified Euler's methods; Runge-Kutta method of fourth order for solving first and second order equations. Milne's and Adam's predicator-corrector methods. Partial differential equations: Finite difference solution two-dimensional Laplace equation and Poisson equation, Implicit and explicit methods for one dimensional heat equation (Bender-Schmidt and Crank-Nicholson methods), Finite difference explicit method for wave equation.

Text / References:

W. E. Boyce and R. C. DiPrima, "Elementary Differential Equations and Boundary Value Problems", Wiley India, 2009.

S. L. Ross, "Differential Equations", Wiley India, 1984.

E. A. Coddington, "An Introduction to Ordinary Differential Equations", Prentice Hall India, 1995.

E. L. Ince, "Ordinary Differential Equations", Dover Publications, 1958.
G.F. Simmons and S.G. Krantz, "Differential Equations", McGraw Hill, 2007.

N.P. Bali and M. Goyal, "A text book of Engineering Mathematics", Laxmi Publications, 2008.

B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 2010.

Course Outcomes: Students will be able to:

- understand the methods which can be used to solve a variety of ordinary and partial differential equations
- demonstrate knowledge of a range of applications of analytical and numerical methods
- develop their attitude towards problem solving.
- Understand how to apply numerical methods to solve the mathematical models.

IK Gujral Punjab Technical University
Bachelor of Technology (B. Tech. 1st Year)

Branch/Course: CHEMICAL ENGINEERING

BTAM106-18	**Mathematics-I**	**4L:1T:0P**	**5 credits**

Course Objectives: The objective of this course is to introduce matrices, vectors, linear system of equations, eigen values and eigen vectors. Vectors are basic to this course. We will learn to manipulate them algebraically and geometrically. They will help us simplify the statements of problems and theorems and to find solutions and proofs. Determinants measure volumes and areas.

Detailed Contents:

Section-A

Unit-I: Linear Algebra: Matrices, Vectors, Determinants, Linear Systems (15 hours)
Matrices, Vectors: Addition and Scalar Multiplication, Matrix Multiplication, Linear Systems of Equations, Linear Independence. Rank of a Matrix. Vector Space, Solutions of Linear Systems: Existence, Uniqueness, Determinants, Cramer's Rule, Inverse of a Matrix. Gauss Elimination and Gauss-Jordan methods.

Unit-II: Linear Algebra: Matrix Eigenvalue Problems (10 hours)

Eigenvalues, Eigenvectors, Applications of Eigenvalue Problems, Symmetric, Skew-Symmetric, and Orthogonal Matrices

Section-B

Unit-III: Vector Differential Calculus. Grad, Div, Curl (13 hours)

Vectors in 2-Space and 3-Space, Inner Product (Dot Product), Vector Product (Cross Product), Vector and Scalar Functions and Fields, Derivatives, Curves. Arc Length. Curvature, Gradient of a Scalar Field, Directional Derivative, Divergence of a Vector Field, Curl of a Vector Field.

Unit-IV: Integral Calculus. Integral Theorems (12 hours):

Line Integrals, Path Independence of Line Integrals, Green's Theorem in the Plane, Surfaces for Surface integrals.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

208

Suggested Text/Reference Books

G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.

Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.

D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.

T. Veerarajan, Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.

B. V. Ramana, Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.

N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.

B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.

V. Krishnamurthy, V.P. Mainra and J.L. Arora, An introduction to Linear Algebra, Affiliated East–West press, Reprint 2005.

Course Outcomes: The students will be able to

- Learn to manipulate how to use matrices to sole linear system of equations.
- Use vectors in various mathematical problems which arise in kinematics.

IK Gujral Punjab Technical University
Bachelor of Technology (B. Tech. 1st Year)

BTAM206-18	**Mathematics-II**	**4L:1T:0P**	**5 Credits**

Course Objective:

The objective of this course is to familiarize the prospective engineers with techniques in integral transform and differential equations. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

Detailed Contents:

Section-A

Unit-I: Integral Transforms (10 hours)

Laplace Transforms, Inverse Laplace transforms, Fourier Series, half range Sine and Cosine series, Fourier transforms.

Unit-II: First-Order and second order linear ODEs (15 hours)

Basic Concepts, Solutions of separable ODEs, Exact ODEs, Linear ODEs, Solving ODEs by Laplace Transforms.

Homogeneous Linear ODEs of Second Order, Euler-Cauchy Equations, Wronskian, Nonhomogeneous ODEs, Solution by method of variation of Parameters

Section-B

Unit-III: Series Solutions of ODEs, Special Functions (15 hours)

Power Series Method, Legendre.'s Equation, Legendre Polynomials, Bessel's Equation, Bessel Functions, Sturm-Liouville boundary Problems, Orthogonal Functions

Unit-IV: Partial Differential Equations (10 hours)

Basic Concepts, Classification, Solution of PDEs: Separation of Variables, with the help of Fourier Series and Laplace Transforms.

210

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144603

Text Books/ Reference Books:

D. Poole, "Linear Algebra: A Modern Introduction", Brooks/Cole, 2005.

N.P. Bali and M. Goyal, "A text book of Engineering Mathematics", Laxmi Publications, 2008.

B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 2010.

V. Krishnamurthy, V. P. Mainra and J. L. Arora, "An introduction to Linear Algebra", Affiliated East-West press, 2005.

Course Outcomes: Students will be able to:

- demonstrate knowledge of a range of applications of these methods
- understand how integral transforms can be used to solve a variety of differential equations
- develop their attitude towards problem solving.
- Understand how to apply integral transforms to solve the mathematical models.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144603

211

IK Gujral Punjab Technical University
Bachelor of Technology (B. Tech. 1st Year)

Branch/Course: BIOTECHNOLOGY ENGINEERING

BTAM107-18	**Basic Mathematics-I**	**4L:1T:0P**	**5 Credits**

Course Objectives: The objective of this course is to familiarize the students with the basic techniques of mathematics which are highly useful to solve simple problems. This introduction aims at making the students understand the basic concepts in mathematics.

Detailed Contents:

Section-A

Unit-I: Algebra (12 hours)

Complex numbers, Solution of quadratic equations, Permutations and combinations, Binomial theorem for positive/negative index and its simple applications, Arithmetic and geometric progression.

Unit-II: Trigonometry (13 hours)

Review of trigonometric functions, Sum and product formulae for trigonometric functions, Trigonometric equations and sum - to - product formulae for trigonometric functions, Identities related to double angle formulae.

Section-B

Unit-III: Determinants and Matrices (12 hours)

Matrices, Operations on matrices, Determinants and its properties, Singular and non-singular matrices, Adjoint and inverse of a matrix and its properties, Solution of system of linear equations using Cramer's rule and matrix method.

Unit-IV: Coordinate Geometry and Statistics (13 hours)

Rectangular coordinate system, Straight lines, Circles (in standard form only).

Measure of dispersion: mean deviation, Variance and standard deviation of grouped/ungrouped data. Correlation and regression.

2/2

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144603

Text books/Reference Books:

1) Mathematics, A Text books (Parts I & II), NCERT, New Delhi 2011.

2) E. Kreyszig, Advanced Engineering Mathematics, John Wiley, 1999.

3) V.K. Krishnamurthy, V.P. Mainra and J.L. Arora, An introduction to Linear Algebra, Associated East West Press 2007.

4) S.L. Loney, The elements of Coordinate Geometry, Michigan Historical Reprint series, 2012.

5) P.L. Meyer, Introductory Probability and Statistical Applications, Addison Wesley 1970.

Course Outcomes: Students will be able to

- acquire knowledge of basic algebra, trigonometry, matrices, coordinate geometry etc.
- apply these concepts to solve complex mathematical problems
- analyze the data of any experiment statistically to extract meaningful result

213

IK Gujral Punjab Technical University
Bachelor of Technology (B. Tech. 1st Year)

BTAM207-18	**Basic Mathematics-II**	**4L:1T:0P**	**5 credits**

Course Objectives: The objective is to develop basic computing skills and application of quantitative required for biological studies and rationalization of experimental designs.

Detailed Contents:

Section-A

Unit-I: Differentiation (12 hours)

Functions, Domain and range, Properties of standard functions (trigonometric, exponential and logarithmic) and their graphs, Limit, Continuity and Differentiability. Differentiation of standard functions (polynomials, trigonometric, inverse trigonometric exponentials and logarithmic), Product rule, Quotient rule, Chain rule.

Unit-II: Applications of derivatives (13 hours)

Applications of derivatives in graphing, Maximum and minimum of single variable function, Functions of several variables, Partial derivatives, Homogeneous functions, Maximum and minimum of several variable functions.

Section-B

Unit-III: Integration (12 hours)

Integral as anti-derivative, Integration: by substitution, by parts and partial fractions, Definite integral and its properties, Double integrals, Areas of bounded regions and rectification.

Unit-IV: Differential Equations (13 hours)

Order and degree, General and particular solution of differential equation, Techniques for solving first order ordinary differential equation and its applications to biological problems (population growth, radioactive decay).

214

Text books/Reference Books:

1. Mathematics, A Text books (Parts I & II), NCERT, New Delhi, 2011.

2. G.B. Thomas and R.L. Finney, Calculus and Analytical Geometry, Pearson Education, 10th ed., 2007.

3. E. Kreyszig, Advanced Engineering Mathematics, 8th Edition, John Wiley, 1999.

4. Shanti Narayan, Differential and Integral Calculus, S. Chand, 2005.

Course Outcomes: Students will be able:

- explain functions, related properties and determine their continuity and differentiability.
- apply derivatives in graphing and maxima and minima of single variable function.
- predict integration of function using by parts, by substitution and partial fraction methods and apply these to find areas of bounded regions and rectifications.
- learn methods to solve first order ordinary differential equations and apply it to biological problems

Category	Engineering Science Course				
Course title	**Basic Electrical Engineering (Theory & Lab.)**				
Scheme and Credits	L	T	P	**Credits**	Semester –I/II
	3	1	2	5	
Pre-requisites (if any): Nil					

Course code: BTEE-101-18

Course Title: Basic Electrical Engineering **(4 credits)**

[L: 3; T:1; P : 0]

Internal Marks: 40 External Marks: 60 Total Marks: 100

Course Outcomes:

At the end of this course, students will:

CO 1	Have the knowledge of DC circuits, AC Circuits, basic magnetic circuits, working principles of electrical machines, and components of low voltage electrical installations
CO 2	Be able to analyze of DC circuits, AC Circuits
CO 3	Understand the basic magnetic circuits and apply it to the working of electrical machines
CO 4	Be introduced to types of wiring, batteries, and LT switchgear.

Detailed contents:

Module 1: DC Circuits (9 hours)

Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff's current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin's and Norton's Theorems. Time-domain analysis of first-order RL and RC circuits.

Module 2: AC Circuits (9 hours)

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three-phase balanced circuits, voltage and current relations in star and delta connections.

Module 3: Electrical Machines (16 hours)

Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections. Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Loss components and efficiency, starting and speed control of induction motor. Single-phase induction motor.

216

Construction, working, torque-speed characteristic and speed control of separately excited dc motor. Construction and working of synchronous generators.

Module 4: Electrical Installations (7 hours)

Components of LT Switchgear: Switch Fuse Unit (SFU), Miniature Circuit Breaker (MCB), Earth Leakage Circuit Breaker (ELCB), MCCB, Contactors, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.

Suggested Text / Reference Books

D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.
T.K. Nagsarkar and M.S. Sukhija, "Basic Electrical Engineering", Oxford University Press
D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill, 2009.
L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.
E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.
V. D. Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 1989.
B. L. Theraja, "Electrical Technology", S Chand Publishing
J. B. Gupta, "Basic Electrical Engineering", S.K. Kataria & Sons

IK Gujral Punjab Technical University
Bachelor of Technology (B. Tech. 1st Year)

Course code: BTEE-102-18
Course Title: Basic Electrical Engineering Laboratory **(1 credit)**

[L: 0; T:0; P : 2]
Internal Marks: 30 External Marks: 20 Total Marks: 50

List of experiments/demonstrations:

- Basic safety precautions. Introduction and use of measuring instruments – voltmeter, ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors.

- Measuring the steady-state and transient time-response of R-L, R-C, and R-L-C circuits to a step change in voltage (transient may be observed on a storage oscilloscope). Sinusoidal steady state response of R-L, and R-C circuits – impedance calculation and verification. Observation of phase differences between current and voltage. Resonance in R-L-C circuits.

- Transformers: Observation of the no-load current waveform on an oscilloscope (non-sinusoidal wave-shape due to B-H curve nonlinearity should be shown along with a discussion about harmonics). Loading of a transformer: measurement of primary and secondary voltages and currents, and power.

- Three-phase transformers: Star and Delta connections. Voltage and Current relationships (line-line voltage, phase-to-neutral voltage, line and phase currents). Phase-shifts between the primary and secondary side. Cumulative three-phase power in balanced three-phase circuits.
- Demonstrate of cut-out sections of machines: dc machine (commutator-brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winging - slip ring arrangement) and single-phase induction machine.
- Torque Speed Characteristic of separately excited dc motor.

- Synchronous speed of two and four-pole, three-phase induction motors. Direction reversal by change of phase-sequence of connections. Torque-Slip Characteristic of an induction motor. Generator operation of an induction machine driven at super-synchronous speed.

- Synchronous Machine operating as a generator: stand-alone operation with a load. Control of voltage through field excitation.

218

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

Laboratory Outcomes

CO 1	The ability to use common electrical measuring instruments and understand the fundamentals of electrical engineering.
CO 2	The ability to make electrical connections, and measure power, power factor using appropriate equipments.
CO 3	Have the knowledge of electrical machines, components and their ratings.
CO 4	Understand the operation of transformers and electrical machines.

S. No.	Suggested List of Experiments
1.	To verify Ohm's Law and its limitations.
2.	To verify Kirchhoff's Laws.
3.	To measure the resistance and inductance of a coil by ammeter-voltmeter method
4.	To find voltage-current relationship in a R-L series circuit and to determine the power factor of the circuit.
5.	To verify the voltage and current relations in star and delta connected systems.
6.	To measure power and power factor in a single- phase AC circuit.
7.	To verify series and parallel resonance in AC circuits.
8.	To observe the B-H loop of ferromagnetic core material on CRO.
9.	To use a bridge rectifier for full- wave rectification of AC supply and to determine the relationship between RMS and average values of the rectified voltage.
10.	To measure the minimum operating voltage, current drawn, power consumed, and the power factor of a fluorescent tube light, Bulb, Single phase induction motor,
11.	To connect measuring analog and digital instruments to measure current, voltage, power and power factor.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

219

12.	To perform open- and short circuit tests on a single- phase transformer and calculate its efficiency.
13.	To start and reverse the direction of rotation of a (i) DC motor (ii) three phase Induction motor
14.	Study of starters for (i) DC motor (ii) Induction motor
15.	Study of Cut section of DC Series motor, DC shunt motor and three phase induction motor
16.	Calibration of energy meter.

Note: A student to perform any 8-10 Experiments from the above list.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

220

Course code	BTME101-18				
Category	Engineering Science Courses				
Course title	Engineering Graphics & Design (Theory & Lab.)				
Scheme and Credits	L	T	P	Credits	Semester – I
	1	0	4	3	
Pre-requisites (if any)	-				
	Common to all branches				

Engineering Graphics & Design [A total of 10 lecture hours & 60 hours of lab.]
[[L : 1; T:0; P : 4 (3 credits)]

Detailed contents

Traditional Engineering Graphics:
Principles of Engineering Graphics; Orthographic Projection; Descriptive Geometry; Drawing Principles; Isometric Projection; Surface Development; Perspective; Reading a Drawing; Sectional Views; Dimensioning & Tolerances; True Length, Angle; intersection, Shortest Distance.
Computer Graphics:
Engineering Graphics Software; -Spatial Transformations; Orthographic Projections; Model Viewing; Co-ordinate Systems; Multi-view Projection; Exploded Assembly; Model Viewing; Animation; Spatial Manipulation; Surface Modelling; Solid Modelling; Introduction to Building Information Modelling (BIM)

(Except the basic essential concepts, most of the teaching part can happen concurrently in the laboratory)

Module 1: Introduction to Engineering Drawing covering,
Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales;

Module 2: Orthographic Projections covering,
Principles of Orthographic Projections-Conventions - Projections of Points and lines inclined to both planes; Projections of planes inclined Planes - Auxiliary Planes;

Module 3: Projections of Regular Solids covering,
those inclined to both the Planes- Auxiliary Views; Draw simple annotation, dimensioning and scale. Floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc.

Module 4:Sections and Sectional Views of Right Angular Solids covering,
Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw the sectional orthographic views of geometrical solids, objects from industry and dwellings (foundation to slab only)

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

Module 5: Isometric Projections covering,

22

Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions;

Module 6: Overview of Computer Graphics covering,
listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids];

Module 7: Customisation & CAD Drawing
consisting of set up of the drawing page and the printer, including scale settings, Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles;

Module 8: Annotations, layering & other functions covering
applying dimensions to objects, applying annotations to drawings; Setting up and use of layers, layers to create drawings, Create, edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen); Printing documents to paper using the print command; orthographic projection techniques; Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation, Computer-aided design (CAD) software modeling of parts and assemblies. Parametric and non-parametric solid, surface, and wireframe models. Part editing and two-dimensional documentation of models. Planar projection theory, including sketching of perspective, isometric, multiview, auxiliary, and section views. Spatial visualization exercises. Dimensioning guidelines, tolerancing techniques; dimensioning and scale multi views of dwelling;

Module 9: Demonstration of a simple team design project that illustrates
Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids; meshed topologies for engineering analysis and tool-path generation for component manufacture; geometric dimensioning and tolerancing; Use of solid-modeling software for creating associative models at the component and assembly levels; floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc. Applying colour coding according to building drawing practice; Drawing sectional elevation showing foundation to ceiling; Introduction to Building Information Modelling (BIM).

Suggested Text/Reference Books:

(i) Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House
(ii) Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
(iii) Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication
(iv) Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers
(v) (Corresponding set of) CAD Software Theory and User Manuals Course Outcomes

222

Course Outcomes

All phases of manufacturing or construction require the conversion of new ideas and design concepts into the basic line language of graphics. Therefore, there are many areas (civil, mechanical, electrical, architectural and industrial) in which the skills of the CAD technicians play major roles in the design and development of new products or construction. Students prepare for actual work situations through practical training in a new state-of-the-art computer designed CAD laboratory using engineering software. This course is designed to address:

- to prepare you to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- to prepare you to communicate effectively
- to prepare you to use the techniques, skills, and modern engineering tools necessary for engineering practice

The student will learn :

- Introduction to engineering design and its place in society
- Exposure to the visual aspects of engineering design
- Exposure to engineering graphics standards
- Exposure to solid modelling
- Exposure to computer-aided geometric design
- Exposure to creating working drawings
- Exposure to engineering communication

Paper Title : Engineering Graphics & Design (Practical)

Course Assessment Methods

End Semester Assessment:

1. University Theory Exam: Nil
2. University Practical Exam: 40 Marks (Evaluation of Traditional Engineering Graphics part of 20 Marks should be based upon written test by External Practical Examiner & Evaluation of Computer Graphics part of 20 marks should be based upon lab performance using computer graphics software & viva voce by External Practical Examiner)

Internal Assessment:

1. 60 Marks (20 marks for day to day work, 20 marks for written test & 20 marks for internal viva voce)

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144003

Semester 2nd

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

229

IK Gujral Punjab Technical University
Bachelor of Technology (B. Tech. 1st Year)

Course code	**BTCH101-18**				
Category	**Basic Science Course**				
Course title	**Chemistry-I (Theory)**				
	Contents				
	(i) Chemistry-I (Concepts in chemistry for engineering)				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester –II**
	3	**1**	**0**	**4**	
Pre-requisites (if any)	**-**				

(i)Chemistry-I (Concepts in chemistry for engineering) [L : 3; T:1; P : 0 (4 credits)]

Detailed contents

(i) Atomic and molecular structure (12 lectures)

Schrodinger equation. Particle in a box solutions and their applications for conjugated molecules and nanoparticles. Forms of the hydrogen atom wave functions and the plots of these functions to explore their spatial variations. Molecular orbitals of diatomic molecules and plots of the multicenter orbitals. Equations for atomic and molecular orbitals. Energy level diagrams of diatomic. Pi-molecular orbitals of butadiene and benzene and aromaticity. Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties. Band structure of solids and the role of doping on band structures.

(ii) Spectroscopic techniques and applications (8 lectures)

Principles of spectroscopy and selection rules. Electronic spectroscopy. Fluorescence and its applications in medicine. Vibrational and rotational spectroscopy of diatomic molecules. Applications. Nuclear magnetic resonance and magnetic resonance imaging, surface characterisation techniques. Diffraction and scattering.

(iii) Intermolecular forces and potential energy surfaces (4 lectures)

Ionic, dipolar and van Der Waals interactions. Equations of state of real gases and critical phenomena. Potential energy surfaces of H_3, H_2F and HCN and trajectories on these surfaces.

(iv) Use of free energy in chemical equilibria (6 lectures)

Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and applications. Acid base, oxidation reduction and solubility equilibria. Water chemistry. Corrosion.

Use of free energy considerations in metallurgy through Ellingham diagrams.

225

(v) Periodic properties (4 Lectures)

Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries

(vi) Stereochemistry (4 lectures)

Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis. Isomerism in transitional metal compounds

(vii) Organic reactions and synthesis of a drug molecule (4 lectures)

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule.

Suggested Text Books

(i) University chemistry, by B. H. Mahan
(ii) Chemistry: Principles and Applications, by M. J. Sienko and R.A. Plane
(iii) Fundamentals of Molecular Spectroscopy, by C. N. Banwell
(iv) Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan
(v) Physical Chemistry, by P. W. Atkins
(vi) Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5th Edition http://bcs.whfreeman.com/vollhardtschore5e/default.asp

Course Outcomes

The concepts developed in this course will aid in quantification of several concepts in chemistry that have been introduced at the 10+2 levels in schools. Technology is being increasingly based on the electronic, atomic and molecular level modifications.

Quantum theory is more than 100 years old and to understand phenomena at nanometer levels, one has to base the description of all chemical processes at molecular levels. The course will enable the student to:

- Analyse microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.
- Rationalise bulk properties and processes using thermodynamic considerations.
- Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques.
- Rationalise periodic properties such as ionization potential, electronegativity, oxidation states and electronegativity.
- List major chemical reactions that are used in the synthesis of molecules.

226

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

Course code	BTCH102-18				
Category	Basic Science Course				
Course title	Chemistry-I (Lab.)				
	Contents				
	(ii) Chemistry Laboratory				
Scheme and Credits	L	T	P	Credits	Semester –II
	0	0	3	1.5	
Pre-requisites (if any)	-				

(ii)Chemistry Laboratory [L : 0; T:0 ; P : 3 (1.5 credits)]

Choice of 10-12 experiments from the following

- Determination of surface tension and viscosity
- Thin Layer Chromatography
- Ion exchange column for removal of hardness of water
- Colligative properties using freezing point depression
- Determination of the rate constant of a reaction
- Determination of cell constant and conductance of solutions
- Potentiometry-determination of redox potentials and emf
- Synthesis of a polymer/drug
- Saponification/acid value of an oil
- Chemical analysis of a salt
- Lattice structures and packing of spheres
- Models of potential energy surfaces
- Chemical oscillations- Iodine clock reaction
- Determination of the partition coefficient of a substance between two immiscible liquids
- Adsorption of acetic acid by charcoal
- Use of the capillary viscometers to the demonstrate of the isoelectric point as the pH of minimum viscosity for gelatin sols and/or coagulation of the white part of egg.

Laboratory Outcomes

The chemistry laboratory course will consist of experiments illustrating the principles of chemistry relevant to the study of science and engineering. The students will learn to:

- Estimate rate constants of reactions from concentration of reactants/products as a function of time
- Measure molecular/system properties such as surface tension, viscosity, conductance of solutions, redox potentials, chloride content of water, etc
- Synthesize a small drug molecule and analyse a salt sample

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

IK Gujral Punjab Technical University
Bachelor of Technology (B. Tech. 1st Year)

Course code	BTPS101-18				
Category	Engineering Science Course				
Course title	**Programming for Problem Solving (Theory)**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	Semester – II
	3	**0**	**0**	**3**	[The lab component should have one hour of tutorial followed or preceded by laboratory assignments.]
Pre-requisites (if any)	-				

(i)Programming for Problem Solving ([L : 3; T:0; P : 0 (3 credits)]
[contact hrs : 40]
Detailed contents

Unit 1
Introduction to Programming **(4 lectures)**

Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.) – **(1 lecture).**

Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/Pseudocode with examples. **(1 lecture)**

From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable code- **(2 lectures)**

Unit 2
Arithmetic expressions and precedence **(2 lectures)**
Conditional Branching and Loops **(6 lectures)**
Writing and evaluation of conditionals and consequent branching **(3 lectures)**
Iteration and loops **(3 lectures)**

Unit 3
Arrays **(6 lectures)**
Arrays (1-D, 2-D), Character arrays and Strings

Unit 4
Basic Algorithms **(6 lectures)**
Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of equations, notion of order of complexity through example programs (no formal definition required)

Unit 5
Function **(5 lectures)**

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

228

Functions (including using built in libraries), Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference

Unit 6

Recursion **(4 -5 lectures)**

Recursion, as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort.

Unit 7

Structure **(4 lectures)**

Structures, Defining structures and Array of Structures

Unit 8

Pointers **(2 lectures)**

Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, notion of linked list (no implementation)

Unit 9

File handling (only if time is available, otherwise should be done as part of the lab)

Suggested Text Books

(i) Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill

(ii) E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill

Suggested Reference Books

(i) Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India.

Course Outcomes

The student will learn

To formulate simple algorithms for arithmetic and logical problems.

To translate the algorithms to programs (in C language).

To test and execute the programs and correct syntax and logical errors.

To implement conditional branching, iteration and recursion.

To decompose a problem into functions and synthesize a complete program using divide and conquer approach.

To use arrays, pointers and structures to formulate algorithms and programs.

To apply programming to solve matrix addition and multiplication problems and searching and sorting problems.

To apply programming to solve simple numerical method problems, namely rot finding of function, differentiation of function and simple integration.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144603

229

IK Gujral Punjab Technical University
Bachelor of Technology (B. Tech. 1st Year)

<table>
<tr><td>Course code</td><td colspan="5">BTPS102-18</td></tr>
<tr><td>Category</td><td colspan="5">Engineering Science Course</td></tr>
<tr><td>Course title</td><td colspan="5">Programming for Problem Solving (Lab)</td></tr>
<tr><td rowspan="2">Scheme and Credits</td><td>L</td><td>T</td><td>P</td><td>Credits</td><td rowspan="2">Semester – II
[The lab component should have one hour of tutorial followed or preceded by laboratory assignments.]</td></tr>
<tr><td>0</td><td>0</td><td>4</td><td>2</td></tr>
<tr><td>Pre-requisites (if any)</td><td colspan="5">-</td></tr>
</table>

(ii) Laboratory - Programming for Problem Solving [L : 0; T:0 ; P : 4 (2credits)]
[The laboratory should be preceded or followed by a tutorial to explain the approach or algorithm to be implemented for the problem given.]

Tutorial 1: Problem solving using computers:
Lab1: Familiarization with programming environment

Tutorial 2: Variable types and type conversions:
Lab 2: Simple computational problems using arithmetic expressions

Tutorial 3: Branching and logical expressions:
Lab 3: Problems involving if-then-else structures

Tutorial 4: Loops, while and for loops:
Lab 4: Iterative problems e.g., sum of series

Tutorial 5: 1D Arrays: searching, sorting:
Lab 5: 1D Array manipulation

Tutorial 6: 2D arrays and Strings
Lab 6: Matrix problems, String operations

Tutorial 7: Functions, call by value:
Lab 7: Simple functions

Tutorial 8 &9: Numerical methods (Root finding, numerical differentiation, numerical integration):
Lab 8 and 9: Programming for solving Numerical methods problems

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

230

Tutorial 10: Recursion, structure of recursive calls
Lab 10: Recursive functions

Tutorial 11: Pointers, structures and dynamic memory allocation
Lab 11: Pointers and structures

Tutorial 12: File handling:
Lab 12: File operations

Laboratory Outcomes

To formulate the algorithms for simple problems
To translate given algorithms to a working and correct program
To be able to correct syntax errors as reported by the compilers
To be able to identify and correct logical errors encountered at run time
To be able to write iterative as well as recursive programs
To be able to represent data in arrays, strings and structures and manipulate them through a program
To be able to declare pointers of different types and use them in defining self referential structures.
To be able to create, read and write to and from simple text files.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

IK Gujral Punjab Technical University
Bachelor of Technology (B. Tech. 1st Year)

Course code	BTMP101-18				
Category	Engineering Science Courses				
Course title	Workshop/Manufacturing Practices (Theory & Lab.)				
Scheme and Credits	L	T	P	Credits	Semester-II
	1	0	4	3	
Pre-requisites (if any)	-				
	Common to all branches				

Workshop/Manufacturing Practices [[L : 1; T:0; P : 0 (1 credit)]
Lectures & videos: (10 hours)

Detailed contents

1. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods (3 lectures)
2. CNC machining, Additive manufacturing (1 lecture)
3. Fitting operations & power tools (1 lecture)
4. Electrical &Electronics (1 lecture)
5. Carpentry (1 lecture)
6. Plastic moulding, glass cutting (1 lecture)
7. Metal casting (1 lecture)
8. Welding (arc welding & gas welding), brazing (1 lecture)

Suggested Text/Reference Books:

(i) Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., " Elements of Workshop Technology" , Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
(ii) Kalpakjian S. And Steven S. Schmid, " Manufacturing Engineering and Technology" , 4th edition, Pearson Education India Edition, 2002.
(iii) Gowri P. Hariharan and A. Suresh Babu," Manufacturing Technology – I" Pearson Education, 2008.
(iv) Roy A. Lindberg, " Processes and Materials of Manufacture", 4th edition, Prentice Hall India, 1998.
(v) Rao P.N., " Manufacturing Technology" , Vol. I and Vol. II, Tata McGrawHill House, 2017.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

232

IK Gujral Punjab Technical University
Bachelor of Technology (B. Tech. 1st Year)

BTHU-101-18 English 2L: 0T: 0P 2 credits

Course Outcomes:

- The objective of the course is to help the students become the independent users of English language.
- Students will acquire basic proficiency in reading & listening, comprehension, writing and speaking skills.
- Students will be able to understand spoken and written English language, particularly the language of their chosen technical field.
- They will be able to converse fluently.
- They will be able to produce on their own clear and coherent texts.

Detailed contents

Unit-1 Vocabulary Building & Basic Writing Skills

- The concept of Word Formation
- Root words from foreign languages and their use in English
- Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives.
- Synonyms, antonyms, and standard abbreviations.
- Sentence Structures
- Use of phrases and clauses in sentences
- Importance of proper punctuation
- Creating coherence
- Organizing principles of paragraphs in documents
- Techniques for writing precisely

Unit-2 Identifying Common Errors in Writing

- Subject-verb agreement
- Noun-pronoun agreement
- Misplaced modifiers
- Articles
- Prepositions
- Redundancies

233

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

Course Outcomes

Upon completion of this course, the students will gain knowledge of the different manufacturing processes which are commonly employed in the industry, to fabricate components using different materials.

(ii) Workshop Practice:(60 hours)[L : 0; T:0 ; P : 4 (2 credits)]

1. Machine shop (10 hours)
2. Fitting shop (8 hours)
3. Carpentry (6 hours)
4. Electrical & Electronics(8 hours)
5. Welding shop (8 hours (Arc welding 4 hrs + gas welding 4 hrs)
6. Casting (8 hours)
7. Smithy (6 hours)
8. Plastic moulding& Glass Cutting (6 hours)

Examinations could involve the actual fabrication of simple components, utilizing one or more of the techniques covered above.

Laboratory Outcomes

- Upon completion of this laboratory course, students will be able to fabricate components with their own hands.
- They will also get practical knowledge of the dimensional accuracies and dimensional tolerances possible with different manufacturing processes.
- By assembling different components, they will be able to produce small devices of their interest.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

234

234

- Clichés

Unit-3 Mechanics of Writing

- Writing introduction and conclusion
- Describing
- Defining
- Classifying
- Providing examples or evidence

Unit-4 Writing Practices

- Comprehension
- Précis Writing
- Essay Writing
- Business Writing-Business letters, Business Emails, Report Writing, Resume/CV

Suggested Readings:

(i) *Practical English Usage*. Michael Swan. OUP. 1995.

(ii) *Remedial English Grammar*. F.T. Wood. Macmillan.2007

(iii) *On Writing Well*. William Zinsser. Harper Resource Book. 2001

(iv) *Study Writing*. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.

(v) *Communication Skills*. Sanjay Kumar and Pushp Lata. Oxford University Press. 2011.

(vi) *Exercises in Spoken English*. Parts. I-III. CIEFL, Hyderabad. Oxford University Press

IK Gujral Punjab Technical University
Bachelor of Technology (B. Tech. 1st Year)

BTHU-102-18 (English Laboratory)

0L: 0T: 2P 1 credit

Course Outcomes:

- The objective of the course is to help the students become the independent users of English language.
- Students will acquire basic proficiency in listening and speaking skills.
- Students will be able to understand spoken English language, particularly the language of their chosen technical field.
- They will be able to converse fluently
- They will be able to produce on their own clear and coherent texts.

Detailed contents

Interactive practice sessions in Language Lab on Oral Communication

- Listening Comprehension
- Self-Introduction, Group Discussion and Role Play
- Common Everyday Situations: Conversations and Dialogues
- Communication at Workplace
- Interviews
- Formal Presentations

Suggested Readings:

(i) *Practical English Usage*. Michael Swan. OUP. 1995.

(ii) *Communication Skills*. Sanjay Kumar and Pushp Lata. Oxford University Press. 2011.

(iii) *Exercises in Spoken English*. Parts. I-III. CIEFL, Hyderabad. Oxford University Press

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

236

IKG Punjab Technical University

Teaching Scheme

(3th - 8th Semester)

for

Undergraduate Degree Programme

Bachelor of Technology

in

ELECTRICAL ENGINEERING

2018 & onwards

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

237

Semester III [Second year]						Branch: Electrical Engineering				
Sr. No.	**Course code**	**Course Title**	**L**	**T**	**P**	**Hours/ Week**	**Internal Marks**	**External Marks**	**Total Marks**	**Credits**
1	BTEE-301-18	Electrical Circuit Analysis	3	1	0	4	40	60	100	4
2	BTEE-302-18	Analog Electronics	3	0	0	3	40	60	100	3
3	BTEE-303-18	Electrical Machines – I	3	0	0	3	40	60	100	3
4	BTEE-304-18	Electromagnetic Fields	3	1	0	4	40	60	100	4
5	BTEE-305-18	Engineering Mechanics	3	1	0	4	40	60	100	4
6	BTEE-311-18	Analog Electronics Laboratory	0	0	2	2	30	20	50	1
7	BTEE-312-18	Electrical Machines – I Laboratory	0	0	2	2	30	20	50	1
8	BTMC-XXX-18	Mandatory Course (BTMC-101-18 or BTMC 102-18)	3	0	0	3	40	60	100	S/US
9	BMPD-301-18	Mentoring and Professional Development of Students	0	1	0	1	50	-	50	S/US
10	BTEE-321-18	Institutional Summer Vacation Training*	-	-	-	35*	-	-		S/US
		Total	**18**	**4**	**4**	**26**	**350**	**400**	**750**	**20**

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

238

Semester IV [Second year]						Branch: Electrical Engineering				
Sr. No.	**Course code**	**Course Title**	**L**	**T**	**P**	**Hours/ Week**	**Internal Marks**	**External Marks**	**Total Marks**	**Credits**
1	BTEE-401-18	Digital Electronics	3	0	0	3	40	60	100	3
2	BTEE-402-18	Electrical Machines – II	3	0	0	3	40	60	100	3
3	BTEE-403-18	Power Electronics	3	0	0	3	40	60	100	3
4	BTEE-404-18	Signals and Systems	3	0	0	3	40	60	100	3
5	BTAM-302-18	Mathematics-III (Probability & Statistics)	3	1	0	4	40	60	100	4
6	BTEE-411-18	Measurements and Instrumentation Lab.	2	0	2	4	30	20	50	3
7	BTEE-412-18	Digital Electronics Laboratory	0	0	2	2	30	20	50	1
8	BTEE-413-18	Electrical Machines – II Laboratory	0	0	2	2	30	20	50	1
9	BTEE-414-18	Power Electronics Laboratory	0	0	2	2	30	20	50	1
10	BTMC-XXX-18	Mandatory Course (BTMC-101-18 or BTMC 102-18)	3	0	0	3	40	60	100	S/US
11	BMPD-401-18	Mentoring and Professional Development of Students	0	1	0	1	50	-	50	S/US
		Total	**20**	**2**	**8**	**30**	**410**	**440**	**850**	**22**
Students to undertake Six weeks summer industry internship/ field training (during vacation).										

Additional Lectures/Tutorials: Need based additional lectures/tutorials may be introduced of any Course, however, the Credits of the course will not change.

BTEE-321-18: Institutional Summer Vacation Training: Four (04) weeks Institutional Summer Vacation Training after 2nd semester for programme. B. Tech. (Electrical Engineering)

Objective: The training is compulsory and is for the orientation of the students of the Electrical Engineering so that they are aware of/can identify the industrial, departmental, environmental, societal and other issues that are a challenge in the society and develop the ability to find solutions. The training in the concerned discipline will be provided in College/Department Labs /Workshops

Content to be covered:

Module I, II & III: Hands on training/ practical knowledge on any three/four of the given contents

Module IV & V: Compulsory

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

Module	Content	Remarks
I	• Hands on training of wiring (Tube light, Incandescent bulb & LED light fitting, extension board, staircase). • Preparation of wiring diagram for domestic load/commercial load • Study of types of switches, protective devices (samples to be made available)	30 hours

Module	Content	Remarks
	• Types of electrical wires and Cables (samples to be made available) • Classification of Insulation (samples to be made available)	
II	• Single Line diagram of power generation, transmission distribution • Power scenario in India (Conventional & renewable sources of energy) (recent information from the website of Ministry of power to be included) • Introduction to the concept of Heating, Ventilation and Air conditioning. • The need of industrial safety. • Introduction to electrical machines and their maintenance.	30 hours
III	• Introduction to multimeter, function generator, CRO, • Identification and testing of resistors, capacitors, transistors and diodes, etc. • Observing the response of various circuits on CRO • Design and fabrication of +5V / +12V powers supply on bread board • Design and fabrication of half wave and/or full wave rectifier • Logics gates (using ICs)	30 hours
IV	• Study of main components of a sub-station and visit to local sub Station • Visit to industry/manufacturing unit related to discipline/branch (In case of small-scale industries/MSMEs, the faculty and students to identify small issues and propose requisite solutions/ remedies/ innovative solutions based on engineering) • Invited talk by Industry Expert • Expert talk on recent technologies	25 hours
V	• Visit to local NGO/village/city to identify socio-economic/ environmental issues and identify a problem and prepare a "Problem formulation report" • To have a group discussion on the issues identified with faculty and to propose requisite solutions/remedies/innovative solutions based on Engineering.	25 hours
Total Time		140 hours

Evaluation Criterion:

i) Four (04) weeks Institutional Summer Vacation Training after 2nd semester is a compulsory non-Credit course.

ii) The students are required to maintain a daily dairy and submit it along with the "Problem formulation report".

iii) Student falling short of 75% attendance criterion is required to repeat the training with next batch.

iv) Continuous evaluation to be done and proper record to be maintained.

v) The result will be "Satisfactory/Unsatisfactory" which is to be recorded within 3 working days after the completion of the training.

239

BTEE-521-18	Summer Industry Internship/ Field Training	(Non-Credit)

Six weeks in an Industry in the area of Electrical Engineering during summer vacations after 4th semester. The summer internship should give exposure to the practical aspects of the discipline. In addition, the student may also work on a specified task or project which may be assigned to him/her. The outcome of the internship should be presented in the form of a report. The student will make a presentation based upon the Industry Internship attended. Performance to be rated as Satisfactory/Un -Satisfactory (S/US). For unsatisfactory the internship to be repeated.

Evaluation scheme (Summer Industry Internship/ Field Training)

Internal ***(to be evaluated by Industry)***	***Marks***	***External**** ***(to be evaluated by Department)***	***Marks***
Attendance	15	Daily Dairy	5
Performance (Work done /simulation/hardware/project developed)	30	Report	10
Report	10	Presentation (Work done /simulation/hardware/project developed)	25
Daily Dairy	05		
Total	***60***	***Total***	***40***

*External examiner not to be called.

Range of credits for Honors Degree -Minimum credits as per scheme are required by a student to be eligible to get Under Graduate degree in Electrical Engineering. A student will be eligible to get Under Graduate degree with Honours, if he/she completes an additional 20 credits. These could be acquired through MOOCs and registering in the department.

Range of Credits and Courses for Major Degree in B. Tech. (Electrical Engineering) and Minor Degree in B.Tech. (Electrical and Computer Engineering)

(i) A student admitted in B. Tech (EE) may opt for Major Degree in B. Tech. (Electrical Engineering) and Minor Degree in B.Tech. (Electrical and Computer Engineering) with effect from 3rd semester onwards..

(ii) The student must clear his/her previous two semesters (1st and 2nd Semester).

(iii) The student/candidate will require to clear at least five theory subjects for Minor Degree in B.Tech.

(iv) The minimum credits for Minor Degree in B. Tech. will be 20 in which the student will have to clear minimum two (2) Core Courses and three (3) Professional Elective (PE) Courses / Core Courses).

(v) A student is permitted to take maximum 8 credits (theory + lab) per semester pertaining to their Minor Degree in B.Tech.

Virtual Laboratories: Students may take at least one virtual laboratory any time before the commencement of the 8th Semester.

Open Elective: A student may take Courses from the list of Open Electives offered by other Departments or MOOCs Courses of SWAYAM/MOOCs courses approved by the Board of Studies.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

240

MANDATORY COURSES (Non-Credit Courses)

Sr. No.	Semester	Course Code	Course Title	Hours/Week	Credits
1.	III/IV	BTMC-101-18	Indian Constitution	3L:0T:0P	Nil
2.	III/IV	BTMC-102-18	Essence of Indian Traditional Knowledge	3L:0T:0P	Nil
3.	V	EVS 101-18	Environmental Studies	2L:0T:0P	Nil

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

241

SEMESTER: III
[Second Year]

Head
Department of Electrical Engineering
IK Gujral Punjab Technical University
Kapurthala-144006

242

BTEE-301-18	**Electrical Circuit Analysis**	**3L:1T:0P**	**4 credits**
Internal Marks: 40	External Marks: 60	Total Marks: 100	

Course Outcomes:

At the end of this course, students will demonstrate the ability to:

CO 1	Apply network theorems for the analysis of electrical circuits.
CO 2	Obtain the transient and steady-state response of electrical circuits.
CO 3	Analyze circuits in the sinusoidal steady-state (single-phase and three-phase). Analyze two port circuit behavior.
CO 4	Synthesize networks and filters.

Module 1: Basic Network Analysis (14 Hours)

Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem, Reciprocity theorem, Compensation theorem. Analysis with dependent current and voltage sources. Node and Mesh Analysis. Concept of duality and dual networks. Solution of first and second order differential equations for series and parallel R-L, R-C, R-L-C circuits, initial and final conditions in network elements, forced and free response, time constants, steady state and transient state response.

Module 2: Electrical circuit and steady state analysis (14 Hours)

Representation of sine function as rotating phasor, phasor diagrams, impedances and admittances, AC circuit analysis, effective or RMS values, average power and complex power. Three-phase circuits. Mutual coupled circuits, Dot convention in coupled circuits, Ideal Transformer. Analysis of electrical circuits using Laplace Transform for standard inputs, transformed network with initial conditions. Frequency response (magnitude and phase plots), series and parallel resonances.

Module 3: Network functions and two port network (10 Hours)

Driving point impedance and admittance, natural response of a network, transfer impedance and admittance, concept of pole and zeros in a network function, Routh Hurwitz criterion of stability.

Two Port Networks: terminal pairs, relationship of two port variables, impedance parameters, admittance parameters, transmission parameters and hybrid parameters, interconnections of two port networks.

Module 4: Network Synthesis and Filters (10 Hours)

Network synthesis techniques for 2-terminal network, Foster and Cauer forms.

Filters: Classification of filters, characteristics impedance and propagation constant of pure reactive network, ladder network, T-section, π-section, terminating half section, pass bands and stop bands, Design of constant-K, m-derived filters.

Text / References:

1. M. E. Van Valkenburg, "Network Analysis", Prentice Hall, 2006.
2. D. Roy Choudhury, "Networks and Systems", New Age International Publications, 1998.
3. W. H. Hayt and J. E. Kemmerly, "Engineering Circuit Analysis", McGraw Hill Education, 2013.
4. C. K. Alexander and M. N. O. Sadiku, "Electric Circuits", McGraw Hill Education, 2004.
5. K. V. V. Murthy and M. S. Kamath, "Basic Circuit Analysis", Jaico Publishers, 1999.

BTEE- 302-18	Analog Electronics	3L:0T:0P	3 credits

Internal Marks: 40 External Marks: 60 Total Marks: 100

Course Outcomes:

At the end of this course, students will demonstrate the ability to:

CO 1	Understand the characteristics of transistors.
CO 2	Design and analyse various rectifier and amplifier circuits.
CO 3	Design sinusoidal and non-sinusoidal oscillators.
CO 4	Understand the functioning of OP-AMP and design OP-AMP based circuits.

Module 1: Diode and BJT circuits (12 Hours)

P-N junction diode, *V-I* characteristics of a diode; review of half-wave and full-wave rectifiers, Zener diodes, clamping and clipping circuits.

BJT circuits: Structure and *V-I* characteristics of a BJT; BJT as a switch. BJT as an amplifier: small-signal model, biasing circuits, current mirror; common-emitter, common-base and common-collector amplifiers.

Module 2: MOSFET circuits (10 Hours)

MOSFET structure and *V-I* characteristics. MOSFET as a switch. MOSFET as an amplifier: small-signal model and biasing circuits, common-source, common-gate and common-drain amplifiers; small signal equivalent circuits - gain, input and output impedances, trans-conductance, high frequency equivalent circuit.

Module 3: Differential, multi-stage and operational amplifiers (10 Hours)

Differential amplifier; power amplifier; direct coupled multi-stage amplifier; internal structure of an operational amplifier, ideal op-amp, non-idealities in an op-amp (Output offset voltage, input bias current, input offset current, slew rate, gain bandwidth product)

Module 4: Linear applications of op-amp (10 Hours)

Idealized analysis of op-amp circuits. Specifications. Inverting and non-inverting amplifier, differential amplifier, instrumentation amplifier, integrator, active filter, voltage regulator, Oscillators: Principle of operation, Wein's bridge and phase shift oscillator.

Text/References:

1. A. S. Sedra & K. C. Smith, "Microelectronic Circuits", New York, Oxford University Press, 1998.
2. J. V. Wait, L. P. Huelsman and G. A. Korn, "Introduction to Operational Amplifier theory and applications", McGraw Hill U. S., 1992.
3. J. Millman and A. Grabel, "Microelectronics", McGraw Hill Education, 1988.
4. P. Horowitz and W. Hill, "The Art of Electronics", Cambridge University Press, 1989.
5. P. R. Gray, R. G. Meyer and S. Lewis, "Analysis and Design of Analog Integrated Circuits", John Wiley & Sons, 2001.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144603

244

BTEE-303-18	Electrical Machines-I	3L:0T:0P	3 credits

Internal Marks: 40 External Marks: 60 Total Marks: 100

Course Outcomes:

At the end of this course, students will demonstrate the ability to:

CO 1	Understand the concepts of magnetic circuits.
CO 2	Understand the operation of DC machines.
CO 3	Analyse the differences in operation of different DC machine configurations.
CO 4	Analyse single phase and three phase transformers circuits.

Module 1: Magnetic fields and magnetic circuits (6 Hours)

Review of magnetic circuits - MMF, flux, reluctance, inductance; Visualization of magnetic fields produced by a bar magnet and a current carrying coil - through air and through a combination of iron and air; influence of highly permeable materials on the magnetic flux lines.

Module 2: DC machines (12 Hours)

Basic construction of a DC machine, magnetic structure - stator yoke, stator poles, pole-faces or shoes, air gap and armature core, visualization of magnetic field produced by the field winding excitation with armature winding open, air gap flux density distribution, flux per pole, induced EMF in an armature coil. Armature winding and commutation - Elementary armature coil and commutator, lap and wave windings, construction of commutator, linear commutation Derivation of back EMF equation, armature MMF wave, derivation of torque equation, armature reaction, air gap flux density distribution with armature reaction.

Module 3: DC machine - motoring and generation (12 Hours)

Armature circuit equation for motoring and generation, Types of field excitations - separately excited, shunt and series. Open circuit characteristic of separately excited DC generator, back EMF with armature reaction, voltage build-up in a shunt generator, critical field resistance and critical speed. *V-I* characteristics and torque-speed characteristics of separately excited, shunt and series motors. Speed control through armature voltage. Losses, load testing and back-to-back testing of DC machines

Module 4: Transformers (12 Hours)

Principle, construction and operation of single-phase transformers, equivalent circuit, phasor diagram, voltage regulation, losses and efficiency, Testing - open circuit and short circuit tests, polarity test, back-to-back test, separation of hysteresis and eddy current losses, Three-phase transformer - construction, types of connection and their comparative features, Parallel operation of single-phase and three-phase transformers, Autotransformers - construction, principle, applications and comparison with two winding transformer, Magnetizing current, effect of nonlinear B-H curve of magnetic core material, harmonics in magnetization current, Phase conversion - Scott connection, three-phase to six-phase conversion, Tap-changing transformers - No-load and on-load tap-changing of transformers, Three-winding transformers. Cooling of transformers.

Text / References:

1. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", New York, McGraw Hill Education, 2013.

245

Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144603

2. A. E. Clayton and N. N. Hancock, "Performance and design of DC machines", CBS Publishers, 2004.
3. M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
4. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
5. I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

246

BTEE-304-18	Electromagnetic Fields	3L:1T:0P	4 credits

Internal Marks: 40 External Marks: 60 Total Marks: 100

Course Outcomes:

At the end of the course, students will demonstrate the ability:

CO 1	To understand the basic laws of electromagnetism.
CO 2	To obtain the electric and magnetic fields for simple configurations under static conditions.
CO 3	To analyse time varying electric and magnetic fields.
CO 4	To understand Maxwell's equation in different forms and different media.
CO 5	To understand the propagation of EM waves.

This course shall have Lectures and Tutorials. Most of the students find difficult to visualize electric and magnetic fields. Instructors may demonstrate various simulation tools to visualize electric and magnetic fields in practical devices like transformers, transmission lines and machines.

Module 1: Review of Vector Calculus (8 hours)

Vector algebra-addition, subtraction, components of vectors, scalar and vector multiplications, triple products, three orthogonal coordinate systems (rectangular, cylindrical and spherical). Vector calculus- differentiation, partial differentiation, integration, vector operator, del, gradient, divergence and curl; integral theorems of vectors. Conversion of a vector from one coordinate system to another.

Module 2: Static Electric Field (15 Hours)

Coulomb's law, Electric field intensity, Electrical field due to point charges. Line, Surface and Volume charge distributions. Gauss law and its applications. Absolute Electric potential, Potential difference, Calculation of potential differences for different configurations. Electric dipole, Electrostatic Energy and Energy density.

Current and current density, Ohms Law in Point form, Continuity of current, Boundary conditions of perfect dielectric materials. Permittivity of dielectric materials, Capacitance, Capacitance of a two wire line, Poisson's equation, Laplace's equation, Solution of Laplace and Poisson's equation, Application of Laplace's and Poisson's equations.

Module 3: Magnetic Forces, and Inductance (10 Hours)

Biot-Savart's law, Ampere's law of force, Ampere's circuital law, Faraday's law, Force on a moving charge, Force on a differential current element, Force between differential current elements, Magnetic boundary conditions, Magnetic circuits, calculations of inductances and mutual inductances for a solenoid and toroid.

Module 4: Maxwell's Equations in Time Varying Fields and Wave theory (15 Hours)

Concept of displacement current and conduction current, Maxwell's equation-differential and integral form, Poynting's theorem, its significance and Poynting's vector, Boundary Conditions.

Wave theory: Derivation of wave equation, uniform plane waves, Maxwell's equation in Phasor form, Wave equation in Phasor form, Plane waves in free space and in a homogenous material. Attenuation, phase and propagation constant, intrinsic impedance, Relation between E & H, wave equation for a conducting medium, Plane waves in lossy dielectrics, Propagation in good conductors, Skin effect.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

247

Text / References:

1. M. N. O. Sadiku, "Elements of Electromagnetics", Oxford University Publication, 2014.
2. A. Pramanik, "Electromagnetism - Theory and applications", PHI Learning Pvt. Ltd, New Delhi, 2009.
3. A. Pramanik, "Electromagnetism-Problems with solution", Prentice Hall India, 2012.
4. G. W. Carter, "The electromagnetic field in its engineering aspects", Longmans, 1954.
5. W. J. Duffin, "Electricity and Magnetism", McGraw Hill Publication, 1980.
6. W. J. Duffin, "Advanced Electricity and Magnetism", McGraw Hill, 1968.
7. E. G. Cullwick, "The Fundamentals of Electromagnetism", Cambridge University Press, 1966.
8. B. D. Popovic, "Introductory Engineering Electromagnetics", Addison-Wesley Educational Publishers, International Edition, 1971.
9. W. Hayt, "Engineering Electromagnetics", McGraw Hill Education, 2012.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

248

BTEE-305-18	**Engineering Mechanics**	**3L:1T:0P**	**4 credits**

Internal Marks: 40 External Marks: 60 Total Marks: 100

Course Outcomes:

At the end of this course, students will demonstrate the ability to:

CO 1	Understand the concepts of co-ordinate systems.
CO 2	Analyse the three-dimensional motion.
CO 3	Understand the concepts of rigid bodies.
CO 4	Analyse the free-body diagrams of different arrangements.
CO 5	Analyse torsional motion and bending moment.

Module 1: Introduction to vectors and tensors and co-ordinate systems (5 hours)

Introduction to vectors and tensors and coordinate systems; Vector and tensor algebra; Indical notation; Symmetric and anti-symmetric tensors; Eigenvalues and Principal axes.

Module 2: Three-dimensional Rotation (4 hours)

Three-dimensional rotation: Euler's theorem, Axis-angle formulation and Euler angles; Coordinate transformation of vectors and tensors.

Module 3: Kinematics of Rigid Body (6 hours)

Kinematics of rigid bodies: Dentition and motion of a rigid body; Rigid bodies as coordinate systems; Angular velocity of a rigid body, and its rate of change; Distinction between twoand three-dimensional rotational motion; Integration of angular velocity to find orientation; Motion relative to a rotating rigid body: Five term acceleration formula.

Module 4: Kinetics of Rigid Bodies (5 hours)

Kinetics of rigid bodies: Angular momentum about a point; Inertia tensor: Dentition and computation, Principal moments and axes of inertia, Parallel and perpendicular axes theorems; Mass moment of inertia of symmetrical bodies, cylinder, sphere, cone etc., Area moment of inertia and Polar moment of inertia, Forces and moments; Newton-Euler's laws of rigid body motion.

Module 5: Free Body Diagram (1 hour)

Free body diagrams; Examples on modelling of typical supports and joints and discussion on the kinematic and kinetic constraints that they impose.

Module 6: General Motion (9 hours)

Examples and problems. General planar motions. General 3-D motions. Free precession, Gyroscopes, Rolling coin.

Module 7: Bending Moment (5 hours)

Transverse loading on beams, shear force and bending moment in beams, analysis of cantilevers, simply supported beams and overhanging beams, relationships between loading, shear force and bending moment, shear force and bending moment diagrams.

Module 8: Torsional Motion (2 hours)

Torsion of circular shafts, derivation of torsion equation, stress and deformation in circular and hollow shafts.

249

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University

Module 9: Friction (3 hours)

Concept of Friction; Laws of Coulomb friction; Angle of Repose; Coefficient of friction.

Text / References:

1. J. L. Meriam and L. G. Kraige, "Engineering Mechanics: Dynamics", Wiley, 2011.
2. M. F. Beatty, "Principles of Engineering Mechanics", Springer Science & Business Media, 1986.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

250.

BTEE-311-18	Analog Electronics Laboratory	0L:0T:2P	1 Credit

Internal Marks: 30 External Marks: 20 Total Marks: 50

Course Outcomes:

At the end of this course, students will demonstrate the ability to:

CO 1	Understand the use and importance of various types of equipments used in the laboratory.
CO 2	Ability to make circuits on bread-board.
CO 3	Analyze, take measurements to understand circuit behavior and performance under different conditions.
CO 4	Troubleshoot, design and create electronic circuits meant for different applications.
CO 5	Evaluate the performance electronic circuits and working small projects employing semiconductor devices.

Hands-on experiments related to the course contents of BTEE302-18

Note: A student to perform any 8-10 experiments and make one minor working model project.

Suggested List of Experiments:

1. To draw *V-I* characteristics of a PN junction diode (Ge, Si, switching and signal).
2. To design half wave rectifier.
3. To design full wave and bridge rectifiers.
4. To study the transistor characteristics in common base, common collector, and common emitter configurations.
5. To study the *V-I* characteristics of a MOSFET.
6. To design a voltage regulator IC using zener diode and also see the effect of line and load regulation
7. To design various clippers and clampers using diodes.
8. To obtain the frequency response of an amplifier and calculate the gain bandwidth of the amplifier.
9. To investigate the emitter follower (Buffer) amplifier and determine A_V, R_i, and R_O
10. To design and study various type of oscillators, and determine frequency of oscillations.
11. To design a transistor series voltage regulator with current limits and observe its current feedback characteristics.
12. To study the characteristics of a complementary symmetry amplifier.
13. To study the application of an Op-Amp (741) as inverting and non-inverting amplifier.
14. To use the OP-AMP as summing, scaling and averaging amplifier.
15. Design differentiator and integrator using OP-AMP and also determine the time constant and cut-off frequency.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

251

BTEE-312-18	**Electrical Machines – I Laboratory**	**0L:0T:2P**	**1 Credit**

Internal Marks: 30 External Marks: 20 Total Marks: 50

Course Outcomes:

At the end of this course, students will demonstrate the ability to:

CO 1	Analyze three-phase transformer/system connections.
CO 2	Evaluation of equivalent circuit parameters, efficiency and voltage regulation by performing various tests on transformer.
CO 3	Analyze parallel operation of transformers.
CO 4	Analyze performance characteristics of DC generators.

Hands-on experiments related to the course contents of BTEE303-18

Note: A student to perform any 8-10 Experiments and make one minor working model project.

Suggested List of Experiments:

1. To perform the load test on a single phase transformer.
2. To perform open circuit and short circuit tests on a single phase transformer and hence draw the equivalent circuit, calculate the voltage regulation and efficiency.
3. To find the efficiency and voltage regulation of single phase transformer under different loading conditions.
4. To perform parallel operation of two single phase transformers.
5. To study the various connections of a three phase transformer.
6. To perform Scott connections on three phase transformer to get two phase supply.
7. To study the constructional details of DC machine and to draw sketches of different components.
8. To measure armature and field resistance of DC shunt generator and to obtain its open circuit characteristics.
9. To obtain load characteristics of DC shunt/series/compound generator.
10. To draw speed-torque and torque-speed characteristics of DC shunt/series /compound generator.
11. To study the three point and four point DC motor starters.
12. To perform Swinburne's test (no load test) to determine various losses of DC shunt motor.
13. To visualize the magnetic fields produced by a bar magnet and a current carrying coil using FEMM/ ANSYS Maxwell.
14. To visualize the magnetic field produced in an electrical machine using FEMM/ ANSYS Maxwell.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144603

252

SEMESTER: IV
[Second Year]

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

252

BTEE-401-18	Digital Electronics	3L:0T:0P	3 credits

Internal Marks: 40 External Marks: 60 Total Marks: 100

Course Outcomes:

At the end of this course, students will demonstrate the ability to:

CO 1	Understand working of logic families and logic gates.
CO 2	Design and implement Combinational and Sequential logic circuits.
CO 3	Understand the process of Analog to Digital conversion and Digital to Analog conversion.
CO 4	Be able to understand memories.

Module 1: Fundamentals of Digital Systems and logic families (10 Hours)

Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples of IC gates, number systems-binary, signed binary, octal hexadecimal number, binary arithmetic, one's and two's complements arithmetic, codes, error detecting and correcting codes, characteristics of digital ICs, digital logic families, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri-state logic.

Module 2: Combinational Digital Circuits (10 Hours)

Standard representation for logic functions, K-map representation, simplification of logic functions using K-map, minimization of logical functions. Don't care conditions, Multiplexer, De-Multiplexer/Decoders, Adders, Subtractors, BCD arithmetic, carry look ahead adder, serial adder, ALU, elementary ALU design, popular MSI chips, digital comparator, parity checker/generator, code converters, priority encoders, decoders/drivers for display devices, Q-M method of function realization.

Module 3: Sequential circuits and systems (12 Hours)

A 1-bit memory, the circuit properties of Bi-stable latch, the clocked SR flip flop, J- K-T and D- types flipflops, applications of flipflops, shift registers, applications of shift registers, serial o parallel converter, parallel to serial converter, ring counter, sequence generator, ripple(Asynchronous) counters, synchronous counters, counters design using flip flops, special counter IC's, asynchronous sequential counters, applications of counters.

Module 4: A/D and D/A Converters (10 Hours)

Digital to analog converters: weighted resistor/converter, R-2R Ladder D/A converter, specifications for D/A converters, examples of D/A converter ICs, sample and hold circuit ,analog to digital converters: quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter, counting A/D converter, dual slope A/D converter, A/D converter using Voltage to frequency and voltage to time conversion, specifications of A/D converters, example of A/D converter ICs, concept of memories.

Text/References:

1. R. P. Jain, "Modern Digital Electronics", McGraw Hill Education, 2009.
2. M. M. Mano, "Digital logic and Computer design", Pearson Education India, 2016.
3. A. Kumar, "Fundamentals of Digital Circuits", Prentice Hall India, 2016.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

253

BTEE-402-18	Electrical Machines – II	3L:0T:0P	3 credits

Internal Marks: 40 External Marks: 60 Total Marks: 100

Course Outcomes:

At the end of this course, students will demonstrate the ability to:

CO 1	Understand the concepts of rotating magnetic fields.
CO 2	Understand the operation of AC machines.
CO 3	Analyse performance characteristics of AC machines.
CO4	To understand the difference between the synchronous machines and asynchronous machines

Module 1: Fundamentals of AC machine windings (8 Hours)

Physical arrangement of windings in stator and cylindrical rotor; slots for windings; single-turn coil - active portion and overhang; full-pitch coils, concentrated winding, distributed winding, winding axis, 3D visualization of the above winding types, Air-gap MMF distribution with fixed current through winding - concentrated and distributed, Sinusoidally distributed winding, winding distribution factor

Module 2: Pulsating and revolving magnetic fields (12 Hours)

Constant magnetic field, pulsating magnetic field - alternating current in windings with spatial displacement, Magnetic field produced by a single winding - fixed current and alternating current Pulsating fields produced by spatially displaced windings, Windings spatially shifted by 90 degrees, Addition of pulsating magnetic fields, Three windings spatially shifted by 120 degrees (carrying three-phase balanced currents), revolving magnetic field.

Module 3: Induction Machines (12 Hours)

Concept of rotating magnetic field, Construction, Types (squirrel cage and slip-ring), Torque Slip Characteristics, Starting and maximum torque, power flow diagram, Equivalent circuit. Phasor diagram, Losses and efficiency. Effect of parameter variation on torque speed characteristics (variation of rotor and stator resistances, stator voltage, frequency). Methods of starting, braking and speed control for induction motors. Generator operation. Self-excitation. Doubly-fed induction machines.

Single phase induction motors: Constructional features, double revolving field theory, equivalent circuit, determination of parameters. Split-phase starting methods and applications

Module 4: Synchronous machines (10 Hours)

Constructional features, cylindrical rotor and salient pole synchronous machine - generated EMF, coil span and distribution factor, equivalent circuit and phasor diagram, armature reaction at different power factor loads, voltage regulation by synchronous impedance and zero power factor method, concept of short circuit ratio, Operating characteristics of synchronous machines, V-curves and inverter-V curves. Hunting. Salient pole machine - two reaction theory, analysis of phasor diagram, power angle characteristics. Parallel operation of alternators - synchronization and load division.

Text/References:

1. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", McGraw Hill Education, 2013.
2. M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
3. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
4. I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.
5. A. S. Langsdorf, "Alternating current machines", McGraw Hill Education, 1984.
6. P. C. Sen, "Principles of Electric Machines and Power Electronics", John Wiley & Sons, 2007.

254

BTEE-403-18	**Power Electronics**	**3L:0T:0P**	**3 credits**

Internal Marks: 40 External Marks: 60 Total Marks: 100

Course Outcomes:

At the end of this course students will demonstrate the ability to:

CO 1	Understand the differences between signal level and power level devices.
CO 2	Analyse controlled rectifier circuits.
CO 3	Analyse the operation of DC-DC choppers.
CO 4	Analyse the operation of voltage source inverters.

Module 1: Power switching devices (8 Hours)

Diode, Thyristor, MOSFET, IGBT: *V-I* characteristics; Firing circuit for thyristor; Voltage and current commutation of a thyristor; Gate drive circuits for MOSFET and IGBT.

Module 2: Thyristor rectifiers (10 Hours)

Single-phase half-wave and full-wave rectifiers, Single-phase full-bridge thyristor rectifier with R-load and highly inductive load; Three-phase full-bridge thyristor rectifier with R-load and highly inductive load; Input current wave shape and power factor.

Module 3: DC-DC buck converter (12 Hours)

Elementary chopper with an active switch and diode, concepts of duty ratio and average voltage, power circuit of a buck converter, analysis and waveforms at steady state, duty ratio control of output voltage. DC-DC boost converter: Power circuit of a boost converter, analysis and waveforms at steady state, relation between duty ratio and average output voltage.

Module 4: Single-phase voltage source inverter (12 Hours)

Power circuit of single-phase voltage source inverter, switch states and instantaneous output voltage, square wave operation of the inverter, concept of average voltage over a switching cycle, bipolar sinusoidal modulation and unipolar sinusoidal modulation, modulation index and output voltage. Three-phase voltage source inverter: Power circuit of a three-phase voltage source inverter, switch states, instantaneous output voltages, average output voltages over a sub-cycle, three-phase sinusoidal modulation

Text/References:

1. M. H. Rashid, "Power electronics: circuits, devices, and applications", Pearson Education India, 2009.
2. N. Mohan and T. M. Undeland, "Power Electronics: Converters, Applications and Design", John Wiley & Sons, 2007.
3. R. W. Erickson and D. Maksimovic, "Fundamentals of Power Electronics", Springer Science & Business Media, 2007.
4. L. Umanand, "Power Electronics: Essentials and Applications", Wiley India, 2009.
5. P. S. Bimbhra, Power Electronics", Khanna Publishers

255
256

BTEE-404-18	Signals and Systems	3L:0T:0P	3 credits

Internal Marks: 40 External Marks: 60 Total Marks: 100

Course Outcomes:

At the end of this course, students will demonstrate the ability to:

CO 1	Understand the concepts of continuous time and discrete time systems.
CO 2	Analyse systems in complex frequency domain.
CO 3	Understand sampling theorem and its implications.
CO 4	Understand mathematical tools to be able to apply in state variable modeling

Module 1: Introduction to Signals and Systems (12 hours):

Signals and systems as seen in everyday life, and in various branches of engineering and science. Signal properties: periodicity, absolute integrability, determinism and stochastic character. Some special signals of importance: the unit step, the unit impulse, the sinusoid, the complex exponential, some special time-limited signals; continuous and discrete time signals, continuous and discrete amplitude signals. System properties: linearity: additivity and homogeneity, shift-invariance, causality, stability, realizability. Examples.

Module 2: Behavior of continuous and discrete-time LTI systems (12 hours)

Impulse response and step response, convolution, input-output behavior with aperiodic convergent inputs, cascade interconnections. Characterization of causality and stability of LTI systems. System representation through differential equations and difference equations. State-space Representation of systems. State-Space Analysis, Multi-input, multi-output representation. State Transition Matrix and its Role. Periodic inputs to an LTI system, the notion of a frequency response and its relation to the impulse response.

Module 3: Fourier, Laplace and z- Transforms (10 hours)

Fourier series representation of periodic signals, Waveform Symmetries, Calculation of Fourier Coefficients. Fourier Transform, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Fourier domain duality. The Discrete-Time Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT). Parseval's Theorem. Review of the Laplace Transform for continuous time signals and systems, system functions, poles and zeros of system functions and signals, Laplace domain analysis, solution to differential equations and system behavior. The z-Transform for discrete time signals and systems, system functions, poles and zeros of systems and sequences, z-domain analysis.

Module 4: Sampling and Reconstruction (8 hours)

The Sampling Theorem and its implications. Spectra of sampled signals. Reconstruction: ideal interpolator, zero-order hold, first-order hold. Aliasing and its effects. Relation between continuous and discrete time systems. Introduction to the applications of signal and system theory: modulation for communication, filtering, feedback control systems.

Text/References:

1. V. Oppenheim, A.S. Willsky & S.H. Nawab, "Signals and systems", Prentice Hall, 1997.
2. G. Proakis and D. G. Manolakis, "Digital Signal Processing: Principles, Algorithms, and Applications", Pearson, 2006.
3. P. Hsu, "Signals and systems", Schaum's series, McGraw Hill Education, 2010.
4. S. Haykin and B. V. Veen, "Signals and Systems", John Wiley and Sons, 2007.
5. A. V. Oppenheim and R. W. Schafer, "Discrete-Time Signal Processing", Prentice Hall,2009.
6. M. J. Robert "Fundamentals of Signals and Systems", McGraw Hill Education, 2007.
7. P. Lathi, "Linear Systems and Signals", Oxford University Press, 2009.

256

BTAM302-18	**Mathematics-III (Probability and Statistics)**	**L-3, T-1,P-0**	**4 Credits**
Internal Marks: 40 External Marks: 60 Total Marks: 100			
Pre-requisite: None			

Course Objectives: The objective of this course is to familiarize the student with statistical techniques. It aims to equip he students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling various problems in the discipline.

Course Outcomes: At the end of the course, the student will be able to

CO1	Have basics knowledge about measure of central tendency, skewness, kurtosis and moments and their applications in engineering fields.
CO2	Familiarize the student with expectations of discrete and continuous random variable.
CO3	Familiarize probability techniques and random variables and detailed knowledge of probability distribution with so as to use it with any date of engineering problem formulation.
CO4	Have basic idea about statistics including correlation, regression and then up to advanced level with testing of large samples that is important in solving problems related to engineering.
CO5	To fit the given data into curves by various methods which forms an important application in engineering .

Section A **(22 lectures)**

Unit I

Measures of Central tendency: Moments, skewness and Kurtosis, Variance, Probability, conditional probability, Discrete and Continuous random variables, Expectations of Discrete and Continuous random variables.

Unit II

Probability distributions: Binomial, Poisson and normal , Poisson approximation to the binomial distribution, evaluation of statistical parameters for these three distribution, Bivariate distributions and their properties.

Section B **(20 lectures)**

Unit III

Correlation and regression for bivariate data, Rank correlation, Curve fitting by the method of least square, fitting of straight lines , second degree parabolas and more general curve.

Unit IV

Test of significances: Sampling and standard error, Tests of significance for large samples and small samples (t-distribution, F-distribution), Chi-square test for goodness of fit and independence of attributes.

Suggestion Text/Reference Books

1. S.P. Gupta, Statistical Methods, Sultan Chand & Sons, 33^{rd} Edition, 2005.
2. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & sons, 2014.
3. S. Ross, A First Course in Probability, 6^{th} Edition, Pearons Education India, 2002.
4. N.P Bali and Mukesh Goyal, A text book of Engineering Mathematics , Laxmi Publications, Reprint, 2010.
5. Robert V. Hogg, Joseph W. Mekean and Allen T. Craig, Introduction to Mathematics Statistics, 7^{th} Edition, Pearsons, 2012.

257
255

BTEE-411-18	Measurements and Instrumentation Laboratory	2L:0T:2P	3 credits

Internal Marks: 30 External Marks: 20 Total Marks: 50

Course Outcomes:

At the end of this course, students will demonstrate the ability to:

CO 1	Design and validate DC and AC bridges.
CO 2	Analyze the dynamic response and the calibration of few instruments.
CO 3	Learn about various measurement devices, their characteristics, their operation and their limitations.
CO 4	Understand statistical data analysis.
CO 5	Understand computerized data acquisition.

Lectures/Demonstrations:

1. Concepts relating to Measurements: True value, Accuracy, Precision, Resolution, Drift, Hysteresis, Dead-band, Sensitivity.
2. Errors in Measurements. Basic statistical analysis applied to measurements: Mean, Standard Deviation, Six-sigma estimation, C_p, C_{pk}.
3. Sensors and Transducers for physical parameters: temperature, pressure, torque, flow. Speed and Position Sensors.
4. Current and Voltage Measurements. Shunts, Potential Dividers. Instrument Transformers, Hall Sensors.
5. Measurements of R, L and C.
6. Digital Multi-meter, True RMS meters, Clamp-on meters, Meggers.
7. Digital Storage Oscilloscope.

Experiments

1. Measurement of a batch of resistors and estimating statistical parameters.
2. Measurement of L using a bridge technique as well as LCR meter.
3. Measurement of C using a bridge technique as well as LCR meter.
4. Measurement of Low Resistance using Kelvin's double bridge.
5. Measurement of High resistance and Insulation resistance using Megger.
6. Usage of DSO for steady state periodic waveforms produced by a function generator. Selection of trigger source and trigger level, selection of time-scale and voltage scale. Bandwidth of measurement and sampling rate.
7. Download of one-cycle data of a periodic waveform from a DSO and use values to compute the RMS values using a C program.
8. Usage of DSO to capture transients like a step change in R-L-C circuit.
9. Current Measurement using Shunt, CT, and Hall Sensor.
10. Measurement of frequency using Wein's Bridge.
11. To find 'Q' of an inductance coil and verify its value using Q- meter.
12. Plotting of Hysteresis loop for a magnetic material using flux meter.

Note: A student to perform any 8-10 Experiments and make one minor working model project.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

258

BTEE-412-18	Digital Electronics Laboratory	0L:0T:2P	1 Credit

Internal Marks: 30 External Marks: 20 Total Marks: 50

Course Outcomes:

At the end of this course, students will demonstrate the ability to:

CO 1	To understand of basic electronic components and circuits
CO 2	Understanding verify truth tables of TTL gates
CO 3	Design and fabrication and realization of all gates and basic circuits
CO 4	Design the truth tables and basic circuits
CO 5	Testing of basic electronics circuits

Hands-on experiments related to the course contents of BTEE401-18

Note: A student to perform any 8-10 Experiments and make one working minor project.

Suggested List of Experiments:

1. Design a delay circuit using 555 timer and study the monostable, bistable and astable operations using 555.
2. a) Verification of the truth tables of TTL gates viz; 7400,7402, 7404, 7408,7432,7486.
   b) Design and fabrication and realization of all gates using NAND/NOR gates.
3. Verification of truth table of Mutiplexer(74150)/Demultiplexer(74154)
4. Design and verification of truth tables of half-adder, full-adder and subtractor circuits using gates 7483 and 7486(controlled inverter).
5. To study the operation of Arithmetic Logic Unit IC 74181.
6. Design fabrication and testing of
   a) Monostable multivibrator of t = 0.1ms approx. using 74121/123.testing for both positive and negative edge triggering, variation in pulse width and retriggering.
   b) Free running mutivibrator at 1KHz and 1Hz using 555 with 50% duty cycle. Verify the timing from theoretical calculations.
7. Design and test S-R flip-flop using NOR/NAND gates.
8. Design, fabricate and test a switch debouncer using 7400.
9. Verify the truth table of a JK flip flop using IC 7476,
10. Verify the truth table of a D flip flop using IC 7474 and study its operation in the toggle and asynchronous mode.
11. Operate the counters 7490, 7493 and 74193(Up/Down counting mode). Verify the frequency division at each stage. Using a frequency clock (say 1 Hz) display the count of LED's.
12. Verify the truth table of decoder driver7447/7448. Hence operate a 7 segment LED display through a counter using a low frequency clock. Repeat the above with the BCD to Decimal decoder 7442.

Head Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144603

259

BTEE-413-18	Electrical Machines-II Laboratory	0L:0T:2P	1 Credit

Internal Marks: 30 External Marks: 20 Total Marks: 50

Course Outcomes:

At the end of this course, students will demonstrate the ability to:

CO 1	Construct equivalent circuits induction motors by routine tests.
CO 2	Comprehend the requirement of starting and speed control methods of induction motors in the various applications of industry.
CO 3	Construct equivalent circuits of synchronous generator and motor.
CO 4	Apply knowledge to show utility of alternator, synchronous motors and synchronous condenser for various applications in power system.
CO 5	Construct characteristic curves for induction and synchronous machines
CO 6	Understand the concept of parallel operation of three phase alternators.

Hands-on experiments related to the course contents of BTEE402-18

Note: A student to perform any 8-10 Experiments and make one hardware/software based minor project.

Suggested List of Experiments:

1. To perform load-test on three-phase Induction motor and to plot torque versus speed characteristics.
   a) To perform no-load and blocked–rotor tests on three-phase Induction motor to obtain equivalent circuit.
   b) To develop an algorithm (Matlab/C/C++) for speed torque characteristics using calculated equivalent circuit parameters.
2. To study the speed control of three-phase Induction motor by Kramer's Concept.
3. To study the speed control of three-phase Induction motor by cascading of two induction motors, i.e. by feeding the slip power of one motor into the other motor.
4. To study star- delta starters physically and
   a) to draw electrical connection diagram
   b) to start the three-phase Induction motor using it.
   c) to reverse the direction of three-phase Induction motor
5. To start a three-phase slip –ring induction motor by inserting different levels of resistance in the rotor circuit and plot torque –speed characteristics.
6. To perform no-load and blocked–rotor test on single-phase Induction motor and to determine the parameters of equivalent circuit drawn on the basis of double revolving field theory.
7. To perform no load and short circuit. Test on three-phase alternator and draw open and short circuit characteristics.
8. To find voltage regulation of an alternator by zero power factor (ZPF.) method.
9. To study effect of variation of field current upon the stator current and power factor with synchronous motor running at no load and draw Voltage and inverted Voltage curves of motor.
10. Parallel operation of three phase alternators using
    (i) Dark lamp method (ii) Two-Bright and one dark lamp method
11. To study synchroscope physically and parallel operation of three-phase alternators using synchroscope.
12. Starting of synchronous motors using:
    (i) Auxiliary motor (ii) Using Damper windings

BTEE-414-18	Power Electronics Laboratory	0L:0T:2P	1 Credit
Internal Marks: 30	External Marks: 20	Total Marks: 50	

Course Outcomes:

At the end of this course, students will demonstrate the ability to:

CO 1	Understand the properties and characteristics of thyristors.
CO 2	Understand the different types of waveforms of inverter and chopper circuits.
CO 3	Analyze speed and direction control of single phase and three phase electric motors using ac and dc drive.
CO 4	Understand the effect of free-wheeling diode on pf with RL load.
CO 5	Check the performance of a choppers, and inverter.

Hands-on experiments related to the course contents of BTEE403-18

Note: A student to perform any 8-10 Experiments and make one hardware/software based minor project.

Suggested List of Experiments:

1. To plot V-I characteristics and study the effect of gate triggering on turning on of SCR.
2. To study the effect of free-wheeling diode on power factor for single phase half-wave rectifier with R-L load.
3. To plot waveforms for output voltage and current, for single phase full-wave, fully controlled bridge rectifier, for resistive and resistive cum inductive loads.
4. Study of the microprocessor-based firing control of a bridge converter.
5. To study three phase fully controlled bridge converter and plot waveforms of output voltage, for different firing angles.
6. To study Jones chopper or any chopper circuit to check the performance.
7. Thyristorised speed control of a D.C. Motor.
8. Speed Control of induction motor using thyristors.
9. Study of series inverter circuit and to check its performance.
10. Study of a single-phase cycloconverter.
11. To check the performance of a McMurray half-bridge inverter.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

261

BTEE-521-18	**Summer Industry Internship/ Field Training**	**(Non-Credit)**

Six weeks in an Industry in the area of Electrical Engineering. The summer internship should give exposure to the practical aspects of the discipline. In addition, the student may also work on a specified task or project which may be assigned to him/her. The outcome of the internship should be presented in the form of a report. The student will make a presentation based upon the Industry Internship attended. Performance to be rated as Satisfactory/Un -Satisfactory (S/US). For unsatisfactory the internship to be repeated.

Evaluation scheme (Summer Industry Internship/ Field Training)

Internal ***(to be evaluated by Industry)***	***Marks***	***External**** ***(to be evaluated by Department)***	***Marks***
Attendance	15	Daily Dairy	5
Performance (Work done /simulation/hardware/project developed)	30	Report	10
Report	10	Presentation (Work done /simulation/hardware/project developed)	25
Daily Dairy	05		
Total	***60***	***Total***	***40***

*External examiner not to be called.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

262

Mandatory Courses (non-credit)

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

263

BTMC-101-18	Indian Constitution	3L:0T:0P	0 credits

Internal Marks: 40 *External Marks: 60* *Total Marks: 100*

The Constitution of India is the supreme law of India. Parliament of India cannot make any law which violates the Fundamental Rights enumerated under the Part III of the Constitution. The Parliament of India has been empowered to amend the Constitution under Article 368, however, it cannot use this power to change the "basic structure" of the constitution, which has been ruled and explained by the Supreme Court of India in its historical judgments. The Constitution of India reflects the idea of "Constitutionalism" – a modern and progressive concept historically developed by the thinkers of "liberalism" – an ideology which has been recognized as one of the most popular political ideology and result of historical struggles against arbitrary use of sovereign power by state. The historic revolutions in France, England, America and particularly European Renaissance and Reformation movement have resulted into progressive legal reforms in the form of "constitutionalism" in many countries. The Constitution of India was made by borrowing models and principles from many countries including United Kingdom and America.

The Constitution of India is not only a legal document but it also reflects social, political and economic perspectives of the Indian Society. It reflects India's legacy of "diversity". It has been said that Indian constitution reflects ideals of its freedom movement, however, few critics have argued that it does nottruly incorporate our own

ancient legal heritage and cultural values. No law can be "static" and therefore the Constitution of India has also been amended more than one hundred times. These amendments reflect political, social and economic developments since the year 1950. The Indian judiciary and particularly the Supreme Court of India has played an historic role as the guardian of people. It has been protecting not only basic ideals of the Constitution but also strengthened the same through progressive interpretations of the text of the Constitution. The judicial activism of the Supreme Court of India and its historic contributions has been recognized throughout the world and it gradually made it "as one of the strongest court in the world".

Course content

1 Meaning of the constitution law and constitutionalism
2 Historical perspective of the Constitution of India
3 Salient features and characteristics of the Constitution of India
4 Scheme of the fundamental rights
5 The scheme of the Fundamental Duties and its legal status
6 TheDirectivePrinciplesofStatePolicy–Itsimportanceandimplementation
7 Federal structure and distribution of legislative and financial powers between the Union and the States
8 Parliamentary Form of Government in India – The constitution powers and status of the President of India
9 Amendment of the Constitutional Powers and Procedure
10 The historical perspectives of the constitutional amendments in India
11 Emergency Provisions : National Emergency, President Rule, Financial Emergency

264

12 Local Self Government – Constitutional Scheme in India
13 Scheme of the Fundamental Right to Equality
14 Scheme of the Fundamental Right to certain Freedom under Article19
15 ScopeoftheRighttoLifeandPersonalLibertyunderArticle21

Objectives: The objective of the course is to provide the basic knowledge about the Political System of the Country. The basic idea is to make the students aware of their duties and rights. Apart from it the course will aim to educate the pupils about the working of different organs of the government, various constitutional bodies and the agencies of the government. In addition to it, students will be given brief knowledge regarding the different challenges of Indian Political System, forms of Government in India and nature & dimensions of Indian Federal System.

Course Pedagogy: Since the course is of Practical Importance, it is recommended that during the course students will be taken out for one visit to any place with the potential of imparting practical knowledge to the students about the Indian Political System. Such places can be Indian Parliament. State Legislative Assembly, Youth Parliament Pune. It is expected that students should be given case studies about the Indian Political System and Debates on Constitutional Issues should be organised in the campus.

Course Outcome: After the successful completion of the course students will be to understand the different dimensions of Indian Political System. They will be aware about their duties towards the fellow citizens. Students will be able to challenges of the democratic institutions and theoretical aspects of the state and its organs.

Suggested Reading:

1. Indian Political System by J C Johri
2. Indian Political System by Mahendra Prasad Singh
3. Fundamentals of Indian Political System by Rajesh K Jha
4. Our Constitution by Subhash C Kashyap
5. Our Political System by Subhash C Kashyap
6. Indian Federalism – An Introduction by Mahendra Prasad Singh
7. Indian Federalism and Autonomy by S Chandrasekhar

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144603

265

BTMC-102-18	Essence of Indian Traditional Knowledge	3L:0T:0P	0 credits

Internal Marks: 40 *External Marks: 60* *Total Marks: 100*

Part-1

Course objective

The course aims at imparting basis principals of thought process. Reasoning and inferencing Sustainability is at the core of Indian Traditional Knowledge Systems connecting society and nature. Holistic life style of yogic science and wisdom capsules in Sanskrit Literature are also important in modern society with rapid technological advancements and societal disruptions Part-1 focuses on introduction to Indian Knowledge System. Indian perspective of modern scientific world -view and basis principal of Yoga and holistic health care system.

Course contents

i. Basic Structure of Indian Knowledge system
ii. Modern Science and Indian Knowledge system
iii. Yoga and Holistic Health Care
iv. Case studies

References

- Fritzof Capra Too of Physics
- Fritzof Capra The Wave of life
- Yoga Sutra of Patanjali. Ramakrishna Mission. Kolkata.
- RN Jha Science of Consciousness Psychotherapy and Yoga Practices. Vidyanidhi Prakashan. Delhi2016
- PB Sharma (English translation) ShodashangHridayam

Pedagogy: Problem based learning, group discussion, collaborative mini projects
Outcome: Ability to understand connect up and explain basics of Indian traditional Knowledge in Modern scientific perspective.

Part-2

Course objective

The course aims at imparting basis principals of thought process. Reasoning and inferencing Sustainability is at the core of Indian Traditional Knowledge Systems connecting society and nature. Holistic life style of yogic science and wisdom capsules in Sanskrit Literature are also important in modern society with rapid technological advancements and societal disruptions Part-2 focuses on Indian philosophical traditions. Indian linguistic Tradition, and Indian artistic tradition.

Course contents

i. Philosophical Tradition
ii. Indian Linguistic Tradition (Phonology, morphology, syntax and semantics)
iii. Indian Artistic Tradition
iv. Case studies

References

- V.Sivaramakrishnan (Ed.), Cultural Heritage of India-Course material, Bhartiya Vaidya Bhawan Mumbai 5th Edition 2014
- S.C Chaterjee &D.M .Datta , An introduction to Indian Philosophy ,University of Calcutta 1984

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

- KS SubrahmaniaIyer ,Vakyapadiya of Bhattaraihari (Brahma Kanda), Deccan College Pune 1965
- VN Jha, Language Thought and Reality
- Pramod Chandra. India Arts Howard Univ. Press 1983
- Krishna Chaitanya Arts of India. Abhinav Publications. 1987
- R Nagaswamy , Foundations of Indian Art Tamil Arts Academy.2002

Pedagogy: Problem based learning, group discussion, collaborative mini projects
Outcome: Ability to understand connects up and explain basics of Indian traditional Knowledge in Modern scientific perspective.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

267

SEMESTER: V
[Third Year]

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

268

BTEE-501-18	Power Systems-I (Apparatus and Modelling)	3L:1T:0P	Credits:4

Internal Marks: 40 *External Marks: 60* *Total Marks: 100*

Course Outcomes:

At the end of this course, students will demonstrate the ability to:

CO 1 Understand the concepts of power systems.

CO 2 Understand the various power system components.

CO 3 Evaluate fault currents for different types of faults.

CO 4 Understand the generation of over-voltages and insulation coordination.

CO 5 Understand basic protection schemes.

CO 6 Understand concepts of HVDC power transmission and renewable energy generation.

Module 1: Basic Concepts (4 hours)

Evolution of Power Systems and Present-Day Scenario. Structure of a power system: Bulk Power Grids and Micro-grids.

Generation: Conventional and Renewable Energy Sources. Distributed Energy Resources. Energy Storage. Transmission and Distribution Systems: Line diagrams, transmission and distribution voltage levels and topologies (meshed and radial systems). Synchronous Grids and Asynchronous (DC) interconnections. Review of Three-phase systems. Analysis of simple three-phase circuits. Power Transfer in AC circuits and Reactive Power.

Module 2: Power System Components (15 hours)

Overhead Transmission Lines and Cables: Electrical and Magnetic Fields around conductors, Corona. Parameters of lines and cables. Capacitance and Inductance calculations for simple configurations. Travelling-wave Equations. Sinusoidal Steady state representation of Lines: Short, medium and long lines. Power Transfer, Voltage profile and Reactive Power. Characteristics of transmission lines. Surge Impedance Loading. Series and Shunt Compensation of transmission lines.

Synchronous Machines: Steady-state performance characteristics. Operation when connected to infinite bus. Real and Reactive Power Capability Curve of generators. Typical waveform under balanced terminal short circuit conditions – steady state, transient and sub-transient equivalent circuits. Loads: Types, Voltage and Frequency Dependence of Loads. Per-unit System and per-unit calculations.

Module 3: Over-voltages and Insulation Requirements (4 hours)

Generation of Over-voltages: Lightning and Switching Surges. Protection against Over-voltages, Insulation Coordination. Propagation of Surges. Voltages produced by traveling surges. Bewley Diagrams.

Module 4: Fault Analysis and Protection Systems (10 hours)

Method of Symmetrical Components (positive, negative and zero sequences). Balanced and Unbalanced Faults. Representation of generators, lines and transformers in sequence networks. Computation of Fault Currents. Neutral Grounding. Types of Circuit Breakers. Attributes of Protection schemes, Back-up Protection. Protection schemes (Over-current, directional, distance protection, differential protection) and their application.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144603

Module 5: Introduction to DC Transmission & Renewable Energy Systems (9 hours)

DC Transmission Systems: Line-Commutated Converters (LCC) and Voltage Source Converters (VSC) based dc link, Real Power Flow control in a dc link. Comparison of ac and dc transmission. Solar PV systems: I-V and P-V characteristics of PV panels, power electronic interface of PV to the grid. Wind Energy Systems: Power curve of wind turbine. Fixed and variable speed turbines.

Text/References:

1. J.S. Dhillon I.J. Nagrath and D.P. Kothari, Power System Engineering, 3rd Edition, McGraw Hill Education (India) Private Ltd., 2019
2. D.P. Kothari and J. S. Dhillon, Power System Optimization, 2nd edition, Prentice Hall of India Pvt. Ltd.,New Delhi, 2011, ISBN -978-81-203-4085-5.
3. J. Grainger and W. D. Stevenson, "Power System Analysis", McGraw Hill Education, 1994.
4. O. I. Elgerd, "Electric Energy Systems Theory", McGraw Hill Education, 1995.
5. A. R. Bergen and V. Vittal, "Power System Analysis", Pearson Education Inc., 1999.
6. D. P. Kothari and I. J. Nagrath, "Modern Power System Analysis", McGraw Hill Education, 2003.
7. B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, "Electric Power Systems", Wiley, 2012.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

270

BTEE-502-18	Control Systems	3L:1T:0P	4 credits

Internal Marks: 40 *External Marks: 60* *Total Marks: 100*

Course Outcomes:

At the end of this course, students will demonstrate the ability to

CO 1 Understand the modelling of linear-time-invariant systems using transfer function and state-space representations.

CO 2 Understand the concept of stability and its assessment for linear-time invariant systems. Design simple feedback controllers.

Module 1: Introduction to control problem (4 hours)

Industrial Control examples. Control hardware and their models. Transfer function models of linear time-invariant systems.

Feedback Control: Open-Loop and Closed-loop systems. Benefits of Feedback. Block diagram algebra.

Module 2: Time Response Analysis (10 hours)

Standard test signals. Time response of first and second order systems for standard test inputs. Application of initial and final value theorem. Design specifications for second-order systems based on the time-response.

Concept of Stability. Routh-Hurwitz Criteria. Relative Stability analysis. Root-Locus technique. Construction of Root-loci.

Module 3: Frequency-response analysis (6 hours)

Relationship between time and frequency response, Polar plots, Bode plots. Nyquist stability criterion. Relative stability using Nyquist criterion – gain and phase margin. Closed-loop frequency response.

Module 4: Introduction to Controller Design (10 hours)

Stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness of control systems.

Root-loci method of feedback controller design.

Design specifications in frequency-domain. Frequency-domain methods of design.

Module 5: State variable Analysis (6 hours)

Concepts of state variables. State space model. Diagonalization of State Matrix. Solution of state equations. Eigenvalues and Stability Analysis. Concept of controllability and observability. Pole-placement by state feedback.

Discrete-time systems. Difference Equations. State-space models of linear discrete-time systems. Stability of linear discrete-time systems.

Module 6: Introduction to Optimal Control and Nonlinear Control (5 hours) Performance Indices. Regulator problem, Tracking Problem. Nonlinear system–Basic concepts.

Text/References:

1. M. Gopal, "Control Systems: Principles and Design", McGraw Hill Education, 1997.
2. B. C. Kuo, "Automatic Control System", Prentice Hall, 1995.
3. K. Ogata, "Modern Control Engineering", Prentice Hall, 1991.
4. I. J. Nagrath and M. Gopal, "Control Systems Engineering", New Age International, 2009.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144603

271

BTEE-503-18	Microprocessors	3L:1T:0P	4 credits

Internal Marks: 40 *External Marks: 60* *Total Marks: 100*

Course Outcomes:

At the end of this course, students will demonstrate the ability to:

CO 1 Study of 8085 and 8086 Microprocessors.

CO 2 Do assembly language programming.

CO 3 Do interfacing design of peripherals like 8255, 8253,8279,8251 etc.

CO 4 Develop systems using different microprocessors.

Module 1: Fundamentals of Microprocessors: (3 Hours)

Digital Computers: General architecture and brief description of elements, programming system, Buses and CPU Timings. Microprocessor and Microprocessor Development Systems: Evolution of Microprocessor, memory, data transfer schemes, architecture advancements of microprocessors, typical microprocessor development system, higher lever languages.

Module 2: The 8085 Architecture (10 Hours)

Microprocessor architecture and its operations, Pin configuration, internal architecture. Timing & Signals: control and status, interrupt: ALU, machine cycles, Instruction format, op-codes, mnemonics, number. of bytes, Instruction Set of 8085: Addressing Modes: Register addressing, direct addressing; register indirect addressing, immediate addressing, and implicit addressing. RTL, variants, number. of machine cycles and T states, addressing modes. Instruction Classification: Data transfer, arithmetic operations, logical operations, branching operation, machine control; Writing assembly Language programs, Assembler directives.

Module 3: The 8086 Architecture (9 Hours)

8086 Microprocessors: Architecture: Architecture of INTEL 8086 (Bus Interface Unit, Execution unit), register organization, memory addressing, memory segmentation, Operating Modes Instruction Set of 8086 Addressing Modes: Instruction format: Discussion on instruction Set: Groups: data transfer, arithmetic, logic string, branch control transfer, processor control. Interrupts: Hardware and software interrupts, responses and types.

Module4: Fundamental of Programming (9 Hours)

Development of algorithms, flowcharts in terms of structures ,(series, parallel, if-then-else etc.) Assembler Level Programming: memory space allocation (mother board and user program) Assembler level programs (ASMs) .

Module 5: Peripheral memory and I/O Interfacing (8 Hours)

Interfacing devices, Interfacing of Memory, Programmed I/O, Interrupt Driven I/O, memory I/O, 8255- Programmable peripheral interface, 8253/8254 Programmable timer/counter. 8259 programmable Interrupt Controller, 8251- USART

Text / References:

1. Gaonkar, Ramesh S, "Microprocessor Architecture, programming and applications with the 8085" Pen ram International Publishing 5th Ed.
2. Uffenbeck, John, "Microcomputers and Microprocessors" PHI/ 3rd Edition.
3. Ray, A.K. & Burchandi, K.M., "Advanced Microprocessors and Peripherals: Architecture, Programaming and Interfacing" Tata Mc. Graw Hill.

272

4. Krishna Kant, "Microprocessors and Microcontrollers" PHI Learning.
5. Brey, Barry B. "INTEL Microprocessors" Prentice Hall (India)
6. ADitya P Mathur, "Introduction to Microprocessor" Tata Mc Graw Hill
7. M. Rafiquzzaman, "Microprocessors- Theory and applications" PHI
8. B. Ram, "Advanced Microprocessor & Interfacing" Tata McGraw Hill
9. Renu Singh & B.P.Singh, "Microprocessor and Interfacing and applications" New Age International 10. N. Senthil Kumar, "Microprocessors and Microcontroller", Oxford University Press.
10. Liu and Gibson G.A., "Microcomputer Systems: The 8086/8088 Family" Prentice Hall (India)

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

273

Semester	Programme Elective	Course Code	Course Title	Hrs/week	Credits
V (odd)	PE-1	BTEE-504A-18	Electrical Engineering Materials	3L:0T:0P	3
V (odd)	PE-1	BTEE-504B-18	Switchgear and Protection	3L:0T:0P	3
V (odd)	PE-1	BTEE-504C-18	Electrical Machine Design	3L:0T:0P	3
V (odd)	PE-1	BTEE-504D-18	Renewable Energy Sources	3L:0T:0P	3

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144008

274

BTEE-504A-18	Electrical Engineering Materials	3L:0T:0P	3 credits

Internal Marks: 40 *External Marks: 60* *Total Marks: 100*

Course Outcomes:

CO 1 To Understand the basic concepts of materials.
CO 2 To use simplified materials selection concepts for design purposes.
CO 3 To Understand the properties of Materials.

Module I: Elementary Materials Science Concepts (8 hours)

Bonding and types of solids, Crystalline state and their defects, Classical theory of electrical and thermal conduction in solids, temperature dependence of resistivity, skin effect, Hall effect.

Module II: Conductivity of Metal (8 hours)

Introduction, factors affecting the resistivity of electrical materials, motion of an electron in an electric field, Equation of motion of an electron, current carried by electrons, mobility, energy levels of a molecule, emission of electrons from metals, thermionic emission, photo electric emission, field emission, effect of temperature on electrical conductivity of metals, electrical conducting materials, thermal properties, thermal conductivity of metals, thermoelectric effects.

Module III: Magnetic properties of Materials (8 hours)

Introduction, Classification of magnetic materials, diamagnetism, paramagnetism, ferromagnetism, magnetization curve, the hysteresis loop, factors affecting permeability and hysteresis loss, common magnetic materials, magnetic resonance.

Module IV: Dielectric Properties (8 hours)

Introduction, effect of a dielectric on the behavior of a capacitor, polarization, the dielectric constant of monatomic gases, frequency dependence of permittivity, dielectric losses, significance of the loss tangent, dipolar relaxation, frequency and temperature dependence of the dielectric constant, dielectric properties of polymeric system, ionic conductivity in insulators, insulating materials, ferroelectricity, piezoelectricity.

Module V: Semiconductors (8 hours)

Energy band in solids, conductors, semiconductors and insulators, types of semiconductors, Intrinsic semiconductors, impurity type semiconductor, diffusion, the Einstein relation, hall effect, thermal conductivity of semiconductors, electrical conductivity of doped materials.

Text Books:

1. Adrianus J Dekker,Electrical Engineering Materials,PHI Learning Publishers.
2. L. Solymar, Electrical Properties of Materials, 8th Edition by Oxford University Press New Delhi.
3. C Indulkar, Introduction to Electrical Engineering Materials 4th Edn. 2004 Edition by, S. Chand & Company Ltd-New Delhi.
4. SK Bhattacharya, Electrical and Electronic Engineering Materials, Khanna Publishers, New Delhi.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

275

BTEE-504B-18	Switchgear and Protection	3L:0T:0P	3 credits

Internal Marks: 40 *External Marks: 60* *Total Marks: 100*

Course Outcomes:

At the end of this course, students will demonstrate the ability to:

CO 1 Understand power system protection.

CO 2 Understand the main components used in power system protection for electric machines, transformers.

CO 3 Understand the bus bars, overhead and underground feeders.

CO 4 Understand the earthing protection.

Module 1: Electrical Switchgear

Fundamentals and Types of Circuit Breakers, Gaseous Discharges and Ionization Process in a Gaseous Insulating Medium, decay Process, Quenching of AC Arc, Arc Interruption Theories, Fuse-types, Rating, Selection, theory and characteristics, application, Factors Affecting RRRV, Re-Striking Voltage and Recovery Voltage, Resistance Switching, Quenching of DC Arc, High-Voltage AC Circuit Breakers, High-Voltage DC (HVDC) Circuit Breakers, Isolators.

Module 2: Protective Relaying System

Basics terminology and operating principle of Relays, Functions of Protective Relay Schemes, Basic Tripping Circuit with System Transducers, Zones of Protection, Requirements of a Protective System, Relay Operating Criteria, Main and Back-Up Protection.

Relays: Introduction, classification, constructional features; and Characteristics of Electromagnetic, Induction, Thermal, Overcurrent relays, Directional relays, Distance relays, Differential, Negative sequence relay, introduction to static and up-based relays.

Static Relays: Introduction, Basic Elements & Classification of Static Relays, Advantages and limitations of Static Relays.

Module 3: Power Apparatus Protection

Generator Protection: Generators faults, Differential Protection, Inter-Turn Fault Protection, Stator Earth-Fault Protection, Rotor Earth-Fault Protection, Negative Phase Sequence Protection (Protection Against Unbalanced Loading), Field Failure Protection (Protection Against Loss of Excitation), Overload Protection, Overvoltage Protection, Reverse Power Protection, Under-Frequency Protection.

Transformer Protection: Faults in Transformers, Gas-Operated Relays, Overcurrent Protection, Restricted Earth-Fault Protection, Differential Protection, Protection Against Over fluxing, Protection of Grounding Transformers, Protection Against Overheating

Module 4: Protection of Feeders and Transmission line:

Protection of Feeders: Basic Radial Feeder, Methods of Discrimination, Time and current protection, different pilot wire protection of feeders, current balance differential protection, Differential and Distance protection of feeders, choice between Impedance, Reactance and Mho relays.

Protection of Transmission Lines: Overcurrent Relays, Rules for Setting the IDMT Relays, Distance Relays: Stepped Distance Characteristics of a Distance Relay, Elementary idea about carrier current protection of lines, Quantities to be Fed to Distance Relays

276

Head
Department of Electrical Engineering

Module 5: Bus Zone, Over voltage and Earthing Protection:
Bus-zone protection: Introduction, Bus-bar arrangements, Bus-zones faults, Protection Requirements, Fault-bus and backup protection of bus-bars, Non-Unit Protection by Back-up Relays, Unit Protection Schemes.
Protection against over voltage and earthing: Ground wires, Rod gap, Impulse gap, Valve type and Metal Oxide Arresters, Line Arrester/Surge Absorber. Ungrounded neutral system, Grounded neutral system and Selection of Neutral Grounding.

Text Books

1. B. A. Oza, Nirmal Kumar, C. Nair, R. P. Mehta, V. H. Makwana, Power System Protection & Switchgear, 1st Edition, Mc Graw Hill
2. Badri Ram, D. N. Vishwakarma, Power System Protection and Switchgear, Mc Graw Hill
3. Power System Protection and Switchgear by Wiley, John Wiley & Sons Canada, Limited,
4. Sunil S. Rao, Switchgear and Protection, 8th Edition, Khanna Book Publications
5. Handbook on switchgears, Bharat Heavy Electrical Limited

BTEE-504C-18	Electrical Machine Design	3L:0T:0P	3 credits

Internal Marks: 40 *External Marks: 60* *Total Marks: 100*

Course Outcomes:

At the end of this course, students will demonstrate the ability to

CO 1 Understand the construction and performance characteristics of electrical machines.

CO 2 Understand the various factors which influence the design: electrical, magnetic and thermal loading of electrical machines

CO 3 Understand the principles of electrical machine design and carry out a basic design of an ac machine.

CO 4 Use software tools to do design calculations.

Module 1: Introduction

Major considerations in electrical machine design, electrical engineering materials, space factor, choice of specific electrical and magnetic loadings, thermal considerations, heat flow, temperature rise, rating of machines.

Module 2: Transformers

Sizing of a transformer, main dimensions, kVA output for single- and three-phase transformers, window space factor, overall dimensions, operating characteristics, regulation, no load current, temperature rise in transformers, design of cooling tank, methods for cooling of transformers.

Module 3: Induction Motors

Sizing of an induction motor, main dimensions, length of air gap, rules for selecting rotor slots of squirrel cage machines, design of rotor bars & slots, design of end rings, design of wound rotor, magnetic leakage calculations, leakage reactance of polyphase machines, magnetizing current, short circuit current, circle diagram, operating characteristics.

Module 4: Synchronous Machines

Sizing of a synchronous machine, main dimensions, design of salient pole machines, short circuit ratio, shape of pole face, armature design, armature parameters, estimation of air gap length, design of rotor, design of damper winding, determination of full load field mmf, design of field winding, design of turbo alternators, rotor design.

Module 5: Computer aided Design (CAD):

Limitations (assumptions) of traditional designs, need for CAD analysis, synthesis and hybrid methods, design optimization methods, variables, constraints and objective function, problem formulation. Introduction to FEM based machine design. Introduction to complex structures of modern machines-PMSMs, BLDCs, SRM and claw-pole machines.

Text / References:

1. A. K. Sawhney, "A Course in Electrical Machine Design", Dhanpat Rai and Sons, 1970.
2. M.G. Say, "Theory & Performance & Design of A.C. Machines", ELBS London.
3. S. K. Sen, "Principles of Electrical Machine Design with computer programmes", Oxford and IBH Publishing, 2006.
4. K. L. Narang, "A Text Book of Electrical Engineering Drawings", SatyaPrakashan, 1969.

5. A. Shanmugasundaram, G. Gangadharan and R. Palani, "Electrical Machine Design Data Book", New Age International, 1979.
6. K. M. V. Murthy, "Computer Aided Design of Electrical Machines", B.S. Publications, 2008.
7. Electrical machines and equipment design exercise examples using Ansoft's Maxwell 2D machine design package.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

279

BTEE-504D-18	Renewable Energy Sources	3L:0T:0P	3 credits

Internal Marks: 40 *External Marks: 60* *Total Marks: 100*

Course Outcomes:

CO 1 To Understand the Need, importance and scope of non-conventional and alternate energy resources.
CO 2 To understand role significance of solar energy and wind energy
CO 3 To understand the role of ocean energy in the Energy Generation.
CO 4 To get the utilization of Biogas plants and geothermal energy
CO 5 To understand the concept of energy Conservation

Module I: Introduction (6 hours)

Causes of Energy Scarcity, Solution to Energy Scarcity, Factors Affecting Energy Resource Development, Energy Resources and Classification, Renewable Energy – Worldwide Renewable Energy Availability, Renewable Energy in India.

Energy from Sun: Sun- earth Geometric Relationship, Layer of the Sun, Earth – Sun Angles and their Relationships, Solar Energy Reaching the Earth's Surface, Solar Thermal Energy Applications

Module II: Solar Thermal Energy Collectors (8 hours)

Types of Solar Collectors, Configurations of Certain Practical Solar Thermal Collectors, Material Aspects of Solar Collectors, Concentrating Collectors, Parabolic Dish – Stirling Engine System, Working of Stirling or Brayton Heat Engine, Solar Collector Systems into Building Services, Solar Water Heating Systems, Passive Solar Water Heating Systems, Applications of Solar Water Heating Systems, Active Solar Space Cooling, Solar Air Heating, Solar Dryers, Crop Drying, Space Cooing, Solar Cookers, Solar pond.

Solar Cells: Components of Solar Cell System, Elements of Silicon Solar Cell, Solar Cell materials, Practical Solar Cells, I – V Characteristics of Solar Cells, Efficiency of Solar Cells, Photovoltaic Panels, Applications of Solar Cell Systems

Module III Hydrogen and Wind Energy (10 hours)

Hydrogen Energy: Benefits of Hydrogen Energy, Hydrogen Production Technologies, Hydrogen Energy Storage, Use of Hydrogen Energy, Advantages and Disadvantages of Hydrogen Energy, Problems Associated with Hydrogen Energy.

Wind Energy: Windmills, Wind Turbines, Wind Resources, Wind Turbine Site Selection.

Geothermal Energy: Geothermal Systems, Classifications, Geothermal Resource Utilization, Resource Exploration, Geothermal Based Electric Power Generation, Associated Problems, environmental Effects

Solid waste and Agricultural Refuse: Waste is Wealth, Key Issues, Waste Recovery Management Scheme, Advantages and Disadvantages of Waste Recycling, Sources and Types of Waste, Recycling of Plastics

Module IV: Biomass and Biogas Energy (12 hours)

Biomass Energy: Biomass Production, Energy Plantation, Biomass Gasification, Theory of Gasification, Gasifier and Their Classifications, Chemistry of Reaction Process in Gasification, Updraft, Downdraft and Cross-draft Gasifiers, Fluidized Bed Gasification, Use of Biomass Gasifier/Gasifier Biomass Feed Characteristics, Applications of Biomass Gasifier, Cooling and Cleaning of Gasifiers.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical Uni
Kapurthala-144603

280

Biogas Energy: Introduction, Biogas and its Composition, Anaerobic Digestion, Biogas Production, Benefits of Biogas, Factors Affecting the Selection of a Particular Model of a Biogas Plant, Biogas Plant Feeds and their Characteristics.
Tidal Energy: Introduction, Tidal Energy Resource, Tidal Energy Availability, Tidal Power Generation in India, Leading Country in Tidal Power Plant Installation, Energy Availability in Tides, Tidal Power Basin, Turbines for Tidal Power, Advantages and Disadvantages of Tidal Power, Problems Faced in Exploiting Tidal Energy.

Module V: Sea Wave and Ocean Thermal Energy (8 hours)
Introduction, Motion in the sea Waves, Power Associated with Sea Waves, Wave Energy Availability, Devices for Harnessing Wave Energy, Advantages and Disadvantages of Wave Power.
Ocean Thermal Energy: Introduction, Principles of Ocean Thermal Energy Conversion (OTEC), Ocean Thermal Energy Conversion plants, Basic Rankine Cycle and its Working, Closed Cycle, Open Cycle and Hybrid Cycle, Carnot Cycle, Application of OTEC in Addition to Produce Electricity, Advantages, Disadvantages and Benefits of OTEC.

Text Books:

1. Reneweble energy resources: Tiwari and ghosal, Narosa publication.
2. Non conventional Energy Sources,Khanna Publication
3. Renewable Energy Sources:Twidell& Weir, CRC Press.
4. Solar Energy/ S.P. Sukhatme, Tata McGraw-Hill.
5. Non Conventional Energy Systems: K M. Mittal, A H Wheeler Publishing Co Ltd.
6. Renewable Energy Technologies: Ramesh & Kumar, Narosa publication.
7. Biomass Energy, Oxford &IBH Publication Co.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

281

EVS-101-18	Environmental Studies	2L:0T:0P (Contact hours 21)	0 credits

Internal Marks: 40 *External Marks: 60* *Total Marks: 100*

*** 40 Hours are kept for various activities under the head of activities. There will be a final theory examination for the students of 50 marks but these marks will not be added to their final result as assessment will be satisfactory or non-satisfactory.**

Course Outcomes:

CO 1 Students will enable to understand environmental problems at local and national level through literature and general awareness.

CO 2 The students will gain practical knowledge by visiting wildlife areas, environmental institutes and various personalities who have done practical work on various environmental Issues.

CO 3 The students will apply interdisciplinary approach to understand key environmental issues and critically analyze them to explore the possibilities to mitigate these problems.

CO 4 Reflect critically about their roles and identities as citizens, consumers and environmental actors in a complex, interconnected world

Environment Science (Mandatory non-credit course)

We as human being are not an entity separate from the environment around us rather we are a constituent seamlessly integrated and co-exist with the environment around us. We are not an entity so separate from the environment that we can think of mastering and controlling it rather we must understand that each and every action of ours reflects on the environment and vice versa. Ancient wisdom drawn from Vedas about environment and its sustenance reflects these ethos. There is a direct application of this wisdom even in modern times. Idea of an activity based course on environment protection is to sensitize the students.

Detailed Contents

Module 1: Natural Resources : Renewable and non-renewable resources

Natural resources and associated problems.

a) Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people.
b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.
c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.
d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.
e) Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies.
f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

- Role of an individual in conservation of natural resources.
- Equitable use of resources for sustainable lifestyles.

Module 2: Ecosystems

Concept of an ecosystem. Structure and function of an ecosystem.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical U...
Kapurthala

80
287

Students to undertake Six Weeks Summer Industry Internship (during vacation).

Semester V [Third year]						Branch: Electrical Engineering				
Sr. No.	**Course code**	**Course Title**	**L**	**T**	**P**	**Hours/ Week**	**Internal Marks**	**External Marks**	**Total Marks**	**Credits**
1	BTEE-501-18	Power Systems – I (Apparatus & Modelling)	3	1	0	4	40	60	100	4
2	BTEE-502-18	Control Systems	3	1	0	4	40	60	100	4
3	BTEE-503-18	Microprocessors	3	1	0	4	40	60	100	4
4	BTEE-601X-18	Programme Elective-1	3	0	0	3	40	60	100	3
5	EVS-101-18	Environmental Studies	2	0	0	2	50	-	50	S/US
6	BTEE-511-18	Power Systems-I Laboratory	0	0	2	2	30	20	50	1
7	BTEE-512-18	Control Systems Laboratory	0	0	2	2	30	20	50	1
8	BTEE-513-18	Microprocessors Laboratory	0	0	2	2	30	20	50	1
9	BTEE-521-18	Summer Industry Internship	-	-	-	-	40	60	100	S/US
10	BMPD-501-18	Mentoring and Professional Development of Students	0	1	0	1	50	-	50	S/US
		Total	**14**	**4**	**6**	**24**	**390**	**360**	**750**	**18**

Semester VI [Third year]						Branch: Electrical Engineering				
Sr. No.	**Course code**	**Course Title**	**L**	**T**	**P**	**Hours/ Week**	**Internal Marks**	**External Marks**	**Total Marks**	**Credits**
1	BTEE-601-18	Power System-II (Operation and Control)	3	1	0	4	40	60	100	4
2	BTEE-602-18	Power Generation and Economics	3	1	0	4	40	60	100	4
3	BTEE-603X-18	Programme Elective-2	3	0	0	3	40	60	100	3
4	BTEE-604-18	Programme Elective-3	3	0	0	3	40	60	100	3
5	OXX-XXX-18	Open Elective-1	3	0	0	3	40	60	100	3
6	HSMC-XXX-18	Humanities & Social Sciences including Mgt.	3	0	0	3	40	60	100	3
7	BTEE-611-18	Electronic Design Laboratory	1	0	2	3	30	20	50	2
8	BTEE-612-18	Power Systems-II Laboratory	0	0	2	2	30	20	50	1
9	BTEE-621-18	Project-1	0	0	6	6	60	40	100	3
10	BMPD-601-18	Mentoring and Professional Development of Students	0	1	0	1	50	-	50	S/US
		Total	**19**	**3**	**10**	**32**	**410**	**440**	**850**	**26**

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144603

283

Semester VII/VIII [Fourth year]					Branch: Electrical Engineering					
Sr. No.	**Course code**	**Course Title**	**L**	**T**	**P**	**Hours/ Week**	**Internal Marks**	**External Marks**	**Total Marks**	**Credits**
1	BTEE-701X-18	Programme Elective-4	3	0	0	3	40	60	100	3
2	BTEE-702X-18	Programme Elective-5	3	0	0	3	40	60	100	3
3	BTOE-703X-18	Programme Elective-6	3	0	0	3	40	60	100	3
4	OXX-XXX-18	Open Elective-2	3	0	0	3	40	60	100	3
5	OXX-XXX-18	Open Elective-3	3	0	0	3	40	60	100	3
6	HSMC-XXX-18	Humanities & Social Sciences including Mgt.	3	0	0	3	40	60	100	3
7	BTEE-721-18	Project-2	0	0	12	12	120	80	200	6
8	BMPD-701-18	Mentoring and Professional Development of Students	-	1	0	1	50	-	50	S/US
Total			**18**	**1**	**12**	**31**	**410**	**440**	**850**	**24**

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

284

Institute/Department/Student may decide for Industry oriented courses in lieu of One Semester Training in 7th or 8th Semester (Subject to approval from Competent Authority).

Semester VII/VIII [Fourth year]					**Branch: Electrical Engineering**		
BTEE-721-18 One Semester Training	**Marks**					**Total Marks**	**Credits**
	Internal				**External**		
	Mid- semester		End-semester				
Evaluation by	***Institute***	***Industry***	***Institute***	***Industry***	***External Examiner***		
Software Training & Project	50	25	50	25	200	500	16
Industrial Training & Project	50	25	50	25			
Total	**300**				**200**	**500**	**16**

or

Semester VII/VIII [Fourth year]						**Branch: Electrical Engineering**				
Sr. No.	**Course code**	**Course Title**	**L**	**T**	**P**	**Hours/ Week**	**Internal Marks**	**External Marks**	**Total Marks**	**Credits**
1	BTEE-801-18	Smart Grids	3	0	0	3	40	60	100	3
2	BTEE-802-18	Artificial Intelligence Techniques	3	0	0	3	40	60	100	3
3	BTEE-803-18	Indian Electricity Standards and Practices	3	1	0	4	40	60	100	4
4	BTEE-811-18	Modelling and Simulation Lab	0	0	4	4	30	20	50	2
5	BTEE-812-18	Technical Report Writing and Presentation	0	0	8	8	60	40	100	4
6	BMPD-801-18	Mentoring and Professional Development of Students	-	1	0	1	50	-	50	S/US
Total			**9**	**2**	**12**	**23**	**260**	**240**	**500**	**16**

or

Students may obtain relevant credits through MOOCS/SWAYAM Courses

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

PROFESSIONAL CORE COURSES [ELECTRICAL ENGINEERING] (also Core Courses for Minor Degree of B. Tech. (Electrical Engineering)										
Sem.	**Course code**	**Course Title**	**L**	**T**	**P**	**Hours/ Week**	**Internal Marks**	**External Marks**	**Total Marks**	**Credits**
Odd	BTEE-301-18	Electrical Circuit Analysis	3	1	0	4	40	60	100	4
Odd	BTEE-302-18	Analog Electronics	3	0	0	3	40	60	100	3
Odd	BTEE-311-18	Analog Electronics Laboratory	0	0	2	2	30	20	50	1
Odd	BTEE-303-18	Electrical Machines – I	3	0	0	3	40	60	100	3
Odd	BTEE-312-18	Electrical Machines – I Laboratory	0	0	2	2	30	20	50	1
Odd	BTEE-304-18	Electromagnetic Fields	3	1	0	4	40	60	100	4
Even	BTEE-401-18	Digital Electronics	3	0	0	3	40	60	100	3
Even	BTEE-412-18	Digital Electronics Laboratory	0	0	2	2	30	20	50	1
Even	BTEE-402-18	Electrical Machines – II	3	0	0	3	40	60	100	3
Even	BTEE-413-18	Electrical Machines – II Laboratory	0	0	2	2	30	20	50	1
Even	BTEE-403-18	Power Electronics	3	0	0	3	40	60	100	3
Even	BTEE-414-18	Power Electronics Laboratory	0	0	2	2	30	20	50	1
Even	BTEE-404-18	Signals and Systems	3	0	0	3	40	60	100	3
Even	BTEE-411-18	Measurements and Instrumentation Lab.	2	0	2	4	30	20	50	3
Odd	BTEE-501-18	Power Systems – I (Apparatus & Modelling)	3	1	0	4	40	60	100	4
Odd	BTEE-511-18	Power Systems-I Laboratory	0	0	2	2	30	20	50	1
Odd	BTEE-502-18	Control Systems	3	1	0	4	40	60	100	4
Odd	BTEE-512-18	Control Systems Laboratory	0	0	2	2	30	20	50	1
Odd	BTEE-503-18	Microprocessors	3	1	0	4	40	60	100	4
Odd	BTEE-513-18	Microprocessors Laboratory	0	0	2	2	30	20	50	1
Even	BTEE-601-18	Power System-II (Operation and Control)	3	1	0	4	40	60	100	4
Even	BTEE-602-18	Power Generation and Economics	3	1	0	4	40	60	100	4
Even	BTEE-611-18	Electronic Design Laboratory	1	0	2	3	30	20	50	2
Even	BTEE-612-18	Power Systems-II Laboratory	0	0	2	2	30	20	50	1

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144603

286

EVS-101-18	Environmental Studies	2L:0T:0P (Contact hours 21)	0 credits

Internal Marks: 40 *External Marks: 60* *Total Marks: 100*

*** 40 Hours are kept for various activities under the head of activities. There will be a final theory examination for the students of 50 marks but these marks will not be added to their final result as assessment will be satisfactory or non-satisfactory.**

Course Outcomes:

CO 1 Students will enable to understand environmental problems at local and national level through literature and general awareness.

CO 2 The students will gain practical knowledge by visiting wildlife areas, environmental institutes and various personalities who have done practical work on various environmental Issues.

CO 3 The students will apply interdisciplinary approach to understand key environmental issues and critically analyze them to explore the possibilities to mitigate these problems.

CO 4 Reflect critically about their roles and identities as citizens, consumers and environmental actors in a complex, interconnected world

Environment Science (Mandatory non-credit course)

We as human being are not an entity separate from the environment around us rather we are a constituent seamlessly integrated and co-exist with the environment around us. We are not an entity so separate from the environment that we can think of mastering and controlling it rather we must understand that each and every action of ours reflects on the environment and vice versa. Ancient wisdom drawn from Vedas about environment and its sustenance reflects these ethos. There is a direct application of this wisdom even in modern times. Idea of an activity based course on environment protection is to sensitize the students.

Detailed Contents

Module 1: Natural Resources : Renewable and non-renewable resources

Natural resources and associated problems.

a) Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people.

b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.

c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.

d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.

e) Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies.

f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

- Role of an individual in conservation of natural resources.
- Equitable use of resources for sustainable lifestyles.

Module 2: Ecosystems

Concept of an ecosystem. Structure and function of an ecosystem.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical U.
Kapurthala-144603

988

PROFESSIONAL ELECTIVE (PE) COURSES [ELECTRICAL ENGINEERING]
(also Professional Elective Courses for Minor Degree of B. Tech. (Electrical Engineering))

Sr. No.	Semester	Programme Elective	Course Code	Course Title	Hrs/week	Credits
1.	V (odd)	PE-1	BTEE-504A-18	Electrical Engineering Materials	3L:0T:0P	3
2.	V (odd)	PE-1	BTEE-504B-18	Switchgear and Protection	3L:0T:0P	3
3.	V (odd)	PE-1	BTEE-504C-18	Electrical Machine Design	3L:0T:0P	3
4.	V (odd)	PE-1	BTEE-504D-18	Renewable Energy Sources	3L:0T:0P	3
5.	VI (even)	PE-2	BTEE-603A-18	Electromagnetic Waves	3L:0T:0P	3
6.	VI (even)	PE-2	BTEE-603B-18	Power System Dynamics and Control	3L:0T:0P	3
7.	VI (even)	PE-2	BTEE-603C-18	Electrical Drives	3L:0T:0P	3
8.	VI (even)	PE-2	BTEE-603D-18	Wind and Solar Energy Systems	3L:0T:0P	3
9.	VI (even)	PE-3	BTEE-604A-18	High Voltage Engineering	3L:0T:0P	3
10.	VI (even)	PE-3	BTEE-604B-18	Power System Reliability	3L:0T:0P	3
11.	VI (even)	PE-3	BTEE-604C-18	Line-Commutated and Active PWM Rectifiers	3L:0T:0P	3
12.	VI (even)	PE-3	BTEE-604D-18	Energy Efficient Systems	3L:0T:0P	3
13.	VII/VIII (Odd/Even)	PE-4	BTEE-701A-18	Electrical Energy Conservation & Auditing	3L:0T:0P	3
14.	VII/VIII (Odd/Even)	PE-4	BTEE-701B-18	Computer Aided Power System Analysis	3L:0T:0P	3
15.	VII/VIII (Odd/Even)	PE-4	BTEE-701C-18	Power Quality and FACTS	3L:0T:0P	3
16.	VII/VIII (Odd/Even)	PE-4	BTEE-701D-18	Electrical and Hybrid Vehicles	3L:0T:0P	3
17.	VII/VIII (Odd/Even)	PE-5	BTEE-702A-18	Computational Electromagnetics	3L:0T:0P	3
18.	VII/VIII (Odd/Even)	PE-5	BTEE-702B-18	Microcontroller and PLC	3L:0T:0P	3
19.	VII/VIII (Odd/Even)	PE-5	BTEE-702C-18	Control Systems Design	3L:0T:0P	3
20.	VII/VIII (Odd/Even)	PE-6	BTEE-702D-18	Distributed Generation	3L:0T:0P	3

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

287

21.	VII/VIII (Odd/Even)	PE-6	BTEE-703A-18	Industrial Electrical Systems	3L:0T:0P	3
22.	VII/VIII (Odd/Even)	PE-6	BTEE-703B-18	Restructured Power Systems	3L:0T:0P	3
23.	VII/VIII (Odd/Even)	PE-6	BTEE-703C-18	Advanced Electric Drives	3L:0T:0P	3
24.	VII/VIII (Odd/Even)	PE-6	BTEE-703D-18	Energy Storage System	3L:0T:0P	3

		The institute may offer Professional Elective (PE) Courses [Electrical Engineering} as per the groups given below (PE in the list if AICTE curriculum)			
Sem		**Group-A: Power Engineering**	**Group-B: Power Systems**	**Group-C: Power Electronics**	**Group-D: Renewable Energy**
V (Odd)	PE-1	Electrical Engineering Materials	Switchgear and Protection	Electrical Machine Design	Renewable Energy Sources
VI (even)	PE-2	Electromagnetic Waves	Power System Dynamics and Control	Electrical Drives	Wind and Solar Energy Systems
	PE-3	High Voltage Engineering	Power System Reliability	Line-Commutated and Active PWM Rectifiers	Energy Efficient Systems
VII /VIII (Odd/Even)	PE-4	Electrical Energy Conservation & Auditing	Computer Aided Power System Analysis	Power Quality and FACTS	Electrical and Hybrid Vehicles
	PE-5	Computational Electromagnetics	Microcontroller and PLC	Control Systems Design	Distributed Generation
	PE-6	Industrial Electrical Systems	Restructured Power Systems	Advanced Electric Drives	Energy Storage System

LIST OF OPEN ELECTIVE COURSES FOR STUDENTS OF OTHER PROGRAMMS OFFERED BY ELECTRICAL ENGINEERING

Prerequisite: To have passed Basic Electrical Engineering/Basic Electronics Engineering Course

Sr. No.	Course Code	Semester	Course Title	L	T	P	Hours/ Week	Credits
1.	OEE-101-18	Odd	Control Systems	3	0	0	3	3
2.	OEE-102-18	Odd-	Power Electronics	3	0	0	3	3
3.	OEE-103-18	Odd	Electrical Energy Conservation & Auditing	3	0	0	3	3
4.	OEE-104-18	Odd	Renewable Energy Sources	3	0	0	3	3
5.	OEE-201-18	Even	Electric Machines	3	0	0	3	3
6.	OEE-202-18	Even	Industrial Electrical Systems	3	0	0	3	3
7.	OEE-203-18	Even	Wind and Solar Energy Systems	3	0	0	3	3
8.	OEE-204-18	Even	Power Systems	3	0	0	3	3

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

288

HUMANITIES & SOCIAL SCIENCES INCLUDING MANAGEMENT

Sr. No.	Course Code	Course Title	Hrs. /Week L: T: P	Credits	Semester
1	BTHU-101-18	English	2:0:0	2	I/II
2	BTHU-102-18	English Laboratory	0:0:2	1	I/II
3	HSMC-XXX-18	To be selected by Individual Institutions from the given list of Humanities & Social Sciences including Management	3:0:0	3	VI
4	HSMC-XXX-18		3:0:0	3	VII
Total			-	9	-

List of Humanities & Social Sciences including Management

Sr. No.	Course Code	Course Title	Hours/ week	Credits
1.	HSMC103-18	Education, Technology and Society	2L:1T:0P	3
2.	HSMC104-18	History of Science and Technology in India	2L:1T:0P	3
3.	HSMC113-18	Values and Ethics	2L:1T:0P	3
4.	HSMC118-18	Introduction to Women's and Gender Studies	2L:1T:0P	3
5.	HSMC124-18	Sanskrit Bhasa	2L:1T:0P	3
6.	HSMC (MME-303)	Law and Engineering	2L:1T:0P	3

Details of Credits and Maximum Marks

Semester	Hrs per week	Credits	Maximum Marks
1&2	24+29	17.5+20.5=38	500+650=1150
3	26	20	750
4	30	22	850
5	24	18	750
6	32	26	850
7	31	24	850
8	23 (for those not opting for one semester training)	16	500
Total		**164**	**5700**

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

289

IKG Punjab Technical University

Syllabus

(3^{th} - 8^{th} Semester)

for

Undergraduate Degree Programme

Bachelor of Technology

in

ELECTRICAL ENGINEERING

2018 & onwards

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

#300

Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of following ecosystems:

a) Forest ecosystem
b) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Module 3 : Biodiversity and its conservation

- Introduction – Definition: genetic, species and ecosystem diversity.
- Biodiversity at global, National and local levels.
- India as a mega-diversity nation
- Hot-sports of biodiversity.
- Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts.
- Endangered and endemic species of India

Module 4 : Social Issues and the Environment

- From Unsustainable to Sustainable development
- Resettlement and rehabilitation of people; its problems and concerns.
- Environmental ethics: Issues and possible solutions.
- Climate change, global warming, acid rain, ozone layer depletion,
- Nuclear accidents and holocaust. Case Studies.
- Public awareness.

***ACTIVITIES**

Nature club (bird watching, recognizing plants at institute/at home, recognizing local animals, appreciating biodiversity

Impart knowledge and inculcate the habit of taking interest and understanding biodiversity in and around the college campus. The students should be encouraged to take interest in bird watching, recognizing local plants, herbs and local animals. The students should be encouraged to appreciate the difference in the local biodiversity in their hometown, in the place of their study and other places they visit for vacation/breaks etc.

Following activities must be included.

Identify a tree fruit flower peculiar to a place or having origin from the place.

Making high resolution big photographs of small creatures (bees, spiders, ants. Mosquitos etc.) especially part of body so that people can recognize (games on recognizing animals/plants).

Videography/ photography/ information collections on specialties/unique features of different types of common creatures.

Search and explore patents and rights related to animals, trees etc. Studying miracles of mechanisms of different body systems.

(A) Awareness Activities:

a) Small group meetings about water management, promotion of recycle use, generation of less waste, avoiding electricity waste
b) Slogan making event
c) Poster making event
d) Cycle rally
e) Lectures from experts
f) Plantation
g) Gifting a tree to see its full growth
h) Cleanliness drive

301

i) To live with some eminent environmentalist for a week or so to understand his work.
j) To work in kitchen garden for mess
k) To know about the different varieties of plants
l) Shutting down the fans and ACs of the campus for an hour or so
m) Visit to a local area to document environmental assets river/forest/grassland/hill/mountain/lake/Estuary/Wetlands
n) Visit to a local polluted site-Urban/Rural/Industrial/Agricultural
o) Visit to a Wildlife sanctuary, National Park or Biosphere Reserve

Suggested Readings

1. Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.
2. Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad – 380 013, India, Email:mapin@icenet.net (R)
3. Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480p
4. Clark R.S., Marine Pollution, Clanderson Press Oxford (TB)
5. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publ. House, Mumbai, 1196p
6. Hawkins R.E., Encyclopedia of Indian Natural History, Bombay Natural History Society, Bombay (R)
7. Heywood, V.H & Waston, R.T. 1995. Global Biodiversity Assessment. Cambridge Univ. Press 1140p.
8. Mhaskar A.K., Matter Hazardous, Techno-Science Publication (TB)
9. Miller T.G. Jr. Environmental Science, Wadsworth Publishing Co. (TB)
10. Odum, E.P. 1971. Fundamentals of Ecology. W.B. Saunders Co. USA, 574p
11. Townsend C., Harper J, and Michael Begon, Essentials of Ecology, Blackwell Science (TB)
12. Trivedi R.K., Handbook of Environmental Laws, Rules Guidelines, Compliances and Standards, Vol I and II, Enviro Media (R)
13. Trivedi R. K. and P.K. Goel, Introduction to air pollution, Techno-Science Publication (TB)
14. Wanger K.D., 1998 Environmental Management. W.B. Saunders Co. Philadelphia, USA 499p

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

302

BTEE-511-18	***Power Systems – I Laboratory***	**0L:0T:2P**	**1 credit**

Internal Marks: 30 *External Marks: 20* *Total Marks: 50*

Hands-on experiments related to the course contents of BTEE501-18. Visits to power system installations (generation stations, EHV substations etc.) are Exposure to fault analysis and Electro-magnetic transient program (EMTP) and Numerical Relays are suggested.

Note: A student to perform any 8-10 Experiments.

Suggested List of Experiments:

(A) Hardware Based:

1. To measure negative sequence and zero sequence reactance of Synchronous Machines.
2. Fault analysis for line-to-line (L-L), Line-to-Ground (L-G) and double line to ground fault.
3. To study the performance of a transmission line and compute its ABCD parameters.
4. To study the earth resistance using three spikes.
5. To study the IDMT over current relay and determine the time current characteristics
6. To study percentage differential relay
7. To study Impedance, MHO and Reactance type distance relays.
8. To study operation of oil testing set.

(B) Simulation Based Experiments (using MATLAB or any other software)

9. To obtain steady state, transient and sub-transient short circuit currents in an alternator
10. To perform symmetrical fault analysis in a power system
11. To perform unsymmetrical fault analysis in a power system

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

303

BTEE-512-18	*Control Systems Laboratory*	0L:0T:2P	1 credit

Internal Marks: 30 *External Marks: 20* *Total Marks: 50*

Hands-on experiments related to the course contents of BTEE502-18

Note: A student to perform any 8-10 Experiments.

Suggested List of Experiments:

1. To study the characteristics of potentiometers and to use 2- potentiometers as an error detector in a control system.
2. To study the synchro Transmitter-Receiver set and to use it as an error detector
3. To study the Speed – Torque characteristics of an AC Servo Motor and to explore its applications.
4. To study the Speed – Torque characteristics of an DC Servo Motor and explore its applications.
5. To study the variations of time lag by changing the time constant using control engineering trainer
6. To simulate a third order differential equations using an analog computer and calculate time response specifications
7. To obtain the transfer function of a D.C. motor – D.C. Generator set using Transfer Function Trainer
8. To study the speed control of an A.C. Servo Motor using a closed loop and an open loop systems
   a) To study the operation of a position sensor and study the conversion of position in to corresponding voltage
   b) To study an PI control action and show its usefulness for minimizing steady state error of time response.
9. To measure Force / Displacement using Strain Gauge in a wheat stone bridge
10. To design a Lag compensator and test its performance characteristics.
11. To design a Lead-compensator and test its performance characteristics.
12. To design a Lead-Lag compensator and test its performance characteristics.

Head
Department of Electrical Engineering
I.K.
K...

304

BTEE-513-18	Microprocessors Laboratory	0L:0T:2P	1 credit

Internal Marks: 30 *External Marks: 20* *Total Marks: 50*

Hands-on experiments related to the course contents of BTEE503-18

Note: A student to perform any 8-10 Experiments.

Suggested List of Experiments:

Suggested List of Experiments:

1. To study 8085 based microprocessor system
2. To study 8086 and 8086A based microprocessor system
3. To study Pentium Processor
4. To develop and run a program for finding out the largest/smallest number from a given set of numbers.
5. To develop and run a program for arranging in ascending/descending order of a set of numbers
6. To perform multiplication/division of given numbers
7. To perform conversion of temperature from 0 F to 0 C and vice-versa
8. To perform computation of square root of a given number
9. To perform floating point mathematical operations (addition, subtraction, multiplication and division) 10. To obtain interfacing of RAM chip to 8085/8086 based system
10. To obtain interfacing of keyboard controller, 8279
11. To obtain interfacing of PPI, 8255
12. To obtain interfacing of USART, 8251
13. To perform microprocessor-based stepper motor operation through 8085 kit
14. To perform microprocessor-based traffic light control
15. To perform microprocessor-based temperature control of hot water.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

305

BTEE-521-18	Summer Industry Internship	(Non-Credit)

Six weeks in an Industry in the area of Electrical Engineering. The summer internship should give exposure to the practical aspects of the discipline. In addition, the student may also work on a specified task or project which may be assigned to him/her. The outcome of the internship should be presented in the form of a report. Performance to be rated as Satisfactory/Un - Satisfactory (S/US). For unsatisfactory the internship to be repeated.

BMPD-501-18	Mentoring and Professional Development of Students	0L:1T:0P	(Non-Credit)

Internal Marks: 50 *External Marks: 00*

The assigned mentor to engage the students to in activities such as:

i. Identification of any one of the local environmental concern and propose workable solution for it.
ii. Arrange an Industrial visit of 2-3 days
iii. Expert/Invited talk pertaining to recent industrial development.
iv. Preparation of database for placement activities.
v. Resume preparation.

The mentor to keep record of all activities (including those mentioned above) and assign internal marks accordingly.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical Univ...
Kapurthala-144006

306

Semester: VI [Third Year]

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

307

BTEE-601-18	Power Systems – II (Operation & Control)	3L:1T:0P	4 credits

Internal Marks: 40 *External Marks: 60* *Total Marks: 100*

Course Outcomes:

At the end of this course, students will demonstrate the ability to:

(i) Use numerical methods to analyze a power system in steady state.
(ii) Understand stability constraints in a synchronous grid.
(iii) Understand methods to control the voltage, frequency and power flow.
(iv) Understand the monitoring and control of a power system.
(v) Understand the basics of power system economics.

Module 1: Power Flow Analysis (8 hours)

Review of the structure of a Power System and its components. Analysis of Power Flows: Formation of Bus Admittance Matrix. Real and reactive power balance equations at a node. Load and Generator Specifications. Application of numerical methods for solution of non-linear algebraic equations – Gauss Seidel and Newton-Raphson methods for the solution of the power flow equations. Computational Issues in Large-scale Power Systems.

Module 2: Stability Constraints in synchronous grids (10 hours)

Swing Equations of a synchronous machine connected to an infinite bus. Power angle curve. Description of the phenomena of loss of synchronism in a single-machine infinite bus system following a disturbance like a three--phase fault. Analysis using numerical integration of swing equations (using methods like Forward Euler, Runge-Kutta 4th order methods), as well as the Equal Area Criterion. Impact of stability constraints on Power System Operation.

Module 3: Control of Frequency and Voltage (8 hours)

Turbines and Speed-Governors, Frequency dependence of loads, Droop Control and Power Sharing. Automatic Generation Control. Generation and absorption of reactive power by various components of a Power System. Excitation System Control in synchronous generators, Automatic Voltage Regulators. Shunt Compensators, Static VAR compensators and STATCOMs. Power flow control using embedded dc links, phase shifters.

Module 4: Monitoring and Control (8 hours)

Overview of Energy Control Centre Functions: SCADA systems. Phasor Measurement Units and Wide-Area Measurement Systems. State-estimation. System Security Assessment. Normal, Alert, Emergency, Extremis states of a Power System. Contingency Analysis. Preventive Control and Emergency Control.

Module 5: Modern Power System Management (8 hours)

Basic Pricing Principles: Generator Cost Curves, Utility Functions, Power Exchanges, Spot Pricing. Electricity Market Models (Vertically Integrated, Purchasing Agency, Whole-sale competition, Retail Competition), Demand Side-management, Transmission and Distributions charges, Ancillary Services. Regulatory framework.

Text/Reference Books:

1. J. Grainger and W. D. Stevenson, Power System Analysis, McGraw Hill Education, 1994.
2. O. I. Elgerd, Electric Energy Systems Theory, McGraw Hill Education, 1995.
3. A. R. Bergen and V. Vittal, Power System Analysis, Pearson Education Inc., 1999.

4. D. P. Kothari and I. J. Nagrath, Modern Power System Analysis, McGraw Hill Education, 2003.
5. B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, Electric Power Systems, Wiley, 2012.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144606

309

292

BTEE-602-18	Power Generation and Economics	3L:1T:0P	4 credits

Internal Marks: 40 *External Marks: 60* *Total Marks: 100*

Course Outcomes:

At the end of the course, students will demonstrate the ability to

(i) Understand the load curves, load-duration Curve.
(ii) Understand the power plant economics and tariff
(iii) Explore the significance of economic operation of steam plants
(iv) Understand the hydro-thermal coordination.

Module 1: Loads and Load curves (8 hours)

Electrical energy sources, organization of power sector in India, single line diagram of thermal, hydro and nuclear power stations. Classification of power plants in base load and peak load plants.

Types of load (fixed voltage loads, resistive loads, Inductive motor loads, Mechanical load), effect of load on supply voltage, Maximum demand, Group diversity factor, Peak diversity factor, Types of load, chronological load curves, load-duration Curve, mass curves, load factor, capacity factor, utilization factor, base load and peak load plants, load forecasting.

Module 2: Power Plant Economics and Tariff (10 hours)

Capital cost of plants, annual fixed cost, operating costs and effect of load factor on cost of energy, depreciation. Objectives of tariff making, different types of tariff (domestic, commercial, agricultural and industrial loads). Need for power factor improvement, power factor improvement using capacitors, determination of economic power factor.

Module 3: Selection of plant, Cogeneration (8 hours)

Plant location, plant size, number and size of units in plants, economic comparison of alternatives based on annual cost, rate of return, present worth and capitalized cost methods. Definition and scope of cogeneration, Topping and Bottoming Cycles, Benefits, cogeneration technologies.

Module 4: Economics of Steam plants (8 hours)

Methods of loading turbo-generators, input- output curve, heat rate, incremental cost, method of Lagrangian multiplier, effect of transmission losses, co- ordination equations, and iterative procedure to solve co-ordination equations.

Module 5: Hydro-thermal co-ordination (8 hours)

Advantages of combined working of Run-off River plant and steam plant, reservoir hydro plants and thermal plants, long-term operational aspects, scheduling methods.

Text/Reference Books

1. M.V. Deshpande, Power Plant Engineering, Tata McGraw Hill (2004).
2. M.M. El-Wakit, Power Plant Engineering, McGraw Hill, USA 8. Rajput R.K., Power Plant Engineering, Luxmi Publications
3. P.C. Sharma, Power Plant Engineering, Kataria and Sons
4. B.G.A. Skrotzki and W.A. Vapot, Power Station Engineering and Economy, Tata McGraw-Hill
5. S.C. Arora and S. Dom Kundwar, A course in Power Plant Engineering, Dhanpat Rai.
6. P.K. Nag, Power Plant Engineering, Tata McGraw Hill
7. B.R. Gupta, Generation of Electrical Energy, S. Chand (1998).
8. I.J. Nagrath and D.P. Kothari, Power System Analysis Tata McGraw-Hill Publication
9. A. Chakrabarti, M.L. Soni, P.V. Gupta and U.S. Bhatanagar, A Textbook on Power System Engineering, Dhanpat Rai and Co

310

BTEE-611-18	**Electronics Design Laboratory**	**1L:0T:2P**	**2 credits**

Internal Marks: 30 *External Marks: 20* *Total Marks: 50*

Course Outcomes:

At the end of the course, students will demonstrate the ability to

(i) Understand the practical issues related to practical implementation of applications using electronic circuits.

(ii) Choose appropriate components, software and hardware platforms.

(iii) Design a Printed Circuit Board, get it made and populate/solder it with components.

(iv) Work as a team with other students to implement an application.

Basic concepts on measurements; Noise in electronic systems; Sensors and signal conditioning circuits; Introduction to electronic instrumentation and PC based data acquisition; Electronic system design, Analog system design, Interfacing of analog and digital systems, Embedded systems, Electronic system design employing microcontrollers, Complex Programmable Logic Devices (CPLDs), and field-programmable gate arrays (FPGAs), and printed circuit boards (PCB) design and layout; System assembly considerations. Group projects involving electronic hardware (Analog, Digital, mixed signal) leading to implementation of an application.

Text/Reference Books

1. S. Sedra and K. C. Smith, "Microelectronic circuits", Oxford University Press, 2007.
2. P. Horowitz and W. Hill, "The Art of Electronics", Cambridge University Press, 1997.
3. H.W.Ott, "Noise Reduction Techniques in Electronic Systems", Wiley, 1989.
4. W.C. Bosshart, "Printed Circuit Boards: Design and Technology", Tata McGraw Hill, 1983.
5. G.L. Ginsberg, "Printed Circuit Design", McGraw Hill, 1991.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

311

BTEE-612-18	***Power Systems-II Laboratory***	**0L:0T:2P**	**1 credit**

Internal Marks: 30 *External Marks: 20* *Total Marks: 50*

Hands-on and computational experiments related to the course contents of BTEE-601-18. This should include programming of numerical methods for solution of the power flow problem and stability analysis.
Visit to load dispatch centre is suggested.

Note: A student to perform any 8-10 Experiments.

Suggested List of Experiments:

1. *Short circuit calculations and calculations of circuit breaker ratings for a power system network.*
2. *a) Y-bus formation using Matlab/PSCAD/Power world.*
   b) Z-bus formulation using Matlab/PSCAD/Power world.
3. *Load flow analysis by Gauss Seidal method.*
4. *Load flow analysis by Newto Raphson method*
5. *To obtain power system stability on High Voltage Alternating current (HVAC) system with the help of Flexible Alternating Current Transmission Systems (FACTS) devices using Matlab/PSCAD/Power world.*
6. *Optimal Capacitor placement on a system having variable reactive power and low voltage profile.*
7. *To obtain relay co-ordination on a power system.*
8. *To find synchronous reactances (Transient, sub-transient) during fault analysis.*
9. *To study the characteristics of a distance relay.*
10. *To study and design a synchronous machine for stability study using swing equation using Matlab/PSCAD/Power world.*

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

3/2

BTEE-621-18	***Project -1***	**0L:0T:6P**	**3 credit**

Internal Marks: 30 *External Marks: 20* *Total Marks: 50*

Course Outcomes:

At the end of this course, students will demonstrate the ability to:

(i) Apply and verify basic scientific principals and technologies.
(ii) Identify the scope of interdisciplinary knowledge
(iii) Make and design a prototype which is preferably a working model

Guidelines

1) A group of 3-4 students under the mentorship of a teacher to make a minor project. Interdisciplinary projects to be encouraged.
2) The project title and scope to be decided and presented in first 2nd/3rd weeks of the semester.
3) The progress of the project to be evaluated (internal) in 8th/9th week of the semester.
4) A draft of the project report to be prepared and the project to be evaluated (internal) 12th/13th week of the semester.
5) The project report and the project to be submitted in the department at the time of external evaluation.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

313

BMPD-601-18	Mentoring and Professional Development of Students	**0L:1T:0P**	**Non-credit**

Internal Marks: 50 *External Marks: -* *Total Marks: 50*

The assigned mentor to engage the students to in activities such as:

1) Identification of any one of the local environmental concern and propose workable solution for it.
2) Arrange an Industrial visit of 2-3 days
3) Expert/Invited talk pertaining to recent industrial development.
4) Preparation of database for placement activities.
5) Resume preparation.

The mentor to keep record of all activities (including those mentioned above) and assign internal marks accordingly.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

314

Programme Electives

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

315

VI (even)	PE-2	BTEE-603A-18	Electromagnetic Waves	3L:0T:0P	3
VI (even)	PE-2	BTEE-603B-18	Power System Dynamics and Control	3L:0T:0P	3
VI (even)	PE-2	BTEE-603C-18	Electrical Drives	3L:0T:0P	3
VI (even)	PE-2	BTEE-603D-18	Wind and Solar Energy Systems	3L:0T:0P	3
VI (even)	PE-3	BTEE-604A-18	High Voltage Engineering	3L:0T:0P	3
VI (even)	PE-3	BTEE-604B-18	Power System Reliability	3L:0T:0P	3
VI (even)	PE-3	BTEE-604C-18	Line-Commutated and Active PWM Rectifiers	3L:0T:0P	3
VI (even)	PE-3	BTEE-604D-18	Energy Efficient Systems	3L:0T:0P	3

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

316

BTEE-603A-18	**Electromagnetic Waves**	**3L:0T:0P**	**3 credits**

Internal Marks: 40 *External Marks: 60* *Total Marks: 100*

Course Outcomes:

At the end of this course, students will demonstrate the ability to

- (i) Analyse transmission lines and estimate voltage and current at any point on transmission line for different load conditions.
- (ii) Provide solution to real life plane wave problems for various boundary conditions.
- (iii) Analyse the field equations for wave propagation in special cases such as lossy and low loss dielectric media.
- (iv) Visualize TE and TM mode patterns of field distributions in a rectangular wave-guide.
- (v) Understand and analyse radiation by antennas.

Module 1: Transmission Lines (8 hours)

Introduction, Concept of distributed elements, Equations of voltage and current, standing waves and impedance transformation, Lossless and low-loss transmission lines, Power transfer on a transmission line, Analysis of transmission line in terms of admittances, Transmission line calculations with the help of Smith chart, Applications of transmission line, Impedance matching using transmission lines.

Module 2: Maxwell's Equations (9 hours)

Basic quantities of Electromagnetics, Basic laws of Electromagnetics: Gauss's law, Ampere's Circuital law, Faraday's law of Electromagnetic induction. Maxwell's equations, Surface charge and surface current, Boundary conditions at media interface.

Module 3: Uniform Plane Wave (9 hours)

Homogeneous unbound medium, Wave equation for time harmonic fields, Solution of the wave equation, Uniform plane wave, Wave polarization, Wave propagation in conducting medium, Phase velocity of a wave, Power flow and Poynting vector.

Module 4: Plane Waves at Media Interface (7 hours)

Plane wave in arbitrary direction, Plane wave at dielectric interface, Reflection and refraction of waves at dielectric interface, Total internal reflection, Wave polarization at media interface, Brewster angle, Fields and power flow at media interface, Lossy media interface, Reflection from conducting boundary.

Module 5: Waveguides (8 hours)

Parallel plane waveguide: Transverse Electric (TE) mode, Transverse Magnetic (TM) mode, Cut-off frequency, Phase velocity and dispersion. Transverse Electromagnetic (TEM) mode, Analysis of waveguide-general approach, Rectangular waveguides. Introduction to antennas.

Text/Reference Books

1. R. K. Shevgaonkar, Electromagnetic Waves, Tata McGraw Hill, 2005.
2. D. K. Cheng, Field and Wave Electromagnetics, Addison-Wesley, 1989.
3. M. N.O. Sadiku, Elements of Electromagnetics, Oxford University Press, 2007.
4. C. A. Balanis, Advanced Engineering Electromagnetics, John Wiley & Sons, 2012.
5. C. A. Balanis, Antenna Theory: Analysis and Design, John Wiley & Sons, 2005.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144606

317

BTEE-603-B-18	**Power System Dynamics and Control**	**3L:0T:0P**	**3 credits**
Internal Marks: 40	*External Marks: 60* *Total Marks: 100*		

Course Outcomes:

At the end of this course, students will demonstrate the ability to

(i) Understand the problem of power system stability and its impact on the system.
(ii) Analyse linear dynamical systems and use of numerical integration methods.
(iii) Model different power system components for the study of stability.
(iv) Understand the need and plan the methods to improve stability.

Module 1: Introduction to Power System Operations (4 hours)

Introduction to power system stability. Power System Operations and Control. Stability problems in Power System. Impact on Power System Operations and control.

Module 2: Analysis of Linear Dynamical System and Numerical Methods (5 hours)

Analysis of dynamical System, Concept of Equilibrium, Small and Large Disturbance Stability. Modal Analysis of Linear System. Analysis using Numerical Integration Techniques. Issues in Modeling: Slow and Fast Transients, Stiff System.

Module 3: Modeling of Synchronous Machines and Associated Controllers (12 hours)

Modeling of synchronous machine: Physical Characteristics. Rotor position dependent model. D-Q Transformation. Model with Standard Parameters. Steady State Analysis of Synchronous Machine. Short Circuit Transient Analysis of a Synchronous Machine. Synchronization of Synchronous Machine to an Infinite Bus. Modeling of Excitation and Prime Mover Systems. Physical Characteristics and Models. Excitation System Control. Automatic Voltage Regulator. Prime Mover Control Systems. Speed Governors.

Module 4: Modeling of other Power System Components (10 hours)

Modeling of Transmission Lines and Loads. Transmission Line Physical Characteristics. Transmission Line Modeling. Load Models - induction machine model. Frequency and Voltage Dependence of Loads.

Module 5: Stability Analysis (11 hours)

Angular stability analysis in Single Machine Infinite Bus System. Angular Stability in multi-machine systems – Intra-plant, Local and Inter-area modes. Frequency Stability: Centre of Inertia Motion. Load Sharing: Governor droop. Single Machine Load Bus System: Voltage Stability. Planning Measures for Enhancing System Stability. Stabilizing Controllers (Power System Stabilizers). Operational Measures-Preventive Control. Emergency Control.

Text/Reference Books

1. K.R. Padiyar, "Power System Dynamics, Stability and Control", B. S. Publications, 2002.
2. P. Kundur, "Power System Stability and Control", McGraw Hill, 1995.
3. P. Sauer and M. A. Pai, "Power System Dynamics and Stability", Prentice Hall, 1997.

318

BTEE-603C-18	**Electrical Drives**	**3L:0T:0P**	**3 credits**

Internal Marks: 40 *External Marks: 60* *Total Marks: 100*

Course Outcomes:

At the end of this course, students will demonstrate the ability to:

(i) Understand the characteristics of dc motors and induction motors.
(ii) Understand the principles of speed-control of dc motors and induction motors.
(iii) Apply the knowledge of power electronics to understand the working of dc-dc converters.
(iv) Apply the knowledge of control system for the speed control of electrical machines.
(v) Understand the working of AC and DC drives

Module 1: DC motor characteristics (6 hours)

Review of emf and torque equations of DC machine, review of torque-speed characteristics of separately excited dc motor, change in torque-speed curve with armature voltage, example load torque-speed characteristics, operating point, armature voltage control for varying motor speed, flux weakening for high speed operation, regenerative braking.

Module 2: Chopper fed DC drive (12 hours)

Review of dc chopper and duty ratio control, chopper fed dc motor for speed control, steady state operation of a chopper fed drive, armature current waveform and ripple, calculation of losses in dc motor and chopper, efficiency of dc drive, smooth starting.
Multi-quadrant DC drive : Review of motoring and generating modes operation of a separately excited dc machine, four quadrant operation of dc machine; single-quadrant, two-quadrant and four-quadrant choppers; steady-state operation of multi-quadrant chopper fed dc drive.

Module 3: Closed-loop control of DC Drive (8 hours)

Control structure of DC drive, inner current loop and outer speed loop, dynamic model of dc motor – dynamic equations and transfer functions, modeling of chopper as gain with switching delay, plant transfer function, for controller design, current controller specification and design, speed controller specification and design.

Module 4: Induction motor characteristics (6 hours)

Review of induction motor equivalent circuit and torque-speed characteristic, variation of torque-speed curve with (i) applied voltage, (ii) applied frequency and (iii) applied voltage and frequency, typical torque-speed curves of fan and pump loads, operating point, constant flux operation, flux weakening operation.

Module 5: Scalar control or constant V/f control of induction motor (8 hours)

Review of three-phase voltage source inverter, generation of three-phase PWM signals, sinusoidal modulation, space vector theory, conventional space vector modulation; constant V/f control of induction motor, steady-state performance analysis based on equivalent circuit, speed drop with loading, slip regulation.

Text / References:

1. G. K. Dubey, Power Semiconductor Controlled Drives, Prentice Hall, 1989.
2. R. Krishnan, Electric Motor Drives: Modeling, Analysis and Control, Prentice Hall, 2001.
3. G. K. Dubey, Fundamentals of Electrical Drives, CRC Press, 2002.
4. W. Leonhard, Control of Electric Drives, Springer Science & Business Media, 2001.

319

BTEE-603D-18	Wind and Solar Energy Systems	3L:0T:0P	3 credits

Internal Marks: 40 *External Marks: 60* *Total Marks: 100*

Course Outcomes:

At the end of this course, students will demonstrate the ability to

(i) Understand the global energy scenario and the consequent growth of the power generation from renewable energy sources.
(ii) Understand the basic physics of wind and solar power generation.
(iii) Apply the knowledge of electrical machines to generate electrical power from wind
(iv) Understand the power electronic interfaces for wind and solar generation.
(v) Understand the issues related to the grid-integration of solar and wind energy systems.

Module 1: Physics of Wind Power: (5 Hours)

History of wind power, Indian and Global statistics, Wind physics, Betz limit, Tip speed ratio, stall and pitch control, Wind speed statistics-probability distributions, Wind speed and power-cumulative distribution functions.

Module 2: Wind generator topologies: (12 Hours)

Review of modern wind turbine technologies, Fixed and Variable speed wind turbines, Induction Generators, Doubly-Fed Induction Generators and their characteristics, Permanent-Magnet Synchronous Generators, Power electronics converters. Generator-Converter configurations, Converter Control.

Module 3: The Solar Resource: (6 Hours)

Introduction, solar radiation spectra, solar geometry, Earth Sun angles, observer Sun angles, solar day length, Estimation of solar energy availability.

Module 4: Solar energy Technologies (12 Hours)

Solar photovoltaic Technologies-Amorphous, monocrystalline, polycrystalline; V-I characteristics of a PV cell, PV module, array, Power Electronic Converters for Solar Systems, Maximum Power Point Tracking (MPPT) algorithms. Converter Control.

Solar thermal power generation: Technologies, Parabolic trough, central receivers, parabolic dish, Fresnel, solar pond, elementary analysis.

Module 5: Network Integration Issues: (7 Hours)

Overview of grid code technical requirements. Fault ride-through for wind farms - real and reactive power regulation, voltage and frequency operating limits, solar PV and wind farm behavior during grid disturbances. Power quality issues. Power system interconnection experiences in the world. Hybrid and isolated operations of solar PV and wind systems.

Text / References:

1. T. Ackermann, Wind Power in Power Systems, John Wiley and Sons Ltd., 2005.
2. G. M. Masters, Renewable and Efficient Electric Power Systems, John Wiley and Sons, 2004.
3. S. P. Sukhatme, Solar Energy: Principles of Thermal Collection & Storage, McGraw Hill, 1984.
4. H. Siegfried and R. Waddington, Grid integration of wind energy conversion systems, John Wiley and Sons Ltd., 2006.
5. G. N. Tiwari and M. K. Ghosal, Renewable Energy Applications, Narosa Publications, 2004.
6. J. A. Duffie and W. A. Beckman, Solar Engineering of Thermal Processes, John Wiley & Sons, 1991.

320

BTEE-604A-18	**High Voltage Engineering**	**3L:0T:0P**	**3 credits**

Internal Marks: 40 *External Marks: 60* *Total Marks: 100*

Course outcomes:

At the end of the course, the student will demonstrate

- (i) Understand the basic physics related to various breakdown processes in solid, liquid, and gaseous insulating materials.
- (ii) Knowledge of generation and measurement of D. C., A.C., & Impulse voltages.
- (iii) Knowledge of tests on H. V. equipment and on insulating materials, as per the standards.
- (iv) Knowledge of how over-voltages arise in a power system, and protection against these over-voltages.

Module 1: Breakdown in Insulating materials (8 Hours)

Ionization processes and de-ionization processes, Types of Discharge, Gases as insulating materials, Breakdown in Uniform gap, non-uniform gaps, Townsend's theory, Streamer mechanism, Corona discharge

Module 2: Breakdown in liquid and solid (9 Hours)

Breakdown in pure and commercial liquids, Solid dielectrics and composite dielectrics, intrinsic breakdown, electromechanical breakdown and thermal breakdown, Partial discharge, applications of insulating materials.

Module 3: Generation of High Voltages (9 Hours)

Generation of high voltages, generation of high D C and AC voltages, generation of impulse voltages, generation of impulse currents, tripping and control of impulse generators.

Module 4: Measurements of High Voltages and Currents (8 Hours)

Peak voltage, impulse voltage and high direct current measurement method, cathode ray oscillographs for impulse voltage and current measurement, measurement of dielectric constant and loss factor, partial discharge measurements.

Module 5: Lightning and Switching Over-voltages (8 Hours)

Charge formation in clouds, stepped leader, Dart leader, Lightning Surges. Switching over-voltages, Protection against over-voltages, Surge diverters, Surge modifiers.

Text/Reference Books

1. M. S. Naidu and V. Kamaraju, High Voltage Engineering, McGraw Hill Education,2013.
2. C. L. Wadhwa, High Voltage Engineering, New Age International Publishers, 2007.
3. D. V. Razevig (Translated by Dr. M. P. Chourasia), High Voltage Engineering Fundamentals, Khanna Publishers, 1993.
4. Kuffel, W. S. Zaengl and J. Kuffel, High Voltage Engineering Fundamentals, Newnes Publication, 2000.
5. R. Arora and W. Mosch High Voltage and Electrical Insulation Engineering, John Wiley & Sons, 2011.
6. Various IS standards for HV Laboratory Techniques and Testing

321
301

BTEE-604B-18	**Power System Reliability**	**3L:0T:0P**	**3 credits**

Internal Marks: 40 *External Marks: 60* *Total Marks: 100*

Course Outcome: This course covers the following topics

(i) Understand the basic quantitative reliability analysis
(ii) Understand the reliability modeling and analysis of electric power systems.
(iii) Knowledge of reliability assessment for elements of transmission system.
(iv) Understand the risk analysis in power system planning.

Module 1: General reliability modelling and evaluation (8 hours)
Introduction to probability and stochastic processes; system modelling for reliability; methods of reliability assessment: state space, cut-set and tie-set analysis, decomposition; Monte Carlo simulation: non-sequential and sequential; synchronous and asynchronous timing, Analysis of risk in power systems; understanding of causes and remedial measures.

Module 2: Reliability modeling and analysis of electric power systems (10 hours)
Bulk power systems, distribution systems, and industrial systems. Component modeling: generator modeling, transmission line modeling, load modeling; capacity outage table; probability and frequency distributions; unit addition algorithm; load modeling algorithm. Generation adequacy assessment using discrete convolution: discrete convolution of generation and load models; generation reserve model.

Module 3: Power System Reliability (8 hours)
Basic Notions of Power System Reliability- sub systems, reliability indices, outage classification, value of reliability tools, Concepts and methodologies, power system structure, Reliability based planning in power systems, Effect of failures on power system, Planning criteria, Risk analysis in power system planning, multi-state systems.

Module 4: Reliability of Generation Systems (8 hours)
Capacity outage calculations, reliability indices using the loss of load probability method, unit commitment and operating constraints, optimal reserve management, single and multi-stage expansion.

Module 5: Reliability Assessment for Elements of Transmission and Transformation Systems (8 hours)
Reliability indices of substations based on the overload capability of the transformers, evaluation and analysis of substation configurations.

Text Books:

1. C. Singh, P. Jirutitijaroen and J. Mitra, Electric Power Grid Reliability Evaluation: Models and Methods. Wiley-IEEE Press, Hoboken, NJ: 2019. ISBN: 9781119486275.
2. R. Ramakumar, Engineering Reliability: Fundamentals and Applications. Prentice Hall. J. Endrenyi, Reliability Modeling in Electric Power Systems. Wiley.
3. Shahidehpour M, Yamin H, Li z, Markey operations in electric power systems Forecasting, Scheduling, and Risk Management, John WIley & sons
4. R. Billinton, R. Allan, Reliability evaluation of power systems, Plenum Press New York, ~~1996.~~
5. Computational Methods in Power system Reliability, D. Elmakias, Springer-Verlag

322

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University

BTEE-604C-18	**Line-Commutated and Active PWM Rectifiers**	**3L:0T:0P**	**3 credits**

Internal Marks: 40 *External Marks: 60* *Total Marks: 100*

Course Outcomes:

At the end of this course, students will demonstrate the ability to

(i) Analyse controlled rectifier circuits.

(ii) Understand the operation of line-commutated rectifiers – 6 pulse and multi-pulse configurations.

(iii) Understand the operation of PWM rectifiers – operation in rectification and regeneration modes and lagging, leading and unity power factor mode.

Module 1: Diode rectifiers with passive filtering (8 Hours)

Half-wave diode rectifier with RL and RC loads; 1-phase full-wave diode rectifier with L, C and LC filter; 3-phase diode rectifier with L, C and LC filter; continuous and discontinuous conduction, input current waveshape, effect of source inductance; commutation overlap.

Module 2: Thyristor rectifiers with passive filtering (9 Hours)

Half-wave thyristor rectifier with RL and RC loads; 1-phase thyristor rectifier with L and LC filter; 3-phase thyristor rectifier with L and LC filter; continuous and discontinuous conduction, input current waveshape.

Module 3: Multi-Pulse converter (9 Lectures)

Review of transformer phase shifting, generation of 6-phase ac voltage from 3-phase AC, 6-pulse converter and 12-pulse converters with inductive loads, steady state analysis, commutation overlap, notches during commutation.

Module 4: Single-phase AC-DC single-switch boost converter (8 Hours)

Review of dc-dc boost converter, power circuit of single-switch AC-DC converter, steady state analysis, unity power factor operation, closed-loop control structure.

Module 5: Ac-dc bidirectional boost converter (8 Hours)

Review of 1-phase inverter and 3-phase inverter, power circuits of 1-phase and 3-phase ac-dc boost converter, steady state analysis, operation at leading, lagging and unity power factors. Rectification and regenerating modes. Phasor diagrams, closed-loop control structure.

Text / References:

1. G. De, "Principles of Thyristorised Converters", Oxford & IBH Publishing Co, 1988.
2. J.G. Kassakian, M. F. Schlecht and G. C. Verghese, "Principles of Power Electronics", Addison-Wesley, 1991.
3. L. Umanand, "Power Electronics: Essentials and Applications", Wiley India, 2009.
4. N. Mohan and T. M. Undeland, "Power Electronics: Converters, Applications and Design", John Wiley & Sons, 2007.
5. R. W. Erickson and D. Maksimovic, "Fundamentals of Power Electronics", Springer Science & Business Media, 2001.

323

BTEE-604D-18	**Energy Efficient Systems**	**3L:0T:0P**	**3 credits**
Internal Marks: 40	*External Marks: 60*	*Total Marks: 100*	

Course Outcomes:

(i) Understand the basic electricity billing and electrical load management
(ii) Understand the refrigeration and air conditioning system
(iii) Knowledge of light source, choice of lighting, luminance requirements, and energy conservation avenues.
(iv) Understand the diesel generating system and energy efficient technologies.

Module 1: Introduction (7 hours)

Electrical systems: Electricity billing, electrical load management and maximum demand control, power factor improvement and its benefit, selection and location of capacitors;

Module 2: motors and compressors (7 hours)

Electric motors: Types, losses in induction motors, motor efficiency, factors affecting motor performance, rewinding and motor replacement issues, energy saving opportunities with energy efficient motors; Compressed Air System: Types of air compressors, compressor efficiency, efficient compressor operation

Module 3: HVAC, Refrigeration System and Pumping Systems (10 hours)

Vapour compression refrigeration cycle, refrigerants, coefficient of performance, capacity, and factors affecting Refrigeration and Air conditioning system performance and savings opportunities. Vapour absorption refrigeration system: Working principle, types and comparison with vapour compression system; Fans and blowers: Types, performance evaluation, efficient system operation, energy conservation opportunities; Pumping System: Types, performance evaluation, efficient system operation, energy conservation opportunities.

Module 3: Cooling Tower and Lighting Systems (8 hours)

Types and performance evaluation, efficient system operation, flow control strategies and energy saving opportunities assessment of cooling towers.
Lighting System: Light source, choice of lighting, luminance requirements, and energy conservation avenues.

Module 5: Diesel Generating system and Energy Efficient Technologies in Electrical Systems (10 hours)

Factors affecting selection, energy performance assessment of diesel conservation avenues. Maximum demand controllers, automatic power factor controllers, energy efficient motors, soft starters with energy saver, variable speed drives, energy efficient transformers, electronic ballast, occupancy sensors, energy efficient lighting controls, energy saving potential of each technology.

Text/References:

1. Online: http://knowledgeplatform.in/wp-content/uploads/2017/03/Chapter-3.10-ENERGY-EFFICIENT-TECHNOLOGIES.pdf
2. P. Venkataseshaiah and K.V. Sharma "Energy Management and Conservation", pp. 168, Dreamteach Press, January 2020.
3. Amlan Chakrabarti, "Energy Engineering and Management", pp. 416, PHI Learning, 2nd revised edition, January 2019.
4. Umesh Rathore, "Energy Management", pp. 450, SK Kataria and sons, January 2013.

324

Open Electives

325

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University

LIST OF OPEN ELECTIVE COURSES FOR STUDENTS OF OTHER PROGRAMMS OFFERED BY ELECTRICAL ENGINEERING

Prerequisite: To have passed Basic Electrical Engineering/Basic Electronics Engineering Course

Sr. No.	Course Code	Semester	Course Title	L	T	P	Hours/ Week	Credits
1.	OEE-101-18	Odd	Control Systems	3	0	0	3	3
2.	OEE-102-18	Odd-	Power Electronics	3	0	0	3	3
3.	OEE-103-18	Odd	Electrical Energy Conservation & Auditing	3	0	0	3	3
4.	OEE-104-18	Odd	Renewable Energy Sources	3	0	0	3	3
5.	OEE-201-18	Even	Electric Machines	3	0	0	3	3
6.	OEE-202-18	Even	Industrial Electrical Systems	3	0	0	3	3
7.	OEE-203-18	Even	Wind and Solar Energy Systems	3	0	0	3	3
8.	OEE-204-18	Even	Power Systems	3	0	0	3	3

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

326

OEE-101-18	Control Systems	3L:0T:0P	3 credits

Internal Marks: 40 *External Marks: 60* *Total Marks: 100*

Course Outcomes:
At the end of this course, students will demonstrate the ability of
- (i) Understanding the model of linear-time-invariant systems using transfer function
- (ii) Understanding state-space representations.
- (iii) Knowledge of the concept of stability
- (iv) Assessment for linear-time invariant systems.
- (v) Knowledge of non-linear systems

Module 1: Introduction to control problem (6 hours)
Industrial Control examples. Mathematical models of physical systems. Control hardware and their models. Transfer function models of linear time-invariant systems.
Feedback Control: Open-Loop and Closed-loop systems. Benefits of Feedback.

Module 2: Time and Frequency Response Analysis (12 hours)
Standard test signals. Time response of first and second order systems for standard test inputs. Application of initial and final value theorem. Design specifications for second-order systems based on the time-response. Concept of Stability. Routh-Hurwitz Criteria.

Module 3: Frequency-response analysis (8 hours)
Relationship between time and frequency response, Polar plots, Bode plots. Nyquist stability criterion.

Module 4: State variable Analysis (8 hours)
Concepts of state variables. State space model. Diagonalization of State Matrix. Solution of state equations. Eigenvalues and Stability Analysis. Concept of controllability and observability. Pole-placement by state feedback.

Module 5: Introduction to Optimal Control and Nonlinear Control (8 hours)
Performance Indices. Regulator problem, Tracking Problem. Nonlinear system–Basic concepts and analysis.

Text/References:
1. M. Gopal, Control Systems: Principles and Design, McGraw Hill Education, 1997.
2. B. C. Kuo, Automatic Control System, Prentice Hall, 1995.
3. K. Ogata, Modern Control Engineering, Prentice Hall, 1991.
4. I. J. Nagrath and M. Gopal, Control Systems Engineering, New Age International, 2009.

327

OEE-102-18	**Power Electronics**	**3L:0T:0P**	**3 credits**

Internal Marks: 40 *External Marks: 60* *Total Marks: 100*

Course Outcomes:

At the end of this course, students will demonstrate the ability to

(i) Knowledge of power semiconductor switches
(ii) Understand the working of various types of converters
(iii) Apply the ac-dc and dc-dc converter in field

Module 1: Semiconductor Devices Construction and Characteristics (8 hours)
Introduction to Thyristor family: SCR, DIACs, TRIACs Power Transistors, Power MOSFET, Insulated Gate Bipolar transistors (IGBTs), Light Activated SCRs (LASCRs), Reverse Conducting Thyristor, (RCT), Asymmetrical SCR (ASCR), Gate turn-off Thyristors (GTOs), Integrated Gate- Commutated Thyristors (IGCTs), MOS controlled Thyristors (MCTs) Power Integrated circuits (PICs), Intelligent Modules

Module 2: Thyristor Fundamentals (10 hours)
Construction of SCR, Operating modes, Two transistor analogy, Static & dynamic characteristics, Gate characteristics, Turn on & turn off methods (Commutation methods), Series and Parallel operations of SCRs : Need, String efficiency, Issues, Static and Dynamic Equalizing circuit and Means to minimize the effect of mis-match Isolation of gate and base drive using pulse transformer and Optocouplers Gate Drive/Triggering circuits: R trigger, RC trigger, Cosine Triggering, UJT and Programmable UJT as an oscillator and triggering circuit based on them Ratings, Cooling and Heat sinks, Thermal Modeling, di/dt and dv/dt protection,

Module 3: Phase Controlled (AC to DC) Converters (8 hours)
Review of half-wave and full-wave diode rectifier (with RL load); Principle of phase-controlled converter operation; Operation of 1-phase half wave converter with R, RL and RLE load; 1- phase full wave converter: Center-tapped and Bridge Configuration; Gating Requirements.

Module 4: Operation and analysis of 1-phase Semi-converter/Half controlled converter (8 hours)
Operation of half wave converter; Full wave fully controlled converters: Semi-controlled converter; Dual Converter: Principle and operation; 1-phase and 3-phase configurations.

Module 5: DC to DC Converters (8 hours)
The chopper, Basic principle of DC chopper, Classification of DC choppers, Principle, operation, and analysis for Step-down (Buck), Step-up (Boost), Step up/down (Buck-Boost), Application of DC-to-DC converters.

Text/References:

1. M. D. Singh and K. B. Khanchandani, Power electronics, TMH, New Delhi, 2nd ed., 2007.
2. M. H. Rashid, Power Electronics - Circuits, Devices and Applications, Prentice Hall of India, 3rd ed., 2003.
3. V. Subramanyam, Power Electronics – Devices, Converters and Applications, New Age International Publishers Pvt. Ltd., Bangalore, 2nd ed. 2006.
4. P. S. Bimbhra, Power Electronics, Khanna Publishers, New Delhi, 2012.
5. N. Mohan, Undeland and Robbins, Power Electronics – Converters, Applications and Design, John Willey & sons, Inc., 3rd ed., 2003.
6. V. R. Moorthi, Power Electronics, Oxford University press, 2005.
7. G. K. Dubey, S.R. Doradla, A. Joshi, and R.M.K. Sinha, Thyristorised Power Controllers, New Age International Ltd. Publishers, 1986 (Reprint 2008).
8. P.T. Krein, Elements of Power Electronics, Oxford University Press, 1998.
9. G. K. Dubey, Fundamentals of Electrical Drives, Narosa Publishing House, New Delhi, 2nd ed. 2001.

328

Head

OEE-103-18	**Electrical Energy Conservation & Auditing**	**3L:0T:0P**	**3 credits**

Internal Marks: 40 *External Marks: 60* *Total Marks: 100*

Course Outcome: After learning the course the students should be able to,

(i) Knowledge of the energy conservation/saving opportunities in different electric system
(ii) Knowledge of energy conservation opportunities in thermal system
(iii) Understand the Demonstrate skills required for energy audit and management.
(iv) Understand the Suggest cost-effective measures towards improving energy efficient and energy conservation.

Module 1: Energy Conservation in Power Generation, Transmission and Distribution (6 hours)
Performance improvement of existing power plant: co-generation, small hydro, DG Set, Demand side management, Load response programmes, Types of tariff and restructuring of electric tariff.

Module 2: Energy Audit Methodology and recent trends (10 hours)
General Philosophy need of Energy Audit and Management, EC Act, Definition and Objective of Energy Management, General Principles of Energy Management. Energy Management Skills, Energy Management Strategy. Economics of implementation of energy optimization projects, it's constraints, barriers and limitations, Report-writing, preparations and presentations of energy audit reports, Post monitoring of energy conservation projects, MIS, Case-studies / Report studies of Energy Audits. Impact of renewable energy on energy audit recommendations.

Module 3: Thermal Systems (10 hours)
Boilers- performance evaluation, Loss analysis, Water treatment and its impact on boiler losses, integration of different systems in boiler operation. Furnaces- Types and classifications, applications, economics and quality aspects, heat distributions, draft controls, waste heat recovering options, Furnaces refractory- types and sections. Thermic Fluid heaters need and applications, Heat recovery and its limitations.

Module 4: Energy Audit (8 hours)
Energy audit and its benefits, Energy flow diagram, Preliminary, Detailed energy audit., Methodology of preliminary energy audit and Detailed energy audit – Phase I, Pre audit, Phase II- Audit and Phase III- Post audit, Energy audit report., Electrical Measuring Instruments - Power Analyser, Combustion analyser, fuel efficiency monitor, thermometer-contact, infrared, pitot tube and manometer, water flowmeter, leak detector, tachometer and luxmeter, IE rules and regulations for energy audit, Electricity act.

Module 5: Energy Conservation Approaches in Industries (8 hours)
Energy saving opportunities in electric motors, Benefits of Power factor improvement and its techniques-Shunt capacitor, Synchronous Condenser etc., Effects of harmonics on – Motors, and remedies leading to energy conservation, Area Sealing, Insulating the Heating / cooling fluid pipes, automatic door closing- Air curtain, Thermostat / Control., Lighting techniques – Natural, CFL, LED lighting sources and fittings. Introduction to green buildings

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University

Textbooks:

1. Energy Audit and Management, Volume-I, IECC Press
2. Energy Efficiency in Electrical Systems, Volume-II, IECC Press
3. W. R. Murphy, G. Mckay, Energy Management: Butterworths Scientific
4. C. B. Smith, Energy Management Principles, Pergamon Press
5. D.A. Reay, Industrial Energy Conservation, Pergammon Press
6. W.C. Turner, Energy Management Handbook, John Wiley and Sons, A Wiley Interscience
7. L.C. Witte, P.S. Schmidt, D.R. Brown, Industrial Energy Management and Utilization, Hemisphere Publication, Washington, 1988.
8. Handbook of Energy Audits, Albert Thumann, P.E., C.E.M. William J. Younger, C.E.M., CRC Press.

OEE-104-18	**Renewable Energy Sources**	**3L:0T:0P**	**3 credits**

Internal Marks: 40 *External Marks: 60* *Total Marks: 100*

Course Outcomes:
At the end of this course, students will demonstrate the ability to
- (i) Knowledge of the basic properties of different renewable sources of energy and technologies
- (ii) Knowledge of the main elements of technical systems designed for utilization of renewable sources of energy
- (iii) Understand the advantages and disadvantages of different renewable sources of energy
- (iv) Understand the energy potential of renewable sources of energy,

Module 1: Solar Radiation and Solar Energy Collection (12 hours)
Role and potential of new and renewable source, the solar energy option, Environmental impact of solar power, physics of the sun, the solar constant, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data.

Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors. Solar Applications- solar heating/cooling technique, solar distillation and drying, photovoltaic energy conversion.

Module 2: Wind Energy (8 hours)
Energy availability of wind, wind resources, principle of wind energy conservation. Wind turbine site and its site selection, classification of wind turbine, characteristics of wind turbine.

Module 3: Bio-Mass (8 hours)
Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking.

Module 4: Geothermal Energy (6 hours)
Resources, types of wells, methods of harnessing the energy, potential in India.

Module 5: Ocean Energy (8 hours)
OTEC, Principles utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques, mini-hydel power plants, and their economics.

Text/References:
1. Non-Conventional Energy Sources /G.D. Rai, Khanna Publishers
2. Renewable Energy Resources – Twidell &Wier, CRC Press (Taylor & Francis)
3. Renewable energy resources/ Tiwari and Ghosal/ Narosa.
4. Ramesh & Kumar, Renewable Energy Technologies / /Narosa
5. D. P. Kothari, K. C. Singhal, Renewable energy sources and emerging technologies, P.H.I.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144606

330

OEE-201-18	Electric Machines	3L:0T:0P	3 credits

Internal Marks: 40   *External Marks: 60*   *Total Marks: 100*

Course Outcomes:

At the end of this course, students will demonstrate the ability to

(i) Summarize the basics of Single-Phase Machines
(ii) Acquire knowledge about testing and applications of induction motors.
(iii) Understand the concepts of Steeper Motors, construction, modes of operation and characteristics
(iv) Understand the basic concept of DC Machines and its torque slip characteristics
(v) Explain the basic concepts of universal and repulsion motors, construction, application.

Module 1: Poly-phase AC Machines (9 hours)

Construction of three phase induction motors, types of three-phase induction motors, rotor induced emf, power flow in induction motor, equivalent circuit of induction motor, Torque -speed characteristics, condition of maximum torque, tests on induction motor: measurement of DC resistance, No-load test, blocked rotor test. Braking: Plugging, rheostatic braking and regenerative braking.

Module 2: Single phase Induction Motors (8 hours)

Pulsating magnetic field, double revolving field, starting methods of single-phase induction motor, Construction, starting characteristics and applications of split phase, capacitor start, capacitor run, capacitor-start capacitor-run and shaded pole motors. Servo motors: DC Sevomotor and AC servo motor,

Module 3: Stepper Motors (8 hours)

Principle of operation, variable reluctance, permanent magnet and hybrid stepper motors, characteristics, drive circuits and applications. Switched Reluctance Motors: Construction; principle of operation; torque production, modes of operation, drive circuits.

Module 4: Permanent Magnet Machines (9 hours)

Types of permanent magnets and their magnetization characteristics, demagnetizing effect, permanent magnet dc motors, sinusoidal PM ac motors, brushless dc motors and their important features and applications, PCB motors. Single phase synchronous motor; construction, operating principle and characteristics of reluctance and hysteresis motors; introduction to permanent magnet generators and applications

Module 5: Special Machines (8 hours)

Construction, principle of operation of: Single phase AC commutator motor, Switched Reluctance motor, brushless dc motor, hysteresis Motor, Synchronous reluctance motor, Linear induction motor.

Text / Reference Books:

1. P.S. Bimbhra, Generalized Theory of Electrical Machines, Khanna Publishers.
2. P.C. Sen, Principles of Electrical Machines and Power Electronics, John willey & Sons, 2001
3. G. K. Dubey, Fundamentals of Electric Drives, Narosa Publishing House, 2001.
4. C. G. Veinott, Fractional and Sub-fractional horsepower electric motors, McGraw Hill International, 1987
5. M.G. Say, Alternating current Machines, Pitman & Sons.

331

OEE-202-18	**Industrial Electrical Systems**	**3L:0T:0P**	**3 credits**

Internal Marks: 40 *External Marks: 60* *Total Marks: 100*

Course Outcomes:

(i) At the end of this course, students will demonstrate the ability to
(ii) Understand the electrical wiring systems for residential, commercial, and industrial consumers, representing the systems with standard symbols and drawings, SLD.
(iii) Understand various components of industrial electrical systems.
(iv) Analyze and select the proper size of various electrical system components.

Module 1: Electrical System Components (10 Hours)
LT system wiring components, selection of cables, wires, switches, distribution box, metering system, Tariff structure, protection components- Fuse, MCB, MCCB, ELCB, inverse current characteristics, symbols, single line diagram (SLD) of a wiring system, Contactor.,

Module 2: Residential and Commercial Electrical Systems (9 Hours)
Types of residential and commercial wiring systems, general rules and guidelines for installation, load calculation and sizing of wire, rating of main switch, distribution board and protection devices, earthing system calculations, requirements of commercial installation, deciding lighting scheme and number of lamps, earthing of commercial installation, selection and sizing of components.

Module 3: Illumination Systems (9 Hours)
Understanding various terms regarding light, lumen, intensity, candle power, lamp efficiency, specific consumption, glare, space to height ratio, waste light factor, depreciation factor, various illumination schemes, Incandescent lamps and modern luminaries like CFL, LED and their operation, energy saving in illumination systems, design of a lighting scheme for a residential and commercial premise, flood lighting.

Module 4: Industrial Electrical Systems I (9 Hours)
HT connection, industrial substation, Transformer selection, Industrial loads, motors, starting of motors, Cable and Switchgear selection, Power factor correction – kVAR calculations, type of compensation, Introduction to PCC, MCC panels. Specifications of LT Breakers, MCB and other LT panel components.

Module 5: Electrical Protection (5 Hours)
Lightning protection, Earthing, circuit breakers, isolators.

Text/Reference Books

6. S. L. Uppal and G. C. Garg, Electrical Wiring, Estimating & Costing, Khanna publishers, 2008.
7. K. B. Raina, Electrical Design, Estimating & Costing, New age International, 2007.
8. S. Singh and R. D. Singh, Electrical estimating, and costing, Dhanat Rai and Co., 1997.
9. Web site for IS Standards.
10. H. Joshi, Residential Commercial and Industrial Systems, McGraw Hill Education, 2008.

332

OEE-203-18	**Wind and Solar Energy Systems**	**3L:0T:0P**	**3 credits**

Internal Marks: 40 *External Marks: 60* *Total Marks: 100*

Course Outcomes:

At the end of this course, students will demonstrate the ability to

(i) Understand the energy scenario and the consequent growth of the power generation from renewable energy sources.
(ii) Understand the basic physics of wind and solar power generation.
(iii) Understand the power electronic interfaces for wind and solar generation.
(iv) Understand the issues related to the solar technologies and wind topologies.

Module 1: Physics of Wind Power (8 Hours)

History of wind power, Indian and Global statistics, Wind physics, Betz limit, Tip speed ratio, stall and pitch control, Wind speed statistics-probability distributions, Wind speed and power-cumulative distribution functions.

Module 2: Wind generator topologies (14 Hours)

Review of modern wind turbine technologies Fixed and Variable speed wind turbines, Induction Generators, Doubly-Fed Induction Generators and their characteristics, Permanent-Magnet Synchronous Generators, Power electronics converters. Generator-Converter configurations, Converter Control.

Module 3: The Solar Resource (6 Hours)

Introduction, solar radiation spectra, solar geometry, Earth Sun angles, observer Sun angles, solar day length, Estimation of solar energy availability.

Module 4: Solar photovoltaic (8 Hours)

Technologies-Amorphous, monocrystalline, polycrystalline; V-I characteristics of a PV cell, PV module, array, Power Electronic Converters for Solar Systems, Maximum Power Point Tracking (MPPT) algorithms.

Module 5: Solar thermal power generation (4 Hours)

Technologies, Parabolic trough, central receivers, parabolic dish, Fresnel, solar pond, elementary analysis.

Text / References:

1. T. Ackermann, Wind Power in Power Systems, John Wiley and Sons Ltd., 2005.
2. G. M. Masters, Renewable and Efficient Electric Power Systems, John Wiley and Sons, 2004.
3. S. P. Sukhatme, Solar Energy: Principles of Thermal Collection and Storage, McGraw Hill, 1984.
4. H. Siegfried and R. Waddington, Grid integration of wind energy conversion systems, John Wiley and Sons Ltd., 2006.
5. G. N. Tiwari and M. K. Ghosal, Renewable Energy Applications, Narosa Publications, 2004.
6. J. A. Duffie and W. A. Beckman, Solar Engineering of Thermal Processes, John Wiley & Sons, 1991.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

333

OEE-204-18	**Power Systems**	**3L:0T:0P**	**3 credits**

Internal Marks: 40 *External Marks: 60* *Total Marks: 100*

Course Outcomes:

At the end of this course, students will demonstrate the ability to

(i) Awareness of supply system
(ii) Understanding of the material used and construction of transmission lines
(iii) Enable the students to do analysis of power transmission line parameters.
(iv) Understand the cables used in power system
(v) Knowledge of neutral grounding.

Module 1: Supply System (8 hours)

Introduction to Transmission and Distribution systems, Comparison between DC and AC systems for Transmission and Distribution, comparison of cost of conductors, choice of working voltage for transmission and distribution, economic size of conductors - Kelvin's law, Radial and mesh distribution networks, Voltage regulation.

Module 2: Conductors and Transmission Line Construction (8 hours)

Conductor materials; solid, stranded, ACSR, hollow and bundle conductors. Different types of supporting structures for overhead lines. Elementary ideas about transmission line construction and erection. Stringing of conductors, spacing, sag and clearance from ground, overhead line insulators, concept of string efficiency.

Module 3: Transmission Line Parameters (10 hours)

Introduction to line parameters, Resistance of transmission line, inductance of single phase two wire line, concept of G.M.D., Inductance of three phase line, Use of bundled conductor, transposition of power lines, capacitance of 1-phase and 3-phase lines. effect of earth on capacitance of conductors.

Module 4: Underground Cables (8 hours)

Classification of cables based upon voltage and dielectric material, insulation resistance and capacitance of single core cable, dielectric stress, Capacitance of 3 core cables, methods of laying, heating effect, Maximum current carrying capacity, cause of failure, comparison with overhead transmission lines.

Module 5: Neutral grounding (8 hours)

Necessity of neutral grounding, various methods of neutral grounding, earthing transformer, grounding practices

Text/Reference Books:

11. W. D. Stevenson, Element of Power System Analysis, McGraw Hill.
12. C. L. Wadhwa, Electrical Power Systems, New age international Ltd. Third Edition
13. Asfaq Hussain, 'Power System, CBS Publishers and Distributors.
14. B. R. Gupta, Power System Analysis and Design, Third Edition, S. Chand & Co.
15. M. V. Deshpande, Electrical Power System Design, Tata Mc Graw Hill. Reference Books.
16. S.N. Singh, "Electric Power Generation, Transmission& distribution." PHI Learning

334

List of Humanities & Social Sciences Including Management

Sr. No.	Course Code	Course Title	Hours per week	Credit
1.	HSMC-103-18	Education, Technology and Society	3L:0T:0P	3
2.	HSMC-104-18	History of Science and Technology in India	3L:0T:0P	3
3.	HSMC-113-18	Values and Ethics	3L:0T:0P	3
4.	HSMC-118-18	Introduction to Women's and Gender Studies	3L:0T:0P	3
5.	HSMC-123-18	Human Relations at Work	-	-
6.	HSMC-124-18	Sanskrit Bhasa	3L:0T:0P	3
7.	HSMC (MME-303)	Law and Engineering	3L:0T:0P	3

Note: (a) On account of a prerequisite, course HSMC-123-18 Human Relations at Work not to be considered. (b) As per AICTE Humanities & Social Sciences Including Management are 3 credit course hence Hours per week to be 3L:0T:0P.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

335

HSMC-103-18	Education, Technology and Society	**3L:0T:0P**	**3 credits**

Internal Marks: 40 External Marks: 60 Total Marks: 100

OBJECTIVES:
The goal of the proposed course is to enable students:

i. To explore the various ways in which technology has and may in future affect not only the mode of delivery of education but also the very nature of education.
ii. To understand the requirement of (a) education for becoming an effective member of the society (b) To fulfill the potential of a learner to the fullest without too much thought of an individual's responsibility towards the contemporary society.

COURSE TOPICS:
Unit 1: Necessity of education for human life, Impact of education on society
Unit 2: Nature and scope of education (Gurukul to ICT driven), Emotional intelligence Domains of learning, Approaches to learning, Learning outcomes
Unit 3: Role of education in technology advancement.
Unit 4: Technology and society; management of technology; technology transfer
Unit 5: Ethical and value implications of education and technology on individual and society

COURSEOUTCOME:
On successful completion of this course, the students will be able to integrate their technical education for betterment of society as well motivates them to lead a good human life.

REFERENCEBOOKS:
Education and Social order by Bertr and Russel
Theories of learning by Bower and Hilgard
Technology and Society by Jan L Harrington

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

336

HSMC-104-18	History of Science and Technology in India	**3L:0T:0P**	**3 credits**

Internal Marks: 40 External Marks: 60 Total Marks: 100

Unit-I CONCEPTS AND PERSPECTIVES

- Meaning of History
- Objectivity, Determinism, Relativism, Causation, Generalization in History; Moral judgment in history
- Extent of subjectivity, contrast with physical sciences, interpretation and speculation, causation verses evidence, concept of historical inevitability, Historical Positivism.
- Science and Technology-Meaning, Scope and Importance, Interaction of science, technology & society, Sources of history on science and technology in India.

Unit-II: HISTORIOGRAPHY OF SCIENCE AND TECHNOLOGY IN INDIA

- Introduction to the works of D.D. Kosambi, Dharmpal, Debiprasad Chattopadhyay, Rehman, S. Irfan Habib, Deepak Kumar, Dhruv Raina, and others.

Unit-III: SCIENCE AND TECHNOLOGY IN ANCIENT INDIA

- Technology in pre-historic period
- Beginning of agriculture and its impact on technology
- Science and Technology during Vedic and Later Vedic times
- Science and technology from 1st century AD toC-1200.

Unit-IV: SCIENCE AND TECHNOLOGY IN MEDIEVAL INDIA

- Legacy of technology in Medieval India, Interactions with Arabs
- Development in medical knowledge, interaction between Unani and Ayurveda and alchemy
- Astronomy and Mathematics: interaction with Arabic Sciences
- Science and Technology on the eve of British conquest

Unit-V: SCIENCE AND TECHNOLOGY IN COLONIAL INDIA

- Science and the Empire
- Indian response to Western Science
- Growth of techno-scientific institutions

Unit-VI: SCIENCE AND TECHNOLOGY IN A POST-INDEPENDENT INDIA

- Science, Technology and Development discourse
- Shaping of the Science and Technology Policy
- Developments in the field of Science and Technology
- Science and technology in globalizing India
- Social implications of new technologies like the Information Technology and Biotechnology

337

HSMC-113-18	Values and Ethics	3L:0T:0P	3 credits

Internal Marks: 40 External Marks: 60 Total Marks: 100

1. Definition and classification of values: Extrinsic values, Universal and Situational values, Physical, Environmental, Sensuous, Economic, Social, Aesthetic, Moral and Religious values.
2. Concepts related to values: Purusartha, Virtue, Right, duty, justice, Equality, Love and Good.
3. Egoism, Altruism and universalism.
4. The Ideal of Sarvodaya and Vasudhaiva Kutumbakam. The Problem of Sustenance of value in the process of Social, Political and Technological changes.
5. The Problem of hierarchy of values and their choice, The views of Pt. Madan Mohan Malviya and Mahatma Gandhi.

BOOKS SUGGESTED

1. डॉनित्यानंदमिश्र : नीतिशास्त्र (Motilal Banarasidas, 2005)
2. डॉवेदप्रकाशवर्मा : नीतिशास्त्रकेमूलसिद्धांत, (Allied Publication, Delhi, 1977)
3. डॉसंगमलालपांडे : नीतिशास्त्रकासर्वेक्षण (सेंट्रलपब्लिशिंगहादस, इलाहाबाद-2005)
4. Little, William, : An Introduction of Ethics (allied Publisher, Indian Reprint 1955)
5. William, K Frankena : Ethics (Prentice Hall of India, 1988)
6. Dr. Awadesh Pradhan : Mahamana ke Vichara. (B.H.U., Vanarasi-2007)

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

338

HSMC-118-18	Introduction to Women's and Gender Studies	**3L:0T:0P**	**3 credits**

Internal Marks: 40 External Marks: 60 Total Marks: 100

Unit-I : Concepts

Sex vs. Gender, masculinity, femininity, socialization, patriarchy, public/ private, essentialism, binaryism, power, hegemony, hierarchy, stereotype, gender roles, gender relation, deconstruction, resistance, sexual division of labour.

Unit-II: ***Feminist Theory***

Liberal, Marxist, Socialist, Radical, Psychoanalytic, postmodernist, ecofeminist.

Unit-III: ***Women's Movements: Global, National and Local***

Rise of Feminism in Europe and America.
Women's Movement in India.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

Unit-IV: ***Gender and Language***

Linguistic Forms and Gender.
Gender and narratives.

Unit-V: ***Gender and Representation***

Advertising and popular visual media.
Gender and Representation in Alternative Media.
Gender and social media.

339

HSMC-124-18	Sanskrit Bhasa	3L:0T:0P	3 credits

Internal Marks: 40 External Marks: 60 Total Marks: 100

- शब्दस्वरूप एवंभेद
- उच्चारण–स्थान एवंप्रयत्न
- पदसंरचना
  - (क) पदस्वरूप, भेद एवंप्रयोग
  - (ख) सुबन्तपद
  - (ग) तिङन्तपद
- वाक्यसंरचना
  - (क) वाक्यस्वरूप, भेद एवंप्रयोग
  - (ख) कर्तृवाच्य
  - (ग) कर्मवाच्य
  - (घ) भाववाच्य
- शब्द–अर्थ–सम्बन्ध
  - (क) शक्ति
  - (ख) लक्षणा
  - (ग) गौणी, व्यञ्जना, तात्पर्यआदि
- कारकपरिचय
  - (क) कारकस्वरूप, भेद एवंप्रयोग
  - (ख) विभक्तियोंकाअर्थ
- सन्धिपरिचय–सन्धिस्वरूप, भेद एवंप्रयोग
- समासपरिचय–स्वरूप, भेद एवंप्रयोग
- शाब्दबोध–प्रक्रिया एवंकारण

  आकांक्षा, योग्यता, आसत्ति, तात्पर्यज्ञान
- संस्कृतसम्भाषण

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

340

HSMC (MME-303)	Law and Engineering	**3L:0T:0P**	**3 credits**
Internal Marks: 40	External Marks: 60	Total Marks: 100	

The aim of this course is to provide a basic understanding of the legal concepts and issues relevant to those wishing to practice as Engineers.

1. THE LEGAL SYSTEM: SOURCES OF LAW AND THE COURTSTRUCTURE:
   1.1 Enacted law -Acts of Parliament are of primary legislation, Common Law or Case law-Principles taken from decisions of judges constitute binding legal rules.
   1.2 The Court System in India and Foreign Courtiers. (District Court, District Consumer Forum, Tribunals, High Courts, Supreme Court)
   1.3 Arbitration: As an alternative to resolving disputes in the normal courts, parties who are in dispute can agree that this will instead be referred to arbitration.
2. BASIC PRINCIPLES OF CONTRACTLAW
3. SALE OF GOODSLAW
4. BUSINESSORGANISATIONS:
   4.1 SOLE TRADERS (Business has no separate identity from you, all business property belongs to you)
   4.2 PARTNERSHIPS: There are three types of Partnerships: Limited Liability Partnership, General Partnership, Limited Partnerships
   4.3 COMPANIES:
      - The nature of companies.
      - Classification of companies.
      - Formation of companies.
      - Features of a public company.
      - Carrying on business.
      - Directors –Their Powers and Responsibilities/Liabilities.
5. LAWS RELATING TO INDUSTRIAL POLLUTION ACCIDENT, ENVIRONMENTAL PROTECTION, HEALTH AND SAFETY AT WORK.
6. PATENTLAW.
7. INFORMATION TECHNOLOGY LAW AND CYBERCRIMES.
8. LAW AND SOCIETY: INTERDISCIPLINARY NATURE OF LAW, LEGAL IDEOLOGIES/PHILOSOPHY/ SCHOOLS OFJURISPRUDENCE.
9. CONSTITUTIONAL LAW: THE SUPREME LAW OF THELAND.
10. CASE STUDIES: IMPORTANT LEGAL DISPUTES AND JUDICIALLITIGATIONS.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

341

324

Semester: VII/VIII

[Fourth Year]

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

342
825

BTEE-721-18	Project-2	0L:0T:12P	6 credits

Internal Marks: 120 **External Marks: 80** **Total Marks: 200**

Course Outcomes:

At the end of this course, students will demonstrate the ability to:

CO 1 Apply and verify basic scientific principals and technologies.

CO 2 Application of interdisciplinary knowledge

CO 3 To identify possible product that can be made from the project for commercial purpose.

The objective of Project-2 including dissertation is to enable the student to extend further the investigative study taken up under Project-1, either fully theoretical/practical or involving both theoretical and practical work, under the guidance of a supervisor from the department alone or jointly with a supervisor drawn from R&D laboratory/industry/other department in the institute. This is expected to provide a good training for the student (s) in R&D work and technical leadership. The assignment to normally include:

1) In depth study of the topic assigned in the light of the report prepared under Project-1
2) Review and finalization of the approach to the assigned topic
3) Preparing an action plan for conducting the investigation, including teamwork
4) Need based detailed analysis/modelling/simulation/design/problem solving/experiment.
5) Final development of product/process, testing, results, conclusions and future directions/scope
6) Preparing a dissertation in the standard format for being evaluated by the department.
7) Final seminar presentation before a departmental committee.
8) Preparing a paper for conference presentation/publication in journals, if possible.

Note: The report submitted should be within the philosophy of science and ethics and publication ethics. Proper citation to be done so as to avoid plagiarism.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

343

BMPD-701-18	Mentoring and Professional Development of Students	0L:1T:0P	0 credits S/US

Internal Marks: 50 **External Marks: 00** **Total Marks: 50**

The assigned mentor to engage the students to in activities such as:

1) Identification of any one of the local social concern and propose workable solution for it.
2) Expert/Invited talk pertaining to recent industrial development.
3) Explore scope of higher education: GATE/GRE/CAT/civil services/engineering services etc.
4) Resume finalization.

The mentor to keep record of all activities (including those mentioned above) and assign internal marks accordingly.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

344

Programme Electives

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

345

BTEE-701A-18	Electrical Energy Conservation and Auditing	3L:0T:0P	3 credits

Internal Marks: 40 **External Marks: 60** **Total Marks: 100**

Course Outcomes:

At the end of this course, students will demonstrate the ability to:

CO 1 Understand the current energy scenario and importance of energy conservation. Understand the concepts of energy management.

CO 2 Understand the methods of improving energy efficiency in different electrical systems.

CO 3 Understand the concepts of different energy efficient devices.

Module 1: Energy Scenario (6 Hours)

Commercial and non-commercial energy, primary energy resources, commercial energy production, final energy consumption, energy needs of growing economy, long term energy scenario, energy pricing, energy sector reforms, energy and environment, energy security, energy conservation and its importance, restructuring of the energy supply sector, energy strategy for the future, air pollution, climate change. Energy Conservation Act-2001 and its features.

Module 2: Energy Management & Audit (6 Hours)

Definition, energy audit, need, types of energy audit. Energy management (audit) approach-understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel energy substitution, energy audit instruments. Material and energy balance: Facility as an energy system, methods for preparing process flow, material and energy balance diagrams.

Module 3: Energy Efficiency in Electrical Systems (7 Hours)

Electrical system: Electricity billing, electrical load management and maximum demand control, power factor improvement and its benefit, selection and location of capacitors, performance assessment of PF capacitors, distribution and transformer losses. Electric motors: Types, losses in induction motors, motor efficiency, factors affecting motor performance, rewinding and motor replacement issues, energy saving opportunities with energy efficient motors.

Module 4: Energy Efficiency in Industrial Systems (8 Hours)

Compressed Air System: Types of air compressors, compressor efficiency, efficient compressor operation, Compressed air system components, capacity assessment, leakage test, factors affecting the performance and savings opportunities in HVAC, Fans and blowers: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities. Pumps and Pumping System: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities. Cooling Tower: Types and performance evaluation, efficient system operation, flow control strategies and energy saving opportunities, assessment of cooling towers.

Module 5: Energy Efficient Technologies in Electrical Systems (8Hours)

Maximum demand controllers, automatic power factor controllers, energy efficient motors, soft starters with energy saver, variable speed drives, energy efficient transformers, electronic ballast, occupancy sensors, energy efficient lighting controls, energy saving potential of each technology.

Text/Reference Books

1. Guide books for National Certification Examination for Energy Manager/Energy Auditors Book-1, General Aspects (available online).
2. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-3, Electrical Utilities (available online).
3. S. C. Tripathy, "Utilization of Electrical Energy and Conservation", McGraw Hill, 1991.
4. Success stories of Energy Conservation by BEE, New Delhi (www.bee-india.org).

346

BTEE-701B-18	Computer Aided Power System Analysis	3L:0T:0P	3 credits
Internal Marks: 40	**External Marks: 60**	**Total Marks: 100**	

Course Outcomes:

At the end of this course, students will demonstrate the ability to:

CO 1 To introduce computer applications in the analysis of power systems.

CO 2 To understand the solution methods and techniques used in power system studies.

CO 3 To solve numerically the complex IEEE bus networks and the energy flows.

Module 1: Graphical Concepts and Network Matrices (8 Hours)

Overview of graph theory -tree, co-tree and incidence matrix, development of network matrices from Graph theoretic approach. Review of solution of linear system of equations by Gauss Jordan method, Gauss elimination, LDU factorization.

Ybus and Zbus formulation through graphical concepts. Bus building algorithm for Zbus formation.

Module 2: Power Flow Studies (16 Hours)

Inversion of YBUS for large systems using LDU factors, Tinney's Optimal ordering. Review of Gauss-Seidel Iteration using YBUS, Newton-Raphson method, Fast Decoupled Load Flow (FDLF) DC load flow, Three-phase load flow.

Module 3: Optimal Power Flow (6 Hours)

Basics concepts, active/reactive power objectives (Economic dispatch, MW and MVAr loss minimization)-applications-security constrained optimal power flow.

Module 4: Fault Analysis (10 Hours)

Network fault calculations using ZBUS and YBUS Table of factors, Algorithm for calculating system conditions after fault-three phase short circuit, three-phase to ground, double line to ground, line to line and single line to ground fault.

Module 5: Contingency Evaluation (6 Hours)

Contingency evaluation using ZBUS and YBUS Table of factors. State estimation-least square and weighted least square estimation methods for linear systems.

Text/References

1. A. R. Bergen, and V. Vittal, "Power Systems Analysis", Pearson Higher Education, 2nd edition.
2. G. L. Kusic, "Computer Aided Power System Analysis", Prentice Hall of India, 1989.
3. J. J. Grainger, and W. D. Stevenson, "Power System Analysis", Tata McGraw-Hill Series in Electrical and Computer Engineering.
4. M. A. Pai, "Computer Techniques in Power Systems Analysis", Tata McGraw-Hill, 2nd edition, 2005.
5. D P Kothari and I J Nagrath, Modern Power System Analysis, Tata Mc Graw Hill, Fourth Edition, 2013.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

347

BTEE-701C-18	Power Quality and FACTS	3L:0T:0P	3 credits

Internal Marks: 40 **External Marks: 60** **Total Marks: 100**

Course Outcomes:

At the end of this course, students will demonstrate the ability to:

CO 1 To introduce the fundamental concepts relevant to harmonics and grounding.

CO 2 To enable the students to understand the factors that cause the power quality and harmonics problems in the distribution system.

CO 3 To provide basic understanding of the emerging power electronics technologies for power utility applications.

CO 4 To enable students to design power electronics circuit that can control active and reactive power flow.

Module 1: Introduction (4 Hours)

Introduction to power quality, voltage quality. Overview of power quality, Power quality phenomena and classification of power quality issues.

Module 2: Power Quality Measures and Standards (6 Hours)

THDTIF-DIN-message weights-flicker factor transient phenomena-occurrence of power quality problems-power acceptability curves-IEEE guides, EMC standards and recommended practices.

Module 3: Harmonic device modelling (10 Hours)

Harmonics background, basic concepts, Fourier analysis. Harmonics-individual and total harmonic distortion-RMS value of harmonic waveform-triplex harmonic-important harmonic introducing devices-Transformer, Three-phase power converters arcing devices-saturable devices. Harmonic distortion due to fluorescent lamps. Effect of power system harmonics on power system equipment and loads

Module 4: Fundamentals of transmission system (8 Hours)

Fundamentals of AC power transmission, transmission problems and needs, emergence of FACTS-FACTS control considerations, FACTS controllers.

Module 5: Shunt Compensation & Series Compensation (14 Hours)

Principles of shunt compensation: Variable impedance type and switching converter type- Static Synchronous Compensator (STATCOM) configuration, characteristics and control.
Design principles of static series compensation: Series compensation using GCSC, TCSC and TSSC, applications, Static Synchronous Series Compensator (SSSC).

Text/References

1. R. C. Dugan, S. Santoso, M. F. McGranaghan, and H. W. Beaty, "Electrical Power System Quality", McGraw Hill, 2003.
2. A. Ghosh, and G. Ledwich, "Power Quality Enhancement Using Custom Power Devices", Kluwer Academic Publishers, 2012.
3. C. Sankaran, "Power Quality", CRC Press, 2002.
4. S. Sivanagaraju, and S. Satyanarayana, "Electric Power Transmission and Distribution Pearson Education", Dorling Kindersley Pvt. Ltd., Pearson Education, 2009.
5. G. Narain, N. Hingorani, and L. Gyugyi, "Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems", Wiley, 2000.

348

BTEE-701D-18	Electrical and Hybrid Vehicles	3L:0T:0P	3 credits

Internal Marks: 40 **External Marks: 60** **Total Marks: 100**

Course Outcomes:

At the end of this course, students will demonstrate the ability to:

CO 1 Understand the conventional vehicles models and electric trains.

CO 2 Understand the different possible ways of energy storage.

CO 3 Compare the different strategies related to energy storage systems and knowledge of the implementation issues

Module 1: Introduction (10 hours)

Conventional vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, mathematical models to describe vehicle performance.

Introduction to hybrid electric vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies.

Hybrid electric drive-trains: Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.

Module 3: Electric Trains (10 hours)

Electric drive-trains: Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis. Electric propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of induction motor drives, configuration and control of permanent magnet motor drives, Configuration and control of switch reluctance motor drives, drive system efficiency.

Module 4: Energy Storage (10 hours)

Energy Storage: Introduction to energy storage requirements in hybrid and electric vehicles, Battery based energy storage and its analysis, Fuel cell-based energy storage and its analysis, Super-capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices. Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, communications, supporting subsystems

Module 5: Energy Management Strategies (9 hours)

Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies.

Case Studies: Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV).

Text/References

1. C. Mi, M. A. Masrur, and D. W. Gao, "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", John Wiley & Sons, 2011.

2. S. Onori, L. Serrao, and G. Rizzoni, "Hybrid Electric Vehicles: Energy Management Strategies", Springer, 2015.

3. M. Ehsani, Y. Gao, S. E. Gay, and A. Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design", CRC Press, 2004.

4. T. Denton, "Electric and Hybrid Vehicles", Routledge, 2016.

Head
Department of Electrical Engineering
IK Gujral Punjab Technical University
Kapurthala-144603

349

BTEE-702A-18	Computational Electromagnetics	3L:0T:0P	3 credits
Internal Marks: 40	**External Marks: 60**		**Total Marks: 100**

Course Outcomes:

At the end of this course, students will demonstrate the ability to:

CO 1 Understand the basic concepts of Electrostatics and Electromagnetics.
CO 2 Understand computational techniques for computing fields.
CO 3 Apply the techniques to simple real-life problems.

Module 1: Introduction (7 hours)

Conventional design methodology, Computer aided design aspects-Advantages. Review of basic fundamentals of Electrostatics and Electromagnetics. Development of Helmhotz equation, energy transformer vectors- Poynting and Slepian, magnetic Diffusion-transients and time-harmonic.

Module 2: Analytical Methods (7 hours)

Analytical methods of solving field equations, method of separation of variables, Roth's method, integral methods- Green's function, method of images.

Module 3: Finite Difference Method (FDM) (7 hours)

Finite Difference schemes, treatment of irregular boundaries, accuracy and stability of FD solutions, Finite-Difference Time-Domain (FDTD) method- Uniqueness and convergence.

Module 4: Finite Element Method (FEM) (7 hours)

Overview of FEM, Variational and Galerkin methods, shape functions, lower and higher order elements, vector elements, 2D and 3D finite elements, efficient finite element computations.

Module 5: Special Topics and Applications (12 hours)

{Background of experimental methods-electrolytic tank, R-C network solution, Field plotting (graphical method)}, hybrid methods, coupled circuit-field computations, electromagnetic-thermal and electromagnetic-structural coupled computations, solution of equations, method of moments, Poisson's fields.

Applications: Low frequency electrical devices, static / time-harmonic / transient problems in transformers, rotating machines, actuators. CAD packages.

Text/Reference Books

1. P. P. Silvester, and R. L. Ferrari, "Finite Element for Electrical Engineers", Cambridge University press, 1996.
2. M. N. O. Sadiku, "Numerical Techniques in Electromagnetics", CRC press, 2001.

350

BTEE-702B-18	Microcontroller and PLC	3L:0T:0P	3 credits

Internal Marks: 40 **External Marks: 60** **Total Marks: 100**

Course Outcomes:

At the end of this course, students will demonstrate the ability to:

CO 1 To understand the working of a microprocessor/controller.
CO 2 To learn configuring and using different peripherals in a digital system.
CO 3 To compile and debug a Program in PLC

Module 1: Introduction (8 Hours)

Microprocessor, Micro-controllers and their comparison. The 8051 Architecture: Introduction, 8051 micro-controller hardware, input/output, pins, ports and circuits, external memory, counters and timers, serial data input/ output, interrupts

Module 2: 8051 Assembly Language Programming (8 Hours)

The mechanics of programming, assembly language programming process, programming tools and techniques, instruction set (data moving, logical operations, arithmetic operations, jump and call instructions)

Module 3: 8051 Microcontroller Design (8 Hours)

Micro-controller specification, external memory and memory space decoding, reset and clock circuits, expanding input and output (I/O), memory mapped I/O, memory address decoding, memory access times, testing the design, timing subroutines, lookup tables for the 8051, serial data transmission

Module 4: Microcontroller Applications (8 Hours)

Interfacing keyboards, displays, Digital-to-Analog (D/A) and Analog-to-Digital (A/D), multiple interrupts, serial data communications, introduction to the use of assemblers and simulators Embedded Systems: Introduction to PLDs and FPGA- architecture, technology and design issues, implementation of 8051 core.

Module 5: Programmable Logic Controllers (PLC) (8 Hours)

Introduction, operation of PLC, difference between PLC and Hardwired system, difference between PLC and Computer, relay logic and ladder logic, ladder commands and examples of PLC ladder diagram realization, PLC timers, PLC counters, PLC classification.

Text/References books

1. K. J. Ayala, "The 8051 Micro Controller-Architecture, Programming and Application", Penram International Publication, 2000.
2. J. B. Peatman, "Design with PIC Micro Controller", Prentice Hall of India, 1998.
3. A. K. Ray, and K. M. Bhurchandi, "Advanced Microprocessors and Peripherals; Architecture, Programming and Interfacing", Tata McGraw Hill, 3rd edition, 2013.
4. M. A. Mazidi, and J. G. Mazidi, "The 8051 Micro-controller and Embedded System", Pearson Education, 2007.
5. V. Udayashankara, and M. S. Mallikarjunaswamy, "8051 Microcontroller Hardware, Software and Applications", TataMcGraw Hill Education Pvt. Ltd., 2010.
6. S. Bhanot, "Process Control", Oxford Higher Education, 2007.
7. J. D. Otter, and J. Dan, "Programmable Logic Controller", PH International, Inc, 1988.
8. J. F. Hooper, "Introduction to PLCs", Carolina Academic Press, 2006.

351

BTEE-702C-18	Control Systems Design	3L:0T:0P	3 credits

Internal Marks: 40 **External Marks: 60** **Total Marks: 100**

Course Outcomes:

At the end of this course, students will demonstrate the ability to:

CO 1 Understand various design specifications.

CO 2 Design controllers to satisfy the desired design specifications using simple controller structures (P, PI, PID, compensators).

CO 3 Design controllers using the state-space approach.

Module 1: Design Specifications (6 hours)

Introduction to design problem and philosophy. Introduction to time domain and frequency domain design specification and its physical relevance. Effect of gain on transient and steady state response. Effect of addition of pole on system performance. Effect of addition of zero on system response.

Module 2: Design of Classical Control System in the time domain (8 hours)

Introduction to compensator. Design of lag, lead lag-lead compensator in time domain. Feedback and feed forward compensator design. Feedback compensation. Realization of compensators.

Module 3: Design of Classical Control System in frequency domain (8 hours)

Compensator design in frequency domain to improve steady state and transient response. Feedback and feed forward compensator design using bode diagram.

Module 4: Design of PID controllers (6 hours)

Design of P, PI, PD and PID controllers in time domain and frequency domain for first, second and third order systems. Control loop with auxiliary feedback-Feed forward control.

Module 5: Control System Design in state space (12 hours)

Review of state space representation. Concept of controllability & observability, effect of pole zero cancellation on the controllability & observability of the system, pole placement design through state feedback. Ackerman's Formula for feedback gain design. Design of Observer. Reduced order observer. Separation principle.

Various types of non-linearities. Effect of various non-linearities on system performance. Singular points. Phase plot analysis.

Text and Reference Books

1. N. S. Nise, "Control system Engineering", John Wiley, 2000.
2. I. J. Nagrath, and M. Gopal, "Control system engineering", Wiley, 2000.
3. M. Gopal, "Digital Control Engineering", Wiley Eastern, 1988.
4. K. Ogata, "Modern Control Engineering", Prentice Hall of India, 2010.
5. B. C. Kuo, "Automatic Control system", Prentice Hall of India, 1995.
6. J. J. D'Azzo, and C. H. Houpis, "Linear control system analysis and design (conventional and modern)", McGraw Hill, 1995.
7. R. T. Stefani, and G. H. Hostetter, "Design of feedback Control Systems", Saunders College Pub, 1994.

352
335

BTEE-702D-18	Distributed Generation	3L:0T:0P	3 credits
Internal Marks: 40	**External Marks: 60**		**Total Marks: 100**

Course Outcomes:

At the end of this course, students will demonstrate the ability to:

CO 1 To impart knowledge about distributed generation technologies

CO 2 Their interconnection in grid

CO 3 To understand relevance of power electronics in DG, to understand concept of microgrid

Module 1: Distributed Generation (DG) Technologies (8 Hours)

Introduction, Comparative study between conventional and non-conventional methods of power generation: energy crisis due to scarcity of fossil fuel, distributed generation (DG) overview and technology trend. Working principle, architecture and application of renewable DG technologies: Solar PV, bioenergy, wind energy, hydroelectricity, tidal power, wave energy, geothermal energy etc. Non-conventional technology based DGs: Fuel cells, CHP based microturbine, IC engines, etc. Storage based DGs: Storage technology: Battery, super capacitor, flywheel etc.

Module 2: Interconnection Issues and Standards of DGs (8 Hours)

Concept of distributed generations (DG) or distributed energy resources (DERs), topologies, selection of source, dependence on storage facilities, regulatory standards/framework, standards for interconnecting DGs to electric power systems: IEEE 1547. DG installation classes, security issues in DG implementations. Grid code and Islanding & non-islanding system

Module 3: Operational Features of Grid Connected DG Systems (8 Hours)

Grid interconnection issues for grid connected operation of various types of DG systems. Constraints on operational parameters: voltage, frequency, THD, response to grid abnormal operating conditions, islanding issues. Reliability, stability and power quality issues involved in grid connected operation of various DGs.

Module 4: Power Electronics and DG Systems (8 Hours)

Relevance of power electronics in DG applications, Power quality requirements and source switching using SCR based static switches, Distribution system loading, line drop model, series voltage regulators and on-line tap changers, power converter topologies, model and specifications for DG applications, issues filter designs, harmonic reduction,

Module 5: Control and Protection in DG Systems (6 Hours)

Control of DG inverters, phase locked loops, current control and DC voltage control for stand-alone and grid parallel operations. Protection of converters, power quality implication, acceptable ranges of voltage and frequency, reactive power compensation and active filtering.

Text/References

1. Renewable Energy-Power for a sustainable future, third edition, Edited by Godfrey Boyle, Oxford University Press, 2013.
2. A. Yezdani, and R. Iravani, "Voltage Source Converters in Power Systems: Modeling, Control and Applications", IEEE John Wiley Publications, 2009.
3. D. Neacsu, "Power Switching Converters: Medium and High Power", CRC Press, Taylor & Francis, 2006.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

358

BTEE-703A-18	Industrial Electrical Systems	3L:0T:0P	3 credits

Internal Marks: 40 **External Marks: 60** **Total Marks: 100**

Course Outcomes:

At the end of this course, students will demonstrate the ability to:

CO 1 Understand the electrical wiring systems for residential, commercial and industrial consumers, representing the systems with standard symbols and drawings, SLD.

CO 2 Understand various components of industrial electrical systems.

CO 3 Analyze and select the proper size of various electrical system components.

Module 1: Electrical System Components (8 Hours)

LT system wiring components, selection of cables, wires, switches, distribution box, metering system, Tariff structure, protection components- Fuse, MCB, MCCB, ELCB, inverse current characteristics, symbols, Single Line Diagram (SLD) of a wiring system, contactor, isolator, relays, MPCB, electric shock and electrical safety practices

Module 2: Residential and Commercial Electrical Systems (8 Hours)

Types of residential and commercial wiring systems, general rules and guidelines for installation, load calculation and sizing of wire, rating of main switch, distribution board and protection devices, earthing system calculations, requirements of commercial installation, deciding lighting scheme and number of lamps, earthing of commercial installation, selection and sizing of components.

Module 3: Illumination Systems (6 Hours)

Understanding various terms regarding light, lumen, intensity, candle power, lamp efficiency, specific consumption, glare, space to height ratio, waste light factor, depreciation factor, various illumination schemes, Incandescent lamps and modern luminaries like CFL, LED and their operation, energy saving in illumination systems, design of a lighting scheme for residential and commercial premises, flood lighting.

Module 4: Industrial Electrical Systems I (8 Hours)

HT connection, industrial substation, Transformer selection, Industrial loads, motors, starting of motors, SLD, cable and switchgear selection, lightning protection, earthing design, power factor correction-kVAR calculations, type of compensation, Introduction to PCC, MCC panels. Specifications of LT Breakers, MCB and other LT panel components.

Module 5: Industrial Electrical Systems II (12 Hours)

DG Systems, UPS System, Electrical Systems for the elevators, Battery banks, Sizing the DG, UPS and Battery banks, Selection of UPS and battery banks.

Study of basic PLC, Role of in automation, advantages of process automation, PLC based control system design, Panel metering and Introduction to SCADA system for distribution automation.

Text/Reference Books

1. S. L. Uppal, and G. C. Garg, "Electrical Wiring, Estimating & Costing", Khanna Publishers, 2008.
2. K. B. Raina, "Electrical Design, Estimating & Costing", New Age International, 2007.
3. S. Singh, and R. D. Singh, "Electrical estimating and costing", Dhanpat Rai and Co., 1997.
4. H. Joshi, "Residential Commercial and Industrial Systems", McGraw Hill Education, 2008.
5. Web site for IS Standards.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

354

Semester VII/VIII [Fourth year]			**Branch: Electrical Engineering**				
BTEE-721-18 One Semester Training	**Marks**					**Total Marks**	**Credits**
	Internal				**External**		
	Mid- semester		End-semester				
Evaluation by	***Institute***	***Industry***	***Institute***	***Industry***	***External Examiner***		
Software Training & Project	50	25	50	25	200	500	16
Industrial Training & Project	50	25	50	25			
Total	**300**				**200**	**500**	**16**

Note: In case a student goes for pre-placement training and such a training could be only software based or only hardware based or a combination of both. The report/evaluation in such a case to be made accordingly.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

385

Semester: VIII

[Fourth Year]

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

356

BTEE-703B-18	Restructured Power Systems	3L:0T:0P	3 credits
Internal Marks: 40	**External Marks: 60**		**Total Marks: 100**

At the end of this course, students will demonstrate the ability to:

CO 1 To impart knowledge about the restructuring and deregulation of power sector.

CO 2 To introduce the fundamental concepts relevant to transmission pricing, models of deregulation,

CO 3 To introduce the fundamental concepts relevant to ancillary services and international experience of deregulation.

CO4 To enable the students to understand the basic concepts of deregulation.

Module 1: Introduction (7 Hours)

Basic concept and definitions, privatization, restructuring, transmission open access, Fundamentals of Deregulation, Restructuring Models and Trading Arrangements, Different Models of Deregulation, Operation and control, wheeling charges and pricing. Motivations for Restructuring the Power Industry; Understanding the restructuring process, entities involved, the levels of competition, marketplace mechanisms, sector-wise major changes required.

Module 2: The Philosophy of Market Models (9 Hours)

Monopoly model, Single buyer model, Wholesale competition model, Retail competition model, distinguishing features of electricity as a commodity, Four pillars of market design, Cournot, Bertrand and Stackelberg competition model. Independent System Operator (ISO), Open Access Transmission Systems

Module 3: Transmission Congestion Management (10 Hours)

Transfer capability, Importance of congestion management, Effects of congestion, Classification of congestion management methods, ATC, TTC, TRM, CBM, ATC calculation using DC and AC model, Nodal pricing, Locational Marginal Prices (LMPs), Implications of nodal pricing, Price area congestion management.

Module 4: Ancillary Service Management (10 Hours)

Type and Classification of ancillary services, Sources of reactive power, Black start capability service, Provisions of ancillary services, Markets for ancillary services, Co-optimization of energy and reserve services, Loss of opportunity cost, International practices of ancillary services.

Module 5: Deregulation Scenario (6 Hours)

Differential Models of Deregulation UK model, California Model, China, California, Australian and New Zeeland Models, Deregulation in Asia including India.

Text/References:

1. Kankar Bhattacharya, Math H J. Bollen and Jaap E. Daalder, "Operation of Restructured Power Systems", Springer, 2001.
2. M. Shahidehpour and M. Alomoush, "Restructured Electric Power Systems – Operations, Trading and Volatility", CRC Press, 2001.
3. Loi Lei Lai (Ed), "Power System Restructuring and Deregulation: Trading, performance and Information Technology," John Wiley publications, 2001.
4. D. Krischen and G. Strabac "Fundaments of Power System Economics" New York, Wiley 2004

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

357

BTEE-703C-18	Advanced Electric Drives	3L:0T:0P	3 credits

Internal Marks: 40 **External Marks: 60** **Total Marks: 100**

Course Outcomes:

At the end of this course, students will demonstrate the ability to:

CO 1 Understand the operation of power electronic converters and their control strategies.

CO 2 Understand the vector control strategies for ac motor drives

CO 3 Understand the implementation of the control strategies using digital signal processors.

Module 1: Power Converters for AC drives (10 hours)

PWM control of inverter, selected harmonic elimination, space vector modulation, current control of VSI, three level inverter, Different topologies, SVM for 3 level inverter, Diode rectifier with boost chopper, PWM converter as line side rectifier, current fed inverters with self-commutated devices. Control of CSI, H bridge as a 4-Q drive.

Module 2: Induction motor drives (10 hours)

Different transformations and reference frame theory, modeling of induction machines, voltage fed inverter control-v/f control, vector control, direct torque and flux control (DTC).

Module 3: Synchronous motor drives (6 hours)

Modelling of synchronous machines, open loop v/f control, vector control, direct torque control, CSI fed synchronous motor drives.

Module 4: Permanent magnet motor drives (10 hours)

Introduction to various PM motors, BLDC and PMSM drive configuration, comparison, block diagrams, Speed and torque control in BLDC and PMSM.

Evolution of switched reluctance motors, various topologies for SRM drives, comparison, Closed loop speed and torque control of SRM.

Module 5: DSP based motion control (6 hours)

Use of DSPs in motion control, various DSPs available, realization of some basic blocks in DSP for implementation of DSP based motion control.

Text / References:

1. B. K. Bose, "Modern Power Electronics and AC Drives", Pearson Education, 2003.
2. P. C. Krause, O. Wasynczuk, and S. D. Sudhoff, "Analysis of Electric Machinery and Drive Systems", John Wiley & Sons, 2013.
3. H. A. Taliyat, and S. G. Campbell, "DSP based Electromechanical Motion Control", CRC press, 2003.
4. R. Krishnan, "Permanent Magnet Synchronous and Brushless DC motor Drives", CRC Press, 2009.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

358

BTEE-703D-18	Energy Storage System	3L:0T:0P	3 credits

Internal Marks: 40 **External Marks: 60** **Total Marks: 100**

Course Outcomes:

At the end of this course, students will demonstrate the ability to:

CO 1 Understand the different possible ways of energy storage.

CO 2 Understand the different strategies related to energy storage systems.

CO 3 Link the real-life examples with various industry related case studies.

Module 1: Introduction to Energy Storage (8 Hours)

Relevance and scenario. Perspective on development of Energy storage systems. Energy storage criteria, General concepts. Conventional batteries-fundamentals and applications. Grid connected and Off grid energy storage systems and requirements.

Module 2: Thermal and Mechanical storage (10 Hours)

Thermal properties of materials, Principle of operations, Efficiency factors, large scale and medium scale operations, Pros and Cons. Advances in thermal storage. Mechanical storage: Types of systems, Principle of operations, Emerging advances and technologies. case study: flywheel.

Module 3: Electrochemical Storage (8 Hours)

Materials, Principle of Operation, Challenges and research survey, Positive electrode materials, negative electrode materials, electrolytes.

Module 4: Fuel Cells and Hydrogen storage (8 Hours)

Principle of operation, challenges and Case studies. Magnetic storage: Principle of operation, emerging challenges, devices and technology review.

Module 5: Electro-optic and Optical storage (8 Hours)

Principles of operation, device fabrication, emerging devices and upcoming technologies.
Supercapacitors: Principle of operation, device fabrication, challenges and technical review.

Text/Reference Books

1. R. Huggins, "Energy Storage", Springer science and business media, 2010.
2. Y. Wu, "Lithium-Ion Batteries: Fundamentals and Applications (Electrochemical Energy Storage and Conversion)", CRC Press, 2015,
3. T. M. Letcher, "Storing Energy: with Special Reference to Renewable Energy Sources", Elsevier science, 2016.
4. P. T. Moseley, and J. Garche, "Electrochemical Energy Storage for Renewable Sources and Grid Balancing", Newnes, 2014.
5. D. Wang, and G. Cao, "Nanomaterials for Energy Conversion and Storage", World Scientific Publishing Company, 2017.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

359

One Semester Training

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

360

BTEE-801-18	Smart Grids		3L:0T:0P	3 credits
Internal Marks: 40	External Marks: 60	Total Marks: 100		

Course Outcomes:

At the end of this course, students will demonstrate the ability to:

CO 1 Understand technologies for smart grid.
CO 2 Appreciate the smart transmission as well distribution systems.
CO 3 Realize the distribution generation and smart consumption.
CO 4 Know the regulations and market models for smart grid.

Module 1: Introduction to Smart Grids (8 Hours)

Definition, justification for smart grids, smart grid conceptual model, smart grid architectures, Interoperability, communication technologies, role of smart grids standards, intelli-grid initiative, national smart grid mission (NSGM) by Govt. of India

Module 2: Smart Transmission Technologies (8 Hours)

Substation automation, Supervisory Control and Data Acquisition (SCADA), Energy Management system (EMS), Phasor Measurement Units (PMU), Wide Area Measurement Systems (WAMS)

Module 3: Smart Distribution Technologies (10 Hours)

Distribution automation, outage management systems, Automated Meter Reading (AMR), Automated Metering Infrastructure (AMI), Fault Location Isolation and Service Restoration (FLISR), Outage Management Systems (OMS), Energy storage, Renewable integration

Module 4: Distributed Generation and Smart Consumption (8 Hours)

Distributed Energy Resources (DERs), smart appliances, Low Voltage DC (LVDC) distribution in homes/buildings, Home Energy Management System (HEMS), Net metering, Building to Grid B2G, Vehicle to grid V2G, Solar to grid, Microgrid

Module 5: Regulations and Market Models for Smart Grid (8 Hours)

Demand response, Tariff design, Time of the day pricing (TOD), Time of use pricing (TOU), Consumer privacy and data protection, consumer engagement etc. Cost benefit analysis of smart grid projects.

Text/References:

1. C. W. Gellings, "The Smart Grid, Enabling Energy Efficiency and Demand Side Response", CRC Press, 2009.

2. J. Momoh, "Smart Grid: Fundamentals of Design and Analysis", IEEE Computer Society Press, 2012.

3. E. J. Jenkins, N. Liyanage, K. Wu, and J. Yokoyama, "Smart Grid: Technology and applications", Wiley Publications.

4. J. Momoh, "Smart Grid: Fundamentals of design and analysis", John Wiley & Sons, 2012.

5. T. Flick, and J. Morehouse, "Securing the smart grid: Next generation power grid security", Elsevier, 2010.

6. India smart grid knowledge portal.

BTEE-802-18	Artificial Intelligence Techniques	3L:0T:0P	3 credits

Internal Marks: 40 External Marks: 60 Total Marks: 100

Course Outcomes:

At the end of this course, students will demonstrate the ability to:

CO 1 Demonstrate knowledge of the building blocks of AI as presented in terms of intelligent agents.

CO 2 Develop intelligent algorithms for constraint satisfaction problems and also design intelligent systems for Game Playing

CO 3 Attain the capability to represent various real life problem domains using logic based techniques and use this to perform inference or planning.

Module 1: Overview of Biological Neurons (8 Hours)

Structure of biological neurons relevant to Artificial Neural Networks (ANN)s. Fundamental concepts of ANN: Models of ANNs; Feed forward & feedback networks; learning rules; Hebbian learning rule, perception learning rule, delta learning rule, Widrow-Hoff learning rule, correction learning rule, Winner –lake all learning rule.

Module 2: Single layer Perceptron Classifier (8 Hours)

Classification model, Features & decision regions, training & classification using discrete perceptron, algorithm, and single layer continuous perceptron networks for linearly separable classifications.

Module 3: Single layer Feedback Networks (6 Hours)

Basic Concepts, Hopfield networks, Training & examples. Self-organizing networks: unsupervised learning of clusters, winner-take-all learning, recall mode, Initialization of weights, separability limitations.

Module 4: Multi-layer Feed Forward Networks (8 Hours)

Linearly non-separable pattern classification, Error back-propagation training, learning factors, Examples.

Module 5: Fuzzy Systems (12)

Introduction, need and Advantages of fuzzy-logic based systems over conventional systems. Fuzzy sets, Triangular, trapezoidal, sigma, Zed-Type Gaussian type fuzzy sets/membership function. operations on fuzzy sets: t-norms, s-norms, inverting, Fuzzy relations.

Fuzzification, rule base, rule composition, rule implication, aggregation and defuzzification modules. Defuzzification, weighted average method, centroid /centre of gravity/centre of area method, centre of sums, centre of largest area, max-membership based method, middle (mean) of maxima, first (last) of maxima.

Text/References

1. J. Ross, "Fuzzy logic with Engineering Applications", John Wiley & Sons, 2008.
2. J. Y. R. Langari, "Fuzzy Logic: Intelligence, Control, and Information", Pearson Education, 1999.
3. S. Haykin, "Neural Networks-A Comprehensive Foundation", Macmillan Publishing Co., 2009.
4. Drinnkov, "Fuzzy Logic Control", Narosa Publishers, 2003.
5. P. D. Wasserman, "Neural computing: Theory & Practice", Auza Research Inc. Van Nostrand, 1993.
6. R. C Berkan and S. Truebatch, "Fuzzy system design principles: building if then rule base", John willey, 2000.
7. Michal Negnevitsky, Artificial Intelligence: A Guide to Intelligent Systems, second edition 2008, Pearson Education.
8. Referred journals/peer reviewed conferences (IEEE/Elsevier/Springer). (IEEE/Elsevier/Springer).

362
345

BTEE-803-18	Indian Electricity Standards and Practices	3L:1T:0P	4 credits

Internal Marks: 40 External Marks: 60 Total Marks: 100

Course Outcomes:

At the end of this course, students will demonstrate the ability to:

CO 1 To know various definitions used in Indian electricity rules

CO 2 Students will now know how to get a new connection and enhancement or reduction of load, recovery of electricity charges and intervals for billing of electricity charges, disconnection, reconnection and restoration of supply of electricity.

CO 3 Authority and responsibility associated with power inspectors.

Module 1: Introduction (8 Hours)

Various definitions used in Indian electricity rule 1956 i.e., appointment and authority of Inspectors and officers under government, license and contents of draft license. Service lines and apparatus on consumer's premises. Cut-out on consumer's premises, Identification of earthed and earthed neutral conductors and position of switches and cut-outs, Earthed terminal on consumer's premises, Accessibility of bare conductors, Danger notices, Handling of electric supply lines and apparatus, Cables for portable or transportable apparatus, Cables protected by bituminous materials, Street boxes,.

Module 2: General conditions relating to supply and use of energy (9 Hours)

Testing of consumer's installation, Precautions against leakage before connection, Leakage on consumer's premises, Supply and use of energy, Provisions applicable to medium, high or extra-high voltage installations, Cost of inspection and test of consumer's installation, Declared voltage of supply to consumer, Declared frequency of supply to consumer, Sealing of meters, and cut-outs,

Module 3: Electric supply lines, systems and apparatus for high and extra-high voltages (10 Hours)

Approval by Inspector, Use of energy at high and extra-high voltage, Testing, Operation and Maintenance, Metal sheathed electric supply lines, Connection with earth, General conditions as to transformation and control of energy, Supply to X-ray and high frequency installation.

Module 4: Overhead lines, under-ground cables and generating stations (10 Hours)

Material and strength, Maximum stresses, Clearance above ground of the lowest conductor, Clearance between conductors and trolley wires, Clearances from buildings of low and medium voltage lines and service lines, Clearances from buildings of high and extra-high voltage lines, Conductors at different voltages on same supports, Erection of or alternation to buildings, structures, flood banks and elevation of roads, Clearances, Routes, Maximum interval between supports, Conditions to apply where telecommunication lines and power lines are carried on same supports, Lines crossing or approaching each other, Service-lines from overhead lines

Module 5: Protection (5 Hours)

Earthing, Safety and protective devices, Protection against lightning, Unused overhead lines. Additional rules for electric traction, Introduction to electric supply in mines and oil fields.

Text/References

1. Indian Electricity Rules, 1956, Manak Bhavan, New Delhi
2. P. S. Satnam, "Substation Design and Practice", Dhanpat Rai and Sons, 2001

Head
Department of Electrical Engineering
IK Gujral Punjab Technical University
Kapurthala-144603

363
364

BTEE-811-18	Modelling and Simulation Lab	0L:0T:4P	2 credits

Internal Marks: 30 External Marks: 20 Total Marks: 50

Course Outcomes:

At the end of this course, students will demonstrate the ability to:

CO 1 design of primary and secondary transmission systems by analyzing power flows at various point of common couplings through simulations.

CO 2 to distinguish power flows and conversion systems among HVAC and HVDC systems.

List of Experiments

1. To design a 5-bus transmission system having voltage levels of 220kV by taking appropriate values of different buses.
2. To design a 5-bus transmission system having voltage levels of 133kV by taking appropriate values of different buses.
3. To design a 5-bus transmission system having voltage levels of 66kV by taking appropriate values of different buses.
4. To design a 5-bus transmission system having voltage levels of 11kV by taking appropriate values of different buses.
5. Compute power (P and Q) flows in each line for experiment 1 and analyze the power flow.
6. Design a transmission system delivering a load of 500 MW using HVAC system.
7. Design a transmission system delivering a load of 500 MW using HVDC system.
8. A major project on designing of IEEE 14 bus system.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

364

BTEE-812-18	Technical Report Writing and Presentation	0L:0T:8P	4 credits

Internal Marks: 40 **External Marks: 60** **Total Marks: 100**

Guidelines:

1. The teaching load of the subject to be equally distributed among all the faculty members of the department.
2. A team of maximum 3 students to write a technical report based on Case Study of an Industry / Industrial project/ Study or implementation of IEEE/IEC/Indian standard / Product design.
3. The report is to be written under the supervision of Faculty member of concerned department, a Co-supervisor from Industry can be taken, if needed. (it should be different from that of the Project-1/Minor project and project-2/major project report.
4. Basic report structure
   - Title page.
   - Summary.
   - Table of contents.
   - Introduction.
   - Body of the report.
   - Conclusions and recommendations.
   - References and appendices.
   - Appendix: Slides of the presentation
5. The presentation of the report is to be made in the Department prior to the External Evaluation.
6. Effort to be made for the publication in Conference/an article in a periodical.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

365

BMPD-801-18	Mentoring and Professional Development of Students	0L:1T:0P	0 credits S/US

Internal Marks: 50 **External Marks: 00** **Total Marks: 50**

The assigned mentor to engage the students to in activities such as:

1) Identification of any one of the local social concern and propose workable solution for it.
2) Expert/Invited talk pertaining to recent industrial development.
3) Explore scope of self-employment/entrepreneurship.

The mentor to keep record of all activities (including those mentioned above) and assign internal marks accordingly.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

366

List of e-books for Under Graduate programme of (Electrical Engineering/Electrical and Electronics Engineering/Electronics and Electrical Engineering.

Title	Author(s)	Publisher
Control Systems, 2nd ed	Anand Kumar	PHI Learning
Advanced Control Systems	Sarkar	PHI Learning
Analog And Digital Communications	TI Singal	Tata McGraw-Hill Education Private Ltd
Analog Communication	Ramakishna Rao	Tata McGraw-Hill Education Private Ltd
Basic Electrical & Electronics Engineering	Muthusubramanian	Tata McGraw-Hill Education Private Ltd
Basic Electrical And Electronic Eng I	Chakrabarti	Tata McGraw-Hill Education Private Ltd
Basic Electrical And Instrumentation Engineering	Salivahnan	Tata McGraw-Hill Education Private Ltd
Basic Electrical Engineering, 3/E	Kothari	Tata McGraw-Hill Education Private Ltd
Basic Electrical, Electronics And Measurement Engineering (Au)	Salivahnan	Tata McGraw-Hill Education Private Ltd
Basic Electronics And Devices Jntu 2018	Salivahan	Tata McGraw-Hill Education Private Ltd
Circuit Analysis	Nagoorkani	Tata McGraw-Hill Education Private Ltd
Circuit Theory (Au 2016)	Nagoorkani	Tata McGraw-Hill Education Private Ltd
Circuit Theory (Au)	Nagoorkani	Tata McGraw-Hill Education Private Ltd
Circuit Theory And Networks	Sp Gosh And Ak Chakraborty	Tata McGraw-Hill Education Private Ltd
Circuit Theory And Networks (MU 2018)	Singh	Tata McGraw-Hill Education Private Ltd
Circuit Theory: Continuous and Discrete-time Systems Elements of Network Synthesis	Kuriakose	PHI Learning
Computer Techniques In Power System Analysis	Pai	Tata McGraw-Hill Education Private Ltd
Control Engineering: Theory and Practice	Bandyopadhyay	PHI Learning
Control System Components	Desai	PHI Learning
Control Systems Wbut Jun'13	Purkait	Tata McGraw-Hill Education Private Ltd
Digital Communication	P Ramakrishna Rao	Tata McGraw-Hill Education Private Ltd
Digital Electronics - Au 2018	Mandal	Tata McGraw-Hill Education Private Ltd
Digital Image Processing	Jayaraman, S.	Tata McGraw-Hill Education Private Ltd

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144603

367

List of e-books for Under Graduate programme of (Electrical Engineering/Electrical and Electronics Engineering/Electronics and Electrical Engineering.

Title	Author(s)	Publisher
Digital Signal Processing	Salivahanan	Tata McGraw-Hill Education Private Ltd
Digital Signal Processors	Venkataramani	Tata McGraw-Hill Education Private Ltd
Electric Drives: Concepts & Appl, 2/E	Subrahmanyam	Tata McGraw-Hill Education Private Ltd
Electric Machines	Kothari	Tata McGraw-Hill Education Private Ltd
Electric Power Distribution	Pabla	Tata McGraw-Hill Education Private Ltd
Electrical Cir Ana-I JNTUK14	Sudhakar	Tata McGraw-Hill Education Private Ltd
Electrical Circuit Analysis (Jntu)	Sudhakar, A.	Tata McGraw-Hill Education Private Ltd
Electrical Circuit Analysis, 2nd ed.	Mahadevan & Chitra	PHI Learning
Electrical Circuit Analysis, 2nd ed.	Mahadevan & Chitra	PHI Learning
Electrical Machines	Chakrabarti	Tata McGraw-Hill Education Private Ltd
Electrical Machines	Bhattacharya, S. K.	Tata McGraw-Hill Education Private Ltd
Electrical Machines	Bhattacharya, S. K.	Tata McGraw-Hill Education Private Ltd
Electrical Machines, 3/E	Bhattacharya, S. K.	Tata McGraw-Hill Education Private Ltd
Electrical Networks	Singh, Ravish	Tata McGraw-Hill Education Private Ltd
Electrical Power Distribution Systems	Kamaraju	Tata McGraw-Hill Education Private Ltd
Electronic Circuits - 1 - Au 2018	Salivahanan	Tata McGraw-Hill Education Private Ltd
Electronic Circuits I - Au'15	Salivahanan	Tata McGraw-Hill Education Private Ltd
Electronic Devices & Circuit Jntu A 2014	Salivahanan	Tata McGraw-Hill Education Private Ltd
Electronic Devices And Circuits	Salivahanan	Tata McGraw-Hill Education Private Ltd
Electronic Devices And Circuits	Venkata Rao	Tata McGraw-Hill Education Private Ltd
Electronic Devices And Circuits Jntu 2018	Salivahnan	Tata McGraw-Hill Education Private Ltd
Electronic Instrumentation, 3e	Kalsi	Tata McGraw-Hill Education Private Ltd
Electronic Principles, 7/E	Malvino	Tata McGraw-Hill Education Private Ltd

Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144603

368

List of e-books for Under Graduate programme of (Electrical Engineering/Electrical and Electronics Engineering/Electronics and Electrical Engineering.

Title	Author(s)	Publisher
Handbook Of Switchgears	Bhel	Tata McGraw-Hill Education Private Ltd
High Voltage Engineering	Naidu	Tata McGraw-Hill Education Private Ltd
Hvdc Transmission	Kamakshaiah	Tata McGraw-Hill Education Private Ltd
Instrumentation And Control Systems	Raju	Tata McGraw-Hill Education Private Ltd
Introduction to Electrical Engineering	Ganguly	PHI Learning
Linear IC Applications	Salivahnan	Tata McGraw-Hill Education Private Ltd
Linear Integrated Circuits	Salivahanan	Tata McGraw-Hill Education Private Ltd
Microprocessers And Microcontrollers	Nagoorkani	Tata McGraw-Hill Education Private Ltd
Microwave Engineering	Vasuki	Tata McGraw-Hill Education Private Ltd
Microwave Engineering	Das, Annapurna	Tata McGraw-Hill Education Private Ltd
Modern Control Engineering	Roy Choudhury	PHI Learning
Modern Digital Electronics, 4/E	Jain	Tata McGraw-Hill Education Private Ltd
Modern Power System Analysis	Kothari, Nagrath	Tata McGraw-Hill Education Private Ltd
Network Analysis & Synth	Ghosh	Tata McGraw-Hill Education Private Ltd
Network Analysis and Synthesis	Anand Kumar	PHI Learning
Network Analysis and Synthesis	Anand Kumar	PHI Learning
Network Theory (Bput)	Satpathy, P. K.	Tata McGraw-Hill Education Private Ltd
Power Electronics	Hart, Daniel	Tata McGraw-Hill Education Private Ltd
Power Electronics	Asghar	PHI Learning
Power Electronics	Singh	Tata McGraw-Hill Education Private Ltd
Power Electronics, 1e	Soumitra Kumar Mandal	Tata McGraw-Hill Education Private Ltd
Power Electronics: Devices and Circuits, 2nd ed.	Jagannathan	PHI Learning
Power System Engineering	Kothari	Tata McGraw-Hill Education Private Ltd

369

List of e-books for Under Graduate programme of (Electrical Engineering/Electrical and Electronics Engineering/Electronics and Electrical Engineering.

Title	Author(s)	Publisher
Power System Protection & Switchgear	Oza	Tata McGraw-Hill Education Private Ltd
Power System Protection And Switchgear	Badri Ram, Dn Vishwakarma	Tata McGraw-Hill Education Private Ltd
Principles of Electronics	Ganguly	PHI Learning
Renewable Energy Sources: Their Impact on Global Warming and Pollution	Abbasi & Abbasi	PHI Learning
Signals & Systems 2e	Nagrath	Tata McGraw-Hill Education Private Ltd
Signals And Systems	Nagoor Kani, A.	Tata McGraw-Hill Education Private Ltd
Signals And Systems	Nagoorkani	Tata McGraw-Hill Education Private Ltd
Theory and Problems of Basic Electrical Engineering, 2nd ed.	Kothari & Nagrath	PHI Learning
Training Manual For Industrial Training Institutes And Centres	Dge&T	Tata McGraw-Hill Education Private Ltd
Transformers	Bhel	Tata McGraw-Hill Education Private Ltd
VLSI Design	Sahu	Tata McGraw-Hill Education Private Ltd

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala-144006

370

Procedure for (a) Minor Degree (b) Honors Degree

(a) Student to opt for Minor degree in relevant programme in 3rd semester

(b) Students having no backlog up till 3rd/4th Semester will be eligible for opting for Honors Degree in the relevant Programme in the 5th Semester.

From the available relevant on-line SWAYAM/ MOOCS courses for the session, the list of the courses to be considered for Minor degree/Honors degree in relevant programme to be approved by BoS.

The number of credits for SWAYAM/MOOCS courses for Minor degree in in relevant programme to be as per the credits mentioned on the certificate of the respective SWAYAM/ MOOCS course.

The following step are proposed to be followed for credits earned through SWAYAM/MOOCS courses:

i) For each semester the student to take up online SWAYAM/MOOCS courses approved by the BoS.

ii) Take permission (written) from Institute/Department for registration.

iii) On successful completion of each SWAYAM/MOOCS in each semester the student to submit self-attested copy of certificate (on-line/hard) to Institute/ Department.

iv) The Institute/Department to verify the certificate and there after Institute/ Department to convey to the Examination Branch through the office of Dean Academics.

v) On obtaining the minimum credits the student will be eligible for Minor Degree in relevant programme.

In case of non-availability of SWAYAM/MOOCS courses the student can earn the minimum credits for (a) Minor Degree from Professional Core / Elective Courses (b) Honors degree from Professional Elective Courses other than those taken up for the concerned B.Tech Programme

The list of (i) Professional Core Courses (ii) Professional Elective Courses, clearly indicating odd and even semester is available in the Teaching Scheme.

Head
Department of Electrical Engineering
I.K. Gujral Punjab Technical University
Kapurthala

Scheme & Syllabus of

Master of Technology
Electrical Engineering
(Power Systems and Renewable Energy)

Batch 2021 & Onwards

By

Board of Studies Electrical Engineering

Department of Academics

I.K. Gujral Punjab Technical University Jalandhar

Master of Technology in
Electrical Engineering (Power Systems and Renewable Energy)

It is a Post Graduate (PG) Programme of 2 years duration (4 semesters).
Additional Lectures/ Tutorials: Need based additional Lectures/ Tutorials may be introduced for any course, however the credits of the course will not change.

Courses & Examination Scheme:
First Semester

Course Code	Course Type	Course Name	L	T	P	Marks Distribution		Total Marks	Credits
						Internal	External		
PSRE-101/21	Core 1 Theory	Computer Aided Power System Analysis	3	0	0	40	60	100	3
PSRE-102/21	Core 2 Theory	Distributed Generation	3	0	0	40	60	100	3
PSRE-103X/21	Elective-I	Professional Elective-I	3	0	0	40	60	100	3
PSRE-104Y/21	Elective-II	Professional Elective-II	3	0	0	40	60	100	3
MTRM-101/21	-	Research Methodology and IPR	2	0	0	40	60	100	2
PSRE-105/21	Practical/ Laboratory 1	Computer Aided Power System Analysis Lab	0	0	4	60	40	100	2
PSRE-106/21	Practical/ Laboratory 2	Power Simulation Lab-I	0	0	4	60	40	100	2
MTA-10X/21	Audit-I	Audit Course-I	2	0	0	00	00	S/ NS*	Non-Credit
Total			**16**	**0**	**8**	**320**	**380**	**700**	**18**

S/NS*: Satisfactory/ Non-Satisfactory

Professional Elective/ Audit	Course Code	Course Name	L	T	P	Marks Distribution		Total Marks	Credits
						Internal	External		
PE1	PSRE-103A/21	FACTS and custom Power Devices	3	0	0	40	60	100	3
	PSRE-103B/21	Advanced Power System Protection	3	0	0	40	60	100	3
	PSRE-103C/21	Mathematical Methods for Power Engineering	3	0	0	40	60	100	3
	PSRE-103D/21	Analysis of Power Converter	3	0	0	40	60	100	3
PE2	PSRE-104A/21	Solar PV Energy System	3	0	0	40	60	100	3
	PSRE-104B/21	Waste to Energy Conversion Technologies	3	0	0	40	60	100	3
	PSRE-104C/21	Small Hydro and Non-Conventional Technologies	3	0	0	40	60	100	3
	PSRE-104D/21	Solar Energy Conversion Technologies	3	0	0	40	60	100	3

Audit-I	MTA-101/21	English for Research Paper Writing	2	0	0	00	00	S/NS*	Non-Credit
	MTA-102/21	Disaster Management	2	0	0	00	00	S/NS*	Non-Credit
	MTA-103//21	Sanskrit for Technical Knowledge	2	0	0	00	00	S/NS*	Non-Credit
	MTA-104/21	Value Education	2	0	0	00	00	S/NS*	Non-Credit

S/NS*: Satisfactory/ Non-Satisfactory

Second Semester

Course Code	Course Type	Course Name	L	T	P	Marks Distribution		Total Marks	Credits
						Internal	External		
PSRE-201/21	Core 3 Theory	Energy Forecasting and Modeling	3	0	0	40	60	100	3
PSRE-202/21	Core 4 Theory	Power System Generation Control	3	0	0	40	60	100	3
PSRE-203X/21	Elective-III	Professional Elective-III	3	0	0	40	60	100	3
PSRE-204Y/21	Elective-IV	Professional Elective-IV	3	0	0	40	60	100	3
MTPR-101/21	-	Mini Project with Seminar	0	0	4	60	40	100	2
PSRE-205/21	Practical/ Laboratory 3	Power Simulation Lab-II	0	0	4	60	40	100	2
PSRE-206/21	Practical/ Laboratory 4	Renewable Energy Lab	0	0	4	60	40	100	2
MTA-10Y/21	Audit-II	Audit Course-II	2	0	0	00	00	S/NS*	Non-Credit
Total			**14**	**0**	**12**	**340**	**360**	**700**	**18**

S/NS*: Satisfactory/ Non-Satisfactory

Professional Elective/ Audit	Course Code	Course Name	L	T	P	Marks Distribution		Total Marks	Credits
						Internal	External		
PE3	PSRE-203A/21	Power Quality and and Harmonic Analysis	3	0	0	40	60	100	3
	PSRE-203B/21	Power System Dynamics	3	0	0	40	60	100	3
	PSRE-203C/21	Reliability Analysis and Protection	3	0	0	40	60	100	3
	PSRE-203D/21	Energy Economics and Policies	3	0	0	40	60	100	3
PE4	PSRE-204A/21	Electric and Hybrid Vehicles	3	0	0	40	60	100	3
	PSRE-204B/21	Smart Grids	3	0	0	40	60	100	3
	PSRE-204C/21	Engineering Optimization	3	0	0	40	60	100	3
	PSRE-204D/21	Artificial Intelligence Techniques	3	0	0	40	60	100	3
Audit-II	MTA-105/21	Constitution of India	2		0	00	00	S/NS*	Non-Credit

	MTA-106/21	Pedagogy Studies	2		0	00	00	S/NS*	Non-Credit
	MTA-107/21	Stress Management of Yoga	2		0	00	00	S/NS*	Non-Credit
	MTA-108/21	Personality Development through Life Enlightenment Skills	2		0	00	00	S/NS*	Non-Credit

S/NS*: Satisfactory/ Non-Satisfactory

Third Semester

Core /Elective	Course Code	Course Name	L	T	P	Marks Distribution		Total Marks	Credits
						Internal	External		
Elective-V	PSRE-301X/21	Professional Elective-V	3	0	0	40	60	100	3
Open Elective	MTOE-301X/21	Open Elective	3	0	0	40	60	100	3
Major Project	PSRE-302/21	Phase-I Dissertation	0	0	20	60	40	100	10
Total			**6**	**0**	**20**	**140**	**160**	**300**	**16**

Professional Elective /Audit	Course Code	Course Name	L	T	P	Marks Distribution		Total Marks	Credits
						Internal	External		
PE5	PSRE-301A/21	Industrial Load Modelling and Control	3	0	0	40	60	100	3
	PSRE-301B/21	Power System Deregulation	3	0	0	40	60	100	3
	PSRE-301C/21	Solar PV Energy System	3	0	0	40	60	100	3
	PSRE-301D/21	Energy Storage System	3	0	0	40	60	100	3
OE	MTOE-301A/21	Business Analysis	3	0	0	40	60	100	3
	MTOE-301B/21	Industrial Safety	3	0	0	40	60	100	3
	MTOE-301C/21	Operations Research	3	0	0	40	60	100	3
	MTOE-301D/21	Cost Management of Engineering Projects	3	0	0	40	60	100	3
	MTOE-301E/21	Composite Materials	3	0	0	40	60	100	3
	MTOE-301F/21	Waste to Energy	3	0	0	40	60	100	3

Fourth Semester

Course Code	Course Type	Course Name	L	T	P	Marks Distribution		Total Marks	Credits
						Internal	External		
PSRE-401/21	Major Project	Phase-II Dissertation	0	0	32	60	40	100	16
Total			**-**	**-**	**32**	**60**	**40**	**100**	**16**

Total Marks of M. Tech Program = 1800

Total Credits of M. Tech Program = 68

Programme Educational Objectives

I	**Preparation:** To prepare students to excel in undergraduate programmes or to succeed in industry/ technical profession through global, rigorous education.
II	**Core Competence:** To provide students with a solid foundation in mathematical, scientific and engineering fundamentals required to solve engineering problems and also to pursue higher studies.
III	**Breadth:** To train students with good scientific and engineering breadth so as to comprehend, analyze, design, and create novel products and solutions for the real-life problems.
IV	**Professionalism:** To inculcate in students professional and ethical attitude, effective communication skills, teamwork skills, multidisciplinary approach, and an ability to relate engineering issues to broader social context.
V	**Learning Environment:** To provide student with an academic environment aware of excellence, leadership, written ethical code and guidelines, and the life-long learning needed for a successful professional career.

Programme Outcomes

PO1	The ability to apply knowledge of mathematics, science, and engineering in solving real life engineering problems.
PO2	The ability to design a component, system or process related to Power systems and Renewable Energy Systems (PSRE) for a defined objective and conduct experiments, as well as to analyze data.
PO3	An ability to design a component, system or process related to PES to meet desired needs within realistic constraints such as safety, environmental, economic, social, ethical, manufacturability and sustainability.
PO4	The ability to function on multidisciplinary tasks and with multidisciplinary teams.
PO5	The ability to perform literature survey to identify, formulate and solve power engineering problems using modern engineering tools (softwares and hardwares).
PO6	The ability to demonstrate the knowledge of professional and ethical responsibilities.
PO7	The ability to communicate effectively in both oral and written forms.
PO8	The ability to analyse the impact of engineering solutions in global, economic, environmental and social perspectives.

PSRE-101/21 COMPUTER AIDED POWER SYSTEM ANALYSIS

L	T	P
3	0	0

Internal Marks: 40
External Marks: 60
Total Marks: 100

Course Objectives:- Students will be able to:
CO1: Understand various methods of load flow and their advantages and disadvantages
CO2: Analyze various types of faults in power system
CO3: Understand power system security concepts and rank the contingencies
CO4: Estimate closeness to voltage collapse and calculate PV curves.

Syllabus

Units	Content	Hours
1	Load flow: Overview of Newton-Raphson, Gauss-Siedel, fast decoupled methods, convergence properties, sparsity techniques, handling Q-max violations in constant matrix, inclusion in frequency effects	8
2	AVR in load flow, handling of discrete variable in load flow, Fault Analysis: Simultaneous faults, open conductor faults, generalized method of fault analysis	8
3	Security Analysis: Security state diagram, contingency analysis, generator shift distribution factors Line outage distribution factor, multiple line outages, overload index ranking, Power System Equivalents: WARD REI. equivalents, State Estimation: Sources of errors in measurement Virtual and Pseudo, Measurement, Observability, Tracking state estimation, WSL method, bad data correction	12
4	Voltage Stability: Voltage collapse, P-V curve, multiple power flow solution, continuation power flow, optimal multiplies load flow, voltage collapse proximity indices	10

Suggested reading:

1. J.J. Grainger & W.D. Stevenson, "Power system analysis", McGraw Hill ,2003
2. A. R. Bergen & Vijay Vittal , "Power System Analysis", Pearson , 2000
3. L.P. Singh, "Advanced Power System Analysis and Dynamics", New Age International, 2006.
4. G.L. Kusic, "Computer aided power system analysis",Prentice Hall India, 1986.
5. J. Wood, "Power generation, operation and control", John Wiley, 1994.
6. P.M. Anderson, "Faulted power system analysis", IEEE Press , 1995

PSRE-102/21 **DISTRIBUTED GENERATION**
Internal Marks: 40
External Marks: 60
Total Marks: 100

L	T	P
3	0	0

Course Objectives:- Students will be able to:

CO1: Understand the planning and operational issues related to Distributed Generation.
CO2: Analyse the impact of Distributed Generation
CO3: Understand the Micro-Grids
CO4: Analyse the micro-grids

Syllabus

Units	Content	Hours
1	Need for Distributed generation. Renewable sources in distributed generation and current scenario in Distributed Generation. Planning of DGs: Sitting and sizing of DGs optimal placement of DG sources in distribution systems. Grid integration of DGs Different types of interfaces, Inverter based DGs and rotating machine based interfaces. Aggregation of multiple DG units.	12
2	Technical impacts of DGs, Transmission systems Distribution Systems De-regulation Impact of DGs, upon protective relaying, Impact of DGs upon transient and dynamic stability of existing distribution systems, Steady-state and Dynamic analysis.	10
3	Economic and control aspects of DGs Market facts. Issues and challenges Limitations of DGs, Voltage control techniques. Reactive power control, Harmonics Power quality issues, Reliability of DG based systems.	10
4	Introduction to micro-grids. .Types of micro-grids: autonomous and non-autonomous grids Sizing of micro-grids. Modeling & analysis of Micro-grids with multiple DGs. Micro-grids with power electronic interfacing units. Transients in micro-grids, Protection of micro-grids, Case studies, Advanced topics.	10

Suggested reading:

1. H. Lee Willis, Walter G. Scott, "Distributed Power Generation – Planning and Evaluation",Marcel Decker Press.
2. M.GodoySimoes, Felix A.Farret, "Renewable Energy Systems – Design and Analysis with Induction Generators", CRC press.
3. Stuart Borlase. "Smart Grid: Infrastructure Technology Solutions" CRC Press.

Professional Electives for 1st Semester

Professional Elective	Course Code	Course Name
PE1	PSRE-103A/21	FACTS and custom Power Devices
	PSRE-103B/21	Advanced Power System Protection
	PSRE-103C/21	Mathematical Methods of Power Engineering
	PSRE-103D/21	Analysis of Power Converter
PE2	PSRE-104A/21	Solar PV Energy System
	PSRE-104B/21	Waste to Energy Conversion Technologies
	PSRE-104C/21	Small Hydro and Non-Conventional Technologies
	PSRE-104D/21	Solar Energy Conversion Technologies

PSRE-103 A/21
Internal Marks: 40
External Marks: 60
Total Marks: 100

FACTS AND CUSTOM POWER DEVICES

L	T	P
3	0	0

Course Objectives:- Students will be able to:

CO1: Acquire knowledge about the fundamental principles of Passive and Active Reactive Power Compensation Schemes at Transmission and Distribution level in Power Systems.

CO2: Learn various Static VAR Compensation Schemes like Thyristor/GTO Controlled.

CO3: Reactive Power Systems, PWM Inverter based Reactive Power Systems and their controls.

CO4: To develop analytical modeling skills needed for modeling and analysis of such Static VAR Systems.

Syllabus

Units	Content	Hours
1	Reactive power flow control in Power Systems – Control of dynamic power unbalances in Power System. Power flow control -Constraints of maximum transmission line loading, Benefits of FACTS Transmission line compensation. Uncompensated line -Shunt compensation - Series compensation –Phase angle control. Reactive power compensation. Shunt and Series compensation principles – Reactive compensation at transmission and distribution level .	6
2	Static versus passive VAR compensator, Static shunt compensators: SVC and STATCOM Operation and control of TSC, TCR and STATCOM Compensator control. Comparison between SVC and STATCOM. Static series compensation: TSSC, SSSC -Static voltage and phase angle regulators – TCVR and TCPAR Operation and Control –Applications, Static series compensation – GCSC,TSSC, TCSC and Static synchronous series compensators and their Control.	12
3	SSR and its damping Unified Power Flow Controller: Circuit Arrangement, Operation and control of UPF. Basic Principle of P and Q control- Independent real and reactivepower flow control- Applications.	10
4	Introduction to interline power flow controller. Modeling and analysis of FACTS Controllers – Simulation of FACTS controllers Power quality problems in distribution systems, harmonics. Loads that create harmonics, modeling, harmonic propagation, series and parallel resonances, mitigation of harmonics, passive filters, active filtering – shunt , series and hybrid and their control. Voltage swells, sags, flicker, unbalance and mitigation of these problems By power line conditioners- IEEE standards on power quality.	12

Suggested reading:

1. K R Padiyar, "FACTS Controllers in Power Transmission and Distribution", New
2. AgeInternationalPublishers, 2007.
3. X P Zhang, C Rehtanz, B Pal, "Flexible AC Transmission Systems- Modelling and
4. Control",Springer Verlag, Berlin, 2006.
5. N.G. Hingorani, L. Gyugyi, "Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems", IEEE Press Book, Standard Publishers and Distributors, Delhi, 2001.
6. K.S.Sureshkumar, S.Ashok , "FACTS Controllers & Applications", E-book edition, Nalanda
7. Digital Library, NIT Calicut, 2003.
8. G. T.Heydt, "Power Quality", McGraw-Hill Professional, 2007.
9. T. J. E. Miller, "Static Reactive Power Compensation", John Wiley and Sons, Newyork, 1982.

PSRE-103B/21 **ADVANCED POWER SYSTEMS PROTECTION**
Internal Marks: 40
External Marks: 60
Total Marks: 100

L	T	P
3	0	0

Course Objectives:- Students will be able to:
CO1: Learn about classification and operation of static relays.
CO2: Understand the basic principles and application of comparators.
CO3: Understand static version of different types of relays.
CO4: Understand about numerical protection techniques.

Syllabus

Units	Content	Hours
1	Static Relays classification and Tools : Comparison of Static with Electromagnetic Relays, Basic classification, Level detectors and Amplitude and phase Comparators – Duality – Basic Tools – Schmitt Trigger Circuit, Multivibrators, Square wave Generation – Polarity detector – Zero crossing detector – Thyristor and UJT Triggering Circuits. Phase sequence Filters – Speed and reliability of static relays.	10
2	Amplitude and Phase Comparators (2 Input) : Generalized equations for Amplitude and Phase comparison – Derivation of different characteristics of relays – Rectifier Bridge circulating and opposed voltage type amplitude comparators – Averaging & phase splitting type amplitude comparators – Principle of sampling comparators. Phase Comparison : Block Spike and phase Splitting Techniques – Transistor Integrating type, phase comparison, Rectifier Bridge Type Comparison – Vector product devices.	10
3	Static over current (OC) relays – Instantaneous, Definite time, Inverse time OC Relays, static distance relays, static directional relays, static differential relays, measurement of sequence impedances in distance relays, multi input comparators, elliptic & hyperbolic characteristics, switched distance schemes, Impedance characteristics during Faults and Power Swings. PILOT Relaying schemes: Wire pilot protection: circulating current scheme – balanced voltage scheme – translay scheme – half wave comparison scheme - carrier current protection: phase comparison type – carrier aided distance protection – operational comparison of transfer trip and blocking schemes – optical fibre channels.	12
4	Microprocessor based relays and Numerical Protection: Introduction – over current relays – impedance relay – directional relay – reactance relay. Numerical Protection: Introduction - numerical relay - numerical relaying algorithms - mannmorrison technique - Differential equation technique and discrete fourier transform technique - numerical over current protection - numerical distance protection.	10

Suggested Reading:

1. T.S.M. Rao, Power System Protection with Static Relays, TMH.
2. Badri Ram & D. N. viswakarma, Power system protection & switchgear, TMH.
3. Warrington Protective Relaying Vol-II, Springer.
4. C R Mason Art & Science of Protective Relaying, Willey.
5. Kimbark, Power System Stability Vol-II, Willey.
1. C. Christopoulos and A. Wright, Electrical Power System Protection, Springer
2. Bhavesh Bhalaja, R. P Maheshwari, Nilesh G. Chothani, Protection & Switchgear, Oxford publisher

PSRE-103C/21 MATHEMATICAL METHODS FOR POWER ENGINEERING

Internal Marks: 40
External Marks: 60
Total Marks: 100

L	T	P
3	0	0

Course Objectives:- Students will be able to:

CO1: Knowledge about vector spaces, linear transformation, eigenvalues and eigenvectors of Linear operators

CO2: Learn about linear programming problems and understanding the simplex method for solving linear programming problems in various fields of science and technology

CO3: Acquire knowledge about nonlinear programming and various techniques used for solving constrained and unconstrained nonlinear programming problems

CO4:.Understanding the concept of random variables, functions of random variable and their probability distribution, stochastic processes and their classification.

Syllabus

Units	Content	Hours
1	Vector spaces, Linear transformations, Matrix representation of linear transformation, Eigen values and Eigen vectors of linear operator	10
2	Linear Programming Problems, Simplex Method, Duality Non Linear Programming problems	8
3	Unconstrained Problems, Search methods, Constrained Problems	8
4	Lagrange method, Kuhn-Tucker conditions, Random Variables, Distributions	8
5	Independent Random Variables, Marginal and Conditional distributions Elements of stochastic processes	8

Suggested reading:

1. Kenneth Hoffman and Ray Kunze, "Linear Algebra", 2nd Edition, PHI, 1992
2. Erwin Kreyszig, "Introductory Functional Analysis with Applications", John Wiley & Sons, 2004
3. Irwin Miller and Marylees Miller, John E. Freund's "Mathematical Statistics", 6th Edn, PHI, 2002
4. J. Medhi, "Stochastic Processes", New Age International, New Delhi., 1994
5. A Papoulis, "Probability, Random Variables and Stochastic Processes", 3rd Edition, McGraw Hill,2002
6. John B Thomas, "An Introduction to Applied Probability and Random Processes", John Wiley, 2000
7. Hillier F S and Liebermann G J, "Introduction to Operations Research", 7th Edition, McGraw Hill, 2001
8. Simmons D M, "Non Linear Programming for Operations Research", PHI, 1975

PSRE-103D/21 **ANALYSIS OF POWER CONVERTER** **L T P**
Internal Marks: 40 **3 0 0**
External Marks: 60
Total Marks: 100

Course Objectives:- Students will be able to:
CO1: Develop a systematic approach AC-DC converters
CO2: Develop a systematic approach for modeling and analysis PWM Inverters
CO3: Ability to model of Multilevel Inverters
CO4: Analysis of boost power factor corrected rectifier.

Syllabus

Units	Content	Hours
1	Overview of Switching Devices: Power MOSFET, IGBT, GTO, GaN devices-static and dynamic characteristics, gate drive circuits for switching devices. AC-DC converters: Single phase fully controlled converters with RL load– Evaluation of input power factor and harmonic factor-Continuous and Discontinuous load current, Power factor improvements, Extinction angle control, symmetrical angle control, PWM control. Three Phase AC-DC Converters, fully controlled converters feeding RL load with continuous and discontinuous load current, Evaluation of input power factor and harmonic factor-three phase dual converters.	12
2	Power Factor Correction Converters: Single-phase single stage boost power factor corrected rectifier, power circuit principle of operation, and steady state- analysis, three phase boost PFC converter	10
3	PWM Inverters: Principle of operation-Voltage control of single phase inverters - sinusoidal PWM – modified PWM – phase displacement Control – Trapezoidal, staircase, stepped, harmonic injection and delta modulation. Voltage Control of Three-Phase Inverters- Sinusoidal PWM- 600PWM- Third Harmonic PWM- Space Vector Modulation- Comparison of PWM Techniques- Three phase current source inverters-Variable dc link inverter.	10
4	Multi level inverters: Introduction, Multilevel Concept, Types of Multilevel Inverters- Diode-Clamped Multilevel Inverter, Principle of Operation, Features of Diode-Clamped Inverter, Improved Diode-Clamped Inverter- Flying-Capacitors Multilevel Inverter- Principle of Operation, Features of Flying-Capacitors Inverter- Cascaded Multilevel Inverter- Principle of Operation- Features of Cascaded Inverter- Switching Device Currents-DC-Link Capacitor Voltage Balancing- Features of Multilevel Inverters-Comparisons of Multilevel Converters.	10

Suggested reading:

1. Power Electronics: Converters, Applications, and Design- Ned Mohan, Tore M. Undeland, William P. Robbins, John Wiley& Sons, 2nd Edition, 2003 Daniel W. Hart - McGraw-Hill,2011.
2. Elements of Power Electronics – Philip T. Krein, Oxford University press, 2014.
3. Power Electronics: Converters, Applications, and Design- Ned Mohan, Tore M. Undeland, William P. Robbins, John Wiley& Sons, 2nd Edition, 2003.

PSRE-104A/21 **SOLAR PV ENERGY SYSTEM**
Internal Marks: 40
External Marks: 60
Total Marks: 100

L	T	P
3	0	0

Course Objectives:- Students will be able to:
CO1: Understand the concept of Solar Radiation Geometry.
CO2: Understand the Solar Cells Conversion of Solar energy.
CO3: Understand the Solar Photovoltaic System Design.
CO4: Introduction of Solar Photo Voltaic System Testing Sun Simulator

Syllabus

Units	Content	Hours
1	Solar Radiation: Sun as Energy Source, Solar Radiation at The Earth's Surface, Solar Radiation Geometry, Solar Time and Equation of Time, Sun Earth angles, Sun path diagram, Sunshine hours, Measurement of Solar Diffuse, Global and Direct Solar Radiation, Equipments, Estimation of Solar radiation on horizontal and tilted Surfaces, Global Solar radiation data, Indian Solar Radiation data analysis	10
2	Solar Cells Conversion of Solar energy into Electricity - Photovoltaic Effect, Equivalent Circuit of the Solar Cell, Analysis of PV Cells: Dark and illumination characteristics, Figure of merits of solar cell, Efficiency limits, Variation of efficiency with band-gap and temperature, Efficiency measurements, High efficiency cells, Recent developments in Solar Cells, Role of nano-technology in Solar cells	10
3	Fabrication Technology for Solar Cells High efficiency multi-junction solar cell, Quantum well solar cell, Technology for the fabrication of thin film cells, Optical concentration, Effect of temperature on Cell performance, Thermo photovoltaic effect Solar Photovoltaic System Design Solar cell array system analysis and performance prediction, Shadow analysis: Reliability, Solar cell array design concepts, PV system design, Design process and optimization: Detailed array design, Voltage regulation, Maximum tracking, Quick sizing method, Array protection.	12
4	Solar Photo Voltaic System Testing Sun Simulator, Testing and performance assessment of Solar PV generator, Electronic Control and Regulation, Power Conditioning, Converters and inverter, Concentrating system, System design and configuration. Solar Photo Voltaic System Testing Sun Simulator, Testing and performance assessment of Solar PV generator, Electronic Control and Regulation, Power Conditioning, Converters and inverter, Concentrating system, System design and configuration	10

Suggested reading:

1. Fundamentals of Solar Cells: PV Solar Energy Conversion by AL Fahrenbruch and RH Bube, Academic Press, New York.
2. Principles of Solar Engineering by F Kreith and JF Kreider, McGraw-Hill.
3. Solar Photovoltaics. Fundamental Technologies and Application by Chetan Singh Solanki, PHI Publicaton.

PSRE-104B/21 WASTE TO ENERGY CONVERSION TECHNOLOGIES

Internal Marks: 40
External Marks: 60
Total Marks: 100

L	T	P
3	0	0

Course Objectives:- Students will be able to:

CO1: Understand the issues related with waste and its impact on environment.

CO2: Knowledge of different type of disposal mechanism for handling different type of waste.

CO3: Understand the analyse concept of recovery from industrial and agricultural waste

CO4: Knowledge of rural issues and the handling of biomass.

Syllabus

Units	Content	Hours
1	Solid Waste -Definitions: Sources, types, compositions; Properties of Solid Waste; Municipal Solid Waste: Physical, chemical and biological property; Collection, transfer stations; Waste minimization and recycling of municipal waste Landfill method of solid waste disposal; Landfill classification; Types, methods & siting consideration; Layout & preliminary design of landfills: Composition, characteristics, generation; Design of Sanitary Land fill - Movement and control of landfill leachate &gases; Environmental monitoring system for landfill gases.- Gas Recovery – Applications.	10
2	Waste treatment & Disposal Size Reduction: incineration; Furnace type & design; Types of Incinerators – Fuel Economy - Medical /Pharmaceutical waste / Hazardous waste / Nuclear Waste incineration, environmental impacts; Measures of mitigate environmental effects due to incineration	8
3	Energy Generation From Waste Types: Biochemical Conversion: Sources of energy generation, Industrial waste, agro residues; Anaerobic Digestion: Biogas production; Aerobic & Anaerobic treatments, Types of digester, Factors affecting bio-digestion, Activated sludge process. Methods of treatment and recovery from the in industrial waste water – Case Studies in sugar, dairy, fertilizer, tanning, textile, and power plant.	8
4	Rural applications of biomass –Combustion, Chulas and improved Chulas, Physical and Chemical composition of biomass, properties of biomass, TGA and DSC characterization – Ash Characterization - Preparation of biomass , Size reduction – Briquetting of loose biomass- Briequtting machine	8

Suggested reading:

1. Parker, Colin, & Roberts, Energy from Waste - An Evaluation of Conversion Technologies, Elsevier Applied Science, London, 1985
2. Shah, Kanti L., Basics of Solid & Hazardous Waste Management Technology, Prentice Hall, 2000
3. Manoj Datta, Waste Disposal in Engineered Landfills, Narosa Publishing House, 1997
4. Rich, Gerald et.al., Hazardous Waste Management Technology, Podvan Publishers, 1987
5. Bhide AD., Sundaresan BB, Solid Waste Management in Developing Countries, INSDOC, New Delhi,1983.

PSRE-104C/21 SMALL HYDRO AND NON-CONVENTIONAL TECHNOLOGIES

Internal Marks: 40
External Marks: 60
Total Marks: 100

L	T	P
3	0	0

Course Objectives:- Students will be able to:
CO1: Understand the issues Small-hydro systems.
CO2: Knowledge of different type of Energy from Oceans
CO3: Understand the analyse concept of Geothermal Energy
CO4: Knowledge of Magneto Hydro Dynamic.

Syllabus

Units	Content	Hours
1	Small-hydro systems: Overview of micro, mini and small hydro systems; Hydrology; Elements of pumps and turbine; Selection and design criteria of pumps and turbines; Site selection and civil works. Protection control and management. Advantages and Limitations, Hybrid systems, Potential of small hydro power in India.	8
2	Energy from Oceans: Ocean thermal electric conversion (OTEC) methods, Open and closed cycle of OTEC, Evaporators, site selection for OTEC and hybrid cycle, Advantages and disadvantages, Prospects of OTEC in india. Tidal energy (TE) basic principal, Operation methods, estimation of energy and power in single and double system, Advantages and disadvantages, Prospects of TE in India. Energy and power from Ocean waves, Wave energy conversion devices, Advantages and disadvantages	10
3	Geothermal Energy: Nature, hydro thermal resources, Geo pressure resources, Hot dry resources, magma resource, Flashed heat and total flow concept, Hybrid systems, Prime movers for geo-thermal energy, Advantages and disadvantages, Enviornmental issues, Potential in India.	8
4	Magneto Hydro Dynamic (MHD) Power: Principal of MHD, MHD systems, Design issues and development, Electric condition, Gas conductivity, Materials for MHD generation, Super-conductivity, International status.	8

Suggested reading:

1. Tong Jiandong(et al.) , Mini Hydropower , John Wiley, 1997
2. Rai, G.D., Non-Conventional Energy Sources, Kh Publishers, New Delhi.
3. Mathur A.N. & Rathore N.S. Renewable Energy Sources, Bohra Ganesh Publications, Udaipur, 1992
4. Kothari, Renewable Energy Sources and Emerging Technologies, PHI, Eastern Economy Edition, 2012.
5. Bansal N. K., Kleeman M. K., Mells M. Renewable Sources of Energy and Conversion Technology, Tata McGraw-Hill, 1990.

PSRE-104D/21 SOLAR ENERGY CONVERSION TECHNOLOGIES

Internal Marks: 40
External Marks: 60
Total Marks: 100

L	T	P
3	0	0

Course Objectives:- Students will be able to: **CO1:** Evaluate the solar thermal devices **CO2:** Optimize the solar thermal power generating system. **CO3:** Knowledge of solar passive concepts and their application to buildings **CO4:** Understanding of government schemes & policies on solar energy.		
Syllabus		
Units	**Content**	**Hours**
1	Solar Energy collectors: Physical principals. Flat plate Collector, Transmissitivity of cover system, Energy balance equations, Collector efficiency, Flat plate Collector thermal efficiency and Thermal analysis, Heat capacity effect Concentrating Collectors, Performance analysis of cylindrical parabolic concentrating collectors, selective surfaces, coating, Anti-reflective coating Measurement & estimation on horizontal and tilted surfaces; Analysis of Indian solar radiation data and applications. Solar energy storage systems, solar pond principal of operation, extraction of thermal energy from solar pond.	10
2	Solar Passive Buildings: Thermal comfort, criterion and parameters, Calculation of solar radiation on buildings, building orientation, Introduction to design of shading devices, Overhangs, Factors that effects energy use in buildings; Ventilation and its significance; Air-conditioning systems. Passive heating concepts:- Direct heat gain, indirect heat gain, isolated gain and sunspaces. Passive cooling concepts:- Evaporative cooling, radiative cooling; Application of wind, water and earth for cooling; Shading, paints and cavity walls for cooling; Roof radiation traps; Earth air-tunnel.	8
3	Dark and illumination characteristics; Figure of merits of solar cell; Efficiency limits; Variation of efficiency with band-gap and temperature; Efficiency measurements; High efficiency cells, Tandem structure. SPV applications - Centralized and decentralized SPV systems; Stand alone, hybrid and, grid connected system, System installation, operation and maintenances; Field experience; PV market analysis and economics of SPV systems – Government Schemes and Polices	8
4	Application of Solar Energy: Heating, cooling, thermal electric conversion, agricultural and Industrial process heat, distillation, pumping, Furnance, Cooking, production of hydrogen, Solar green houses, Thermal drying.	8

Suggested reading:

1. H. P Garg, J. Prakash, Solar Energy: Fundamentals & Applications, Tata McGraw Hill, New Delhi, 1997
2. S P Sukhatme, Solar Energy, Tata McGraw Hill, 2008
3. J. F. Kreider and Frank Kreith, Solar Energy Handbook, McGraw Hill, 2000
4. D. Y. Goswami, Frank Kreith and J F Kreider,Principles of Solar Engineering, Taylor & Francis, 1998

5. G. N. Tiwari, S. Suneja, Solar Thermal Engineering System, Narosa Publishing House, New Delhi, 1997.
6. Alan L Fahrenbruch and Richard H Bube , Fundamentals of Solar Cells: PV Solar Energy Conversion, Academic Press, New York , 1983
7. Larry D Partain (ed.), Solar Cells and their Applications, John Wiley and Sons, Inc, New York, 1995
8. Richard H Bube, Photovoltaic Materials, ImperialCollege Press, 1998
9. H S Rauschenbach, Solar Cell Array Design Handbook, Van Nostrand Reinfold Company, New York, 1980.

MTRM-101/21 **RESEARCH METHODOLOGY AND IPR** **L T P**
Internal Marks: 40 **2 0 0**
External Marks: 60
Total Marks: 100

Course Objectives:- Students will be able to:
1. To understand research problem formulation and research ethics
2. To understand about control of information technology
3. To understand the need of IPR & its protection

Syllabus

Units	Content	Hours
1	Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations	8
2	Effective literature studies approaches, analysis Plagiarism, Researchethics,	4
3	Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee	6
4	Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research,innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT	8
5	Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications	4
6	New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.	6

References:
1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science &engineering students'"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2nd Edition , "Research Methodology: A Step by Step Guide for beginners
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
5. Mayall , "Industrial Design", McGraw Hill, 1992
6. Niebel , "Product Design", McGraw Hill, 1974.
7. Asimov , "Introduction to Design", Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.
9. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

Course Outcomes: At the end of this course, students will be able to

CO1: Understand research problem formulation. Analyze research related information
CO2: Follow research ethics
CO3: Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.

CO4: Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
CO5: Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

PSRE-105/21 COMPUTER AIDED POWER SYSTEM ANALYSIS LAB

Internal Marks: 60
External Marks: 40
Total Marks: 100

L	T	P
0	0	4

Course Outcomes::-Students will be able :

CO1: To understand the formation of Y and Z bus

CO2: To understand how to analyze the power system load flow studies, Faults occurring in power system

CO3: To understand the security analysis

CO4: To understand the commercial software used by industry

Syllabus

Sr. No.	List of Experiments
1	Write a program to form Y bus by Inspection method.
2	Write a program for formation of Y bus by singular matrix transformation
3	Study of load flow methods a) Gauss-Siedel method b) Newton Raphson Method
4	Write a program for fault analysis for a) LG b)LLG c)LLL
5	Write a program for security analysis using load flow & ranking of contingency
6	Write a program for ranking of contingency using overload security analysis
7	Study of ready-made industry standard / commercial software packages for above analysis
8	Write a program to form Zbus matrix.

PSRE-106/21 **POWER SIMULATION LAB-I**
Internal Marks: 60
External Marks: 40
Total Marks: 100

L	T	P
0		0 4

Course Outcomes::-Students will be able :
CO1: Various power curves considering different renewable sources
CO2: Evaluate the capability of fuel cells and capacitors
CO3: Understand practical issues related to wind power
CO4: Analyze the effect of variations of parameters on solar panels

Syllabus

Sr. No.	List of Experiments
1	Simulation and analysis of Governor System for impulse, unit step, and ramp inputs using SIMULINK.
2	Simulation and response analysis of Excitation system for impulse, unit step, and ramp inputs using SIMULINK.
3	SIMULINK modelling of power electronic 3 phase, 6 pulse converter using PWM technique.
4	Development of any five classical optimization techniques.
5	Design of passive and active filters using SIMULINK.
6	Simulation and analysis of Governor System for impulse, unit step, and ramp inputs using SIMULINK.
7	Simulation of power quality problems (like Sag/Swell, interruption, transients, harmonics, flickers etc.) using SIMULINK.
8	Simulation, and Performance of Nonlinear and linear Loads
9	Modelling, Simulation, and Performance of Active Series Compensators,

Audit Courses-1 for 1st Semester

Type of Course	Course Code	Course Name
Audit-1	MTA-101/21	English for Research Paper Writing
	MTA-102/21	Disaster Management
	MTA-103//21	Sanskrit for Technical Knowledge
	MTA-104/21	Value Education

MTA-101/21 **ENGLISH FOR RESEARCH PAPER WRITING**

L	T	P
2	0	0

Internal Marks: 00
External Marks: 00
Total Marks: 00

Course Objectives:- Students will be able to:
1. Understand that how to improve your writing skills and level of readability
2. Learn about what to write in each section
3. Understand the skills needed when writing a Title

Syllabus

Units	Content	Hours
1	Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing, Redundancy, Avoiding Ambiguity and Vagueness	4
2	Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction	4
3	Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.	4
4	key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature,	4
5	skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions.	4
6	Useful phrases, how to ensure paper is as good as it could possibly be the first time submission	4

Suggested Studies:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book .
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

Course Outcome:- Students will be able to learn

CO1: Improve writing and readability levels for English
CO2: How to write and what write according to section
CO3: Skills in title writing

MTA-102/21 **DISASTER MANAGEMENT**

Internal Marks: 00
External Marks: 00
Total Marks: 00

L	T	P
2	0	0

Course Objectives: -Students will be able to:

1. Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
2. Critically evaluate disaster risk reduction and humanitarian response policy and practicefrom multiple perspectives.
3. Develop an understanding of standards of humanitarian response and practical relevance inspecific types of disasters and conflict situations.
4. Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or thecountries they work in

Syllabus

Units	Content	Hours
1	Introduction, Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.	4
2	Repercussions Of Disasters And Hazards: Economic Damage, Lossof Human And Animal Life, Destruction Of Ecosystem. NaturalDisasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-madedisaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War AndConflicts	4
3	Disaster Prone Areas In India, Study Of Seismic Zones; Areas ProneTo Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics	4
4	Disaster Preparedness And Management Preparedness: MonitoringOf Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From MeteorologicalAnd Other Agencies, Media Reports: Governmental And Community Preparedness.	4
5	Risk Assessment , Disaster Risk: Concept And Elements, DisasterRisk Reduction, Global And National Disaster Risk Situation.Techniques Of Risk Assessment, Global Co- Operation In RiskAssessment And Warning, People's Participation In Risk Assessment. Strategies for Survival.	4

Suggested readings:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies" New Royal book Company.
2. Sahni, Pardeep Et.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.
3. Goel S. L. Disaster Administration And Management Text And Case Studies" ,Deep & Deep Publication Pvt. Ltd., New Delhi.

Course Outcome:- Student will be able

CO1: Know, how to reduce disaster risk and humanitarian response.

CO2: Policy and practice for disaster risk reduction

CO3: Understand the practical relevance of conflict situations and standards of humanitarianresponse in that situation

CO4: Planning, programming and strength and weakness of disaster risk management.

MTA-103/21 **SANSKRIT FOR TECHNICAL KNOWLEDGE**

L	T	P
2	0	0

Internal Marks: 00
External Marks: 00
Total Marks: 00

Course Objectives:-Students will be able to:

1. To get a working knowledge in illustrious Sanskrit, the scientific language in the world
2. Learning of Sanskrit to improve brain functioning
3. Learning of Sanskrit to develop the logic in mathematics, science & othersubjects enhancing the memory power.
4. The engineering scholars equipped with Sanskrit will be able toexplore the huge knowledge from ancient literature

Syllabus

Units	Content	Hours
1	Alphabets in Sanskrit, Past/Present/Future Tense, Simple Sentences	8
2	Order Introduction of roots Technical information about Sanskrit Literature	8
3	Technical concepts of Engineering—Electrical, Mechanical,Architecture, Mathematics	8

Suggested readings:

1. "Abhyaspustakam" – Dr.Vishwas, Sanskrit-Bharti Publication,New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-Vempati Kutumbshastri, Rashtriya SanskritSansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

Course Outcome:-Students will be able to
CO1: Understanding basic Sanskrit language
CO2: Ancient Sanskrit literature about science & technology can be understood
CO3: Being a logical language will help to develop logic in students.

MTA-104/21 **VALUE EDUCATION**

L	T	P
2	0	0

Internal Marks: 00
External Marks: 00
Total Marks: 00

Course Objectives:-Students will be able to:
1. Understand value of education and self- development
2. Imbibe good values in students
3. Let the should know about the importance of character

Syllabus

Units	Content	Hours
1	Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism, Moral and non- moral valuation. Standards and principles, Value judgements	4
2	Importance of cultivation of values, Sense of duty. Devotion, Self-reliance, Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity, Patriotism, Lovefor nature, Discipline	6
3	Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline, Punctuality, Love and Kindness, Avoid fault Thinking, Free from anger, Dignity of labour, Universal brotherhood and religious tolerance, True friendship, Happiness Vs suffering, love for truth, Aware of self-destructivehabits, Association and Cooperation, Doing best for saving nature	6
4	Character and Competence –Holy books vs Blind faith, Self- management and Good health, Science of reincarnation, Equality,Nonviolence, Humility, Role of Women, All religions and same message, Mind your Mind, Self-control, Honesty, Studying effectively	6

Suggested Reading:
1. Chakroborty , S.K. "Values and Ethics for organizations Theory and practice", Oxford University Press ,New Delhi

Course outcomes:-Students will be able to

CO1: Knowledge of self-development
CO2: Learn the importance of Human values
CO3: Developing the overall personality

PSRE-201/21 **ENERGY FORECASTING AND MODELING** **L T P**
Internal Marks: 40 **3 0 0**
External Marks: 60
Total Marks: 100

Course Objectives:- Students will be able to: **CO1:** Interpret the Energy & GDP, GNP and its dynamics **CO2:** Develop energy system models for short term and long-term forecasting **CO3:** Knowledge about different Energy Sources **CO4:** Knowledge about different types of Development of Energy Optimization Model		
Syllabus		
Units	**Content**	**Hours**
1	Energy Scenario: Role of energy in economic development and social transformation: Energy & GDP, GNP and its dynamics. Energy Sources and Overall Energy demand and Availability-Energy Consumption in various sectors and its changing pattern-Status of Nuclear and Renewable Energy: Present Status and future promise.	10
2	Global warming; Green House Gas emissions, impacts, mitigation; Sustainability; Externalities, Future energy systems; Clean energy technologies; United Nations Framework Convention on Climate Change (UNFCC); Sustainable development; Kyoto Protocol; Conference of Parties (COP); Clean Development Mechanism (CDM); Prototype Carbon Fund (PCF).	10
3	Forecasting Model: Forecasting Techniques-Regression Analysis-Double Moving Average-Double Experimental Smoothing-Triple Exponential Smoothing–ARIMA model-Validation techniques–Qualitative forecasting–Delphi technique-Concept of Neural Net Works.	10
4	Optimization Model: Principles of Optimization-Formulation of Objective Function -Constraints-Multi Objective Optimization–Mathematical Optimization Software–Development of Energy Optimization Model - Development of Scenarios– Sensitivity Analysis	10

Suggested Reading:

1.S. Makridaki s, "Forecasting Methods and Applications", Wiley 1983.
2.Yang X.S., "Introduction to Mathematical Optimization: From Linear Programming to Metaheuristics", Cambridge, Int. Science Publishing, 2008.
3. Armstrong, J.Scott (ed.),"Principles of Forecasting: A Hand Book for Researchers and Practitioners", Norwell, Masschusetts: Kluwer Academic Publishers.2001

PSRE-202/21 **POWER SYSTEM GENERATION CONTROL**

L	T	P
3	0	0

Internal Marks: 40
External Marks: 60
Total Marks: 100

Course Objectives:- Students will be able to:
CO1: To study the unit commitment problem for economic load dispatch.
CO2: To study the load frequency control of single area and two area systems with and without control.
CO3: To study the effect of generation with limited energy supply.
CO4: To study the effectiveness of interchange evaluation in interconnected power systems.

Syllabus

Units	Content	Hours
1	Automatic Generation and Voltage Control: Introduction; Load Frequency Control (Single Area Case); Load Frequency Control and Economic Despatch Control; Two-Area Load Frequency Control; Optimal (Two-Area) Load Frequency Control; Automatic Voltage Control; Load Frequency Control with Generation Rate Constraints (GRCs); Speed Governor Dead-Band and Its Effect on AGC; Digital LF Controllers; Decentralized Control.	10
2	Reactive Power and Voltage Control: Introduction; Reactive power requirement of an uncompensated line; Implication of surge impedance loading; Reactive loss characteristics of transmission line; Operation of a transmission line at no load condition; Operation of a transmission line under heavy loading condition; Voltage regulation of the transmission line and its relation with reactive power; Maximum power transfer in an uncompensated line; Line loadability. Reactive power-voltage (Q-V) coupling concept; Governing effects on reactive power flow; Relation between voltage and reactive power at a node in a power system;	10
3	State Estimation: Introduction; Least Squares Estimation: The Basic Solution; Static State Estimation of Power Systems; Tracking State Estimation of Power Systems; Some Computational Considerations; External System Equivalency; Treatment of Bad Data; Network Observability and Pseudo-Measurements; Application of Power System State Estimation	10
4	Load Forecasting: Introduction; Forecasting Methodology; Estimation of Average and Trend Terms; Estimation of Periodic Components; Estimation of ys(k): Time Series Approach; Long-Term Load Predictions Using Econometric Models; Reactive Load Forecasting.	10

Suggested reading:

1. Modern Power System Analysis – D. P. Kothari, I. J. Nagrath, TMH Publication
2. An introduction to Reactive Power Control and Voltage Stability in Power Transmission Systems – A Chakrabarti, D P Kothari, A K Mukhopadhyay, Abhinandan De, PHI
3. Electrical Power Systems – P. Venkatesh, B.V. Manikandan, S.C. Raja, A. Srinivasan, PHI
4. Power System Analysis – J. J. Grainger, W.D. Stevenson, Mc-GrawHill series publication
5. Power Generation Operation and Control – A. J. Wood, B. F. Woolenberg, John Wiley and Sons

Professional Electives for 2nd Semester

Professional Elective	Course Code	Course Name
PE3	PSRE-203A/21	Power Quality and Harmonic Analysis
	PSRE-203B/21	Power System Dynamics
	PSRE-203C/21	Reliability Analysis and Protection
	PSRE-203D/21	Energy Economics and Policies
PE4	PSRE-204A/21	Electric and Hybrid Vehicles
	PSRE-204B/21	Smart Grids
	PSRE-204C/21	Engineering Optimization
	PSRE-204D/21	Artificial Intelligence Techniques

PSRE-203A/21 POWER QUALITY AND HARMONIC ANALYSIS

L	T	P
3	0	0

Internal Marks: 40
External Marks: 60
Total Marks: 100

Course Objectives:-Students will be able to:
CO1: To understand significance of power quality and power quality parameters.
CO2: To understand harmonics, their effects, harmonic indices and harmonic minimization techniques
CO3: Formulate energy action planning for various types of industry.
CO4: To understand different compensation techniques to minimize power quality disturbances.

Syllabus

Units	Content	Hours
1	Introduction to power quality: Overview of Power Quality, Concern about the Power Quality, General Classes of Power Quality Problems, Voltage Unbalance, Waveform Distortion, Voltage fluctuation, Power Frequency Variations, Power Quality Terms, Voltage Sags, swells, flicker and Interruptions - Sources of voltage and current interruptions, Nonlinear loads.	10
2	Transient and Long Duration Voltage Variations: Source of Transient Over Voltages - Principles of Over Voltage Protection, Devices for Over Voltage Protection, Utility Capacitor Switching Transients, Utility Lightning Protection, Load Switching Transient Problems. Principles of Regulating the Voltage, Device for Voltage Regulation, Utility Voltage Regulator Application, Capacitor for Voltage Regulation, End-user Capacitor Application, Regulating Utility Voltage with Distributed generation	10
3	Harmonic Distortion and solutions: Voltage vs. Current Distortion, Harmonics vs. Transients - Power System Quantities under Non-sinusoidal Conditions, Harmonic Indices, Sources of harmonics,	10
4	Locating Sources of Harmonics, System Response Characteristics, Effects of Harmonic Distortion, Inter harmonics, Harmonic Solutions Harmonic Distortion Evaluation, Devices for Controlling Harmonic Distortion, Harmonic Filter Design, Standards on Harmonics.	10

Suggested Reading:

1. Electrical Power Systems Quality, Dugan R C, McGranaghan M F, Santoso S, and Beaty H W, Second Edition, McGraw-Hill, 2002.
2. Understanding Power Quality Problems: Voltage Sags and Interruptions, Bollen M H J, First Edition, IEEE Press; 2000.
3. Guidebook on Custom Power Devices, Technical Report, Published by EPRI, Nov 2000
4. Power Quality Enhancement Using Custom Power Devices – Power Electronics and Power Systems, Gerard Ledwich, ArindamGhosh, Kluwer Academic Publishers, 2002.

PSRE-203B/21
Internal Marks: 40
External Marks: 60
Total Marks: 100

POWER SYSTEM DYNAMICS

L	T	P
3	0	0

Course Objectives:- Students will be able to:
CO1: Understand the modeling of synchronous machine in details
CO2: Development of mathematical models for synchronous machine
CO3: Analysis and physical interpretation of models of Synchronous machine
CO4: Modeling of induction motor and Understand the load modeling in power system.

Syllabus

Units	Content	Hours
1	Synchronous Machines: Per unit systems; Park's Transformation (modified), Flux-linkage equations.	10
2	Voltage and current equations; Formulation of State-space equations, Equivalent circuit.	8
3	Sub-transient and transient inductance and Time constants, Simplified models of synchronous machines	8
4	Small signal model: Introduction to frequency model. Excitation systems and Philips-Heffron model; PSS Load modeling.	10
5	Modeling of Induction Motors Prime mover controllers.	6

Suggested reading:

1. P. M. Anderson & A. A. Fouad "Power System Control and Stability", Galgotia , New Delhi, 1981
2. J. Machowski, J. Bialek& J. R. W. Bumby, "Power System Dynamics and Stability", John Wiley & Sons, 1997
3. P. Kundur, "Power System Stability and Control", McGraw Hill Inc., 1994.
4. E.W. Kimbark, "Power system stability", Vol. I & III, John Wiley & Sons, New York 2002

PSRE-203C/21 RELIABILITY ANALAYSIS AND PROTECTION

L	T	P
3	0	0

Internal Marks: 40
External Marks: 60
Total Marks: 100

Units	Content	Hours
Course Objectives:- Students will be able to: **CO1:** Have knowledge of different methods to estimate different electrical quantities **CO2:** Acquire skills in planning and building reliable power system. **CO3:** Manage skills required in the field of power system engineering are enhanced. **CO4:** Understand about modes of failure and calculate relevant indices.		
Syllabus		
Units	**Content**	**Hours**
1	Long and short term planning. Load forecasting, characteristics of loads. Methodology of forecasting, energy forecasting. Peak demand forecasting, total forecasting. Annual and monthly peak demand forecasting.	6
2	Reliability concepts, exponential distributions. Meantime to failure, series and parallel system, MARKOV process. Recursive technique. Generator system reliability analysis. Probability models for generators unit and loads. Reliability analysis of isolated and interconnected system, generator system cost analysis, corporate model. Energy transfer and off peak loading.	12
3	Transmission system reliability model analysis: Monte Carlo simulation. Average interruption rate. LOLP method, frequency and duration method.	7
4	Two plant single load system. Two plant two load system. Load forecasting uncertainly interconnections benefits.	7
5	Introduction to system modes of failure. The loss of load approach. Frequency& duration approach. Spare value assessment. Multiple bridge equivalents. Distribution system reliability analysis. Calculation of indices SAIFI. SAIDI, CAIDI, etc.	10

Suggested Reading:

1. Sullivan, R.L., "Power System Planning", Heber Hill.
2. Roy Billington, "Power System Reliability Evaluation", Gordan& Breach Scain Publishers.

PSRE-203D/21 ENERGY ECONOMICS AND POLICIES

Internal Marks: 40
External Marks: 60
Total Marks: 100

L	T	P
3	0	0

Course Objectives:- Students will be able to:
CO1: understand the importance of energy in economic development.
CO2: Understand the need of sustainable energy.
CO3: Understand the issues related to energy pricing taxes
CO4: Take up research in energy economics.

Syllabus

Units	Content	Hours
1	Introduction: Natural Resources, Classification, Importance, Role of Natural Resources in Economic Development, Energy Resources – Classification, Properties and forms of Energy , Energy Economics – origin, Scope and Nature. Energy and development: Role of Energy in Economic Development, Energy Indicators, Energy Intensity and Energy Elasticity – National and International Comparison – Role of International Institutions-OPEC, OAPEC, IEA, and World Bank.	10
2	Energy and environment: Energy Environment Nexus Crisis – Causes and Consequences – Remedial Measures –Impact of Energy Consumption and Production on Environment with illustrations – Role of Energy Economists in solving Energy Crises.	8
3	Planning and Development: Energy Planning and Energy Conservation – Meaning, Objectives and Importance.	8
4	Energy Management: Meaning, Objectives and Importance – Recent Developments, Energy Auditing, Energy Accounting, Energy conservation, Energy Pricing and Taxes – Role of Economists in Sustainable Energy Management.	8
5	Indian Energy Sector: Organizational Structure, Energy Supply sources and trends in production, Energy Demand on sectoral consumption trend, Renewable Energy Sources and Technologies Renewable Energy Programmes in India	8

Suggested Reading:

1. Agarwal, M.C. and Monga, J.R. (1992): Economic and Commercial Geography,National Publishing House, New Delhi.
2. Agarwal, S.K. (1985): Environment and Natural Resources Economics, Scott Foresman & Co., London.
3. Common, M. (1985): Environmental and Resource Economics, Longman, London.
4. David Pearct et al., (1990): Sustainable Development – Economics and Environment in the Third World, Earths Can Publications, London.
5. Karpagam, M. (1991): Environmental Economics, Sterling, New Delhi.
6. Kneese. A.V and Sweeny, J.L, 1993): Handbook of Natural Resource and Energy Economics, North Holland.
7. Munasinghe, M and Meier, P (1993): Energy Policy and Modeling, Cambridge, University Press, UK.
8. Richard Eden (1981): Energy Economics – Growth, Resources and Policies, Cambridge University Press, London.
9. TERI (2015): Teri Energy Data Directory and Year Book 2014-15, The Energy Research Institute, New Delhi.

PSRE-204A/21 **ELECTRIC AND HYBRID VEHICLES** **L T P**

Internal Marks: 40 **3 0 0**
External Marks: 60
Total Marks: 100

Course Objectives:-Students will be able to:
CO1: Know the concept of electric vehicles and hybrid electric vehicles.
CO2: Familiar with different motors used for hybrid electric vehicles.
CO3: Understand the power converters used in hybrid electric vehicles
CO4: Know different batteries and other energy storage systems.

Syllabus

Units	Content	Hours
1	Introduction: History of hybrid vehicles, architectures of HEVs, series and parallel HEVs, complex HEVs.	6
2	Hybridization of Automobile: Fundamentals of vehicle, components of conventional vehicle and propulsion load; Drive cycles and drive terrain; Concept of electric vehicle and hybrid electric vehicle; Plug-in hybrid vehicle, constituents of PHEV, comparison of HEV and PHEV; Fuel Cell vehicles and its constituents.	8
3	Plug-in Hybrid Electric Vehicle: PHEVs and EREVs blended PHEVs, PHEV Architectures, equivalent electric range of blended PHEVs; Fuel economy of PHEVs, power management of PHEVs, end-of-life battery for electric power grid support, vehicle to grid technology, PHEV battery charging.	8
4	Power Electronics in HEVs: Rectifiers used in HEVs, voltage ripples; Buck converter used in HEVs, non-isolated bidirectional DC-DC converter, regenerative braking, voltage source inverter, current source inverter, isolated bidirectional DCDC converter, PWM rectifier in HEVs, EV and PHEV battery chargers.	8
5	Battery and Storage Systems Energy Storage Parameters; Lead–Acid Batteries; Ultra capacitors; Flywheels - Superconducting Magnetic Storage System; Pumped Hydroelectric Energy Storage; Compressed Air Energy Storage - Storage Heat; Energy Storage as an Economic Resource	8

Suggested Reading:

1. Ali Emadi, Advanced Electric Drive Vehicles, CRC Press, 2014.
2. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.
3. MehrdadEhsani, YimiGao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.
4. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.
5. H. Partab: Modern Electric Traction - DhanpatRai& Co, 2007.
6. Pistooa G., "Power Sources , Models, Sustanability, Infrstructure and the market", Elsevier 2008
7. Mi Chris, Masrur A., and Gao D.W., " Hybrid Electric Vehicle: Principles and Applications with Practical Perspectives" 1995.

PSRE-204B/21 **SMART GRIDS** **L T P**
Internal Marks: 40 **3 0 0**
External Marks: 60
Total Marks: 100

Course Objectives:-Students will be able to:
CO1: Understand concept of smart grid and developments on smart grid.
CO2: Understand smart grid technologies and application of smart grid concept in hybrid electric vehicles.
CO3: Have knowledge on smart substations, feeder automation and
CO4: Knowledge of monitoring and protection of grid.

Syllabus

Units	Content	Hours
1	Introduction to Smart Grid: Evolution of Electric Grid, Concept of Smart Grid, Definitions, Need of Smart Grid, Functions of Smart Grid, Opportunities & Barriers of Smart Grid, Difference between conventional & smart grid, Concept of Resilient &Self-Healing Grid, Present development & International policies on Smart Grid. Case study of Smart Grid.	6
2	Smart Grid Technologies: Part 1: Introduction to Smart Meters, Real Time Prizing, Smart Appliances, Automatic Meter Reading(AMR), Outage Management System(OMS), Plug in Hybrid Electric Vehicles(PHEV), Vehicle to Grid, Smart Sensors, Home & Building Automation, Phase Shifting Transformers.	8
3	Smart Grid Technologies: Part 2: Smart Substations, Substation Automation, Feeder Automation. Geographic Information System(GIS), Intelligent Electronic Devices(IED) & their application for monitoring & protection, Smart storage like Battery, SMES, Pumped Hydro, Compressed Air Energy Storage, Wide Area Measurement System(WAMS), Phase Measurement Unit(PMU).	8
4	Micro grids and Distributed Energy Resources: Concept of micro grid, need & applications of microgrid, formation of microgrid, Issues of interconnection, protection & control of microgrid. Plastic & Organic solar cells, Thin film solar cells, Variable speed wind generators, fuel cells, microturbines, Captive power plants, Integration of renewable energy sources.	8
5	Power Quality Management in Smart Grid: Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit. Information and Communication Technology for Smart Grid: Advanced Metering Infrastructure (AMI), Home Area Network (HAN), Neighbourhood Area Network (NAN), Wide Area Network (WAN).	8

Suggested Reading:

1. Ali Keyhani, Mohammad N. Marwali, Min Dai "Integration of Green and Renewable Energy in Electric Power Systems", Wiley.
2. Clark W. Gellings, "The Smart Grid: Enabling Energy Efficiency and Demand Response", CRC Press.
3. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, "Smart Grid: Technology and Applications", Wiley.
4. Jean Claude Sabonnadière, NouredineHadjsaïd, "Smart Grids", Wiley Blackwell 19
5. Peter S. Fox Penner, "Smart Power: Climate Changes, the Smart Grid, and the Future of Electric Utilities", Island Press; 1 edition 8 Jun 2010.
6. S. Chowdhury, S. P. Chowdhury, P. Crossley, "Micro-grids and Active Distribution Networks." Institution of Engineering and Technology, 30 Jun 2009.
7. Stuart Borlase, "Smart Grids (Power Engineering)", CRC Press.
8. Andres Carvallo, John Cooper, "The Advanced Smart Grid: Edge Power Driving Sustainability: 1", Artech House Publishers July 2011.

PSRE-204C/21 **ENGINEERING OPTIMIZATION**

L	T	P
3	0	0

Internal Marks: 40
External Marks: 60
Total Marks: 100

Course Objectives: Students will be able to:
CO1: Understand the need for optimization and different techniques involved and also constraints.
CO2: Knowledge of Linear/Non-linear Programming.
CO3: Understand the importance of optimization to solve Engineering problems
CO4: Knowledge of genetic algorithm for Engineering Optimization

Syllabus

Units	Contents	Hours
1	Concepts of optimization: Engineering applications Statement of optimization Problem, Classification - type and size of the problem Classical Optimization Techniques: Single and multi variable problems-Types of Constraints Semi definite case-saddle point	8
2	Linear programming: Standard form-Geometry of LP problems-Theorem of LP Relation to convexity - formulation of LP problems - simplex method and algorithm Matrix form- two phase method. Duality dual simplex method- LU Decomposition	8
3	Sensitivity analysis. Artificial variables and complementary solutions-QP Engineering Applications: Minimum cost flow problem Network problems-transportation, assignment & allocation, scheduling Karmarkar method-unbalanced and routing problems.	8
4	Nonlinear programming: Non linearity concepts-convex and concave functions non-linear programming-gradient and Hessian. Unconstrained optimization First & Second order necessary conditions- Minimization & Maximization Local & Global convergence- Speed of convergence	6
5	Basic decent methods: Fibonacci & Golden section search – Gradient methods – Newton Method-Lagrange multiplier method - Kuhn-tucker conditions Quasi-Newton method- separable convex programming- Frank and Wolfe method, Engineering applications Nonlinear programming-Constrained optimization: Characteristics of constraints -Direct methods- SLP, SQP-Indirect methods. Transformation techniques-penalty function-Lagrange multiplier methods checking convergence- Engineering applications	8
6	Dynamic programming: Multistage decision process- Concept of sub optimization and principle of optimality Computational procedure- Engineering applications. Genetic algorithms-Simulated. Annealing Methods - Optimization programming, tools and Software packages	6

Suggested reading:

1. David G Luenberger, "Linear and Non Linear Programming", 2nd Ed, Addison-Wesley Pub.Co.,Massachusetts, 2003
2. W.L.Winston, "Operation Research-Applications & Algorithms",2nd Ed., PWS-KENT Pub.Co.,Boston, 2007.
3. S.S. Rao, "Engineering Optimization", 3rd Ed.,New Age International (P) Ltd,New Delhi, 2007.
4. W.F. Stocker, "Design of Thermal Systems", 3rd Ed., McGraw Hill, New York. 1990.
5. G.B. Dantzig, "Linear Programming and Extensions" Princeton University Press, N.J., 1963.
6. L.C.W. Dixton, "Non Linear Optimisation: theory and algorithms" Birkhauser, Boston, 1980.

PSRE-204D/21 **ARTIFICIAL INTELLIGENCE TECHNIQUES** **L T P**
Internal Marks: 40 **3 0 0**
External Marks: 60
Total Marks: 100

Course Objectives: Students will be able to:
CO1: Learn the concepts of biological foundations of artificial neural networks
CO2: Learn Feedback networks and radial basis function networks and fuzzy logics
CO3: Identifications of fuzzy and neural network
CO4: Acquire the knowledge of GA

Syllabus

Units	Contents	Hours
1	Biological foundations to intelligent Systems: Artificial Neural Networks Single layer and Multilayer Feed Forward NN LMS and Back Propagation Algorithm. Feedback networks and Radial Basis Function Networks	8
2	Fuzzy Logic Knowledge Representation and Inference Mechanism Defuzzification Methods	8
3	Fuzzy Neural Networks: Some algorithms to learn the parameters of the network like GA	8
4	System Identification using Fuzzy and Neural Network Genetic algorithm: Reproduction cross over, mutation Introduction to evolutionary program	8
5	Applications of above mentioned techniques to practical problems	10

Suggested reading:

1. J. M. Zurada , "An Introduction to ANN",Jaico Publishing House
2. Simon Haykins, "Neural Networks", Prentice Hall
3. Timothy Ross, "Fuzzy Logic with Engg.Applications", McGraw. Hill
4. Driankov, Dimitra, "An Introduction to Fuzzy Control", Narosa Publication
5. Golding, "Genetic Algorithms", Addison-Wesley Publishing Com.

PSRE-206/21
Internal Marks: 60
External Marks: 40
Total Marks: 100

POWER SIMULATION LAB-II

L	T	P
0	0	4

Course Objectives:-Students will be able :
CO1: To understand power curves for energy sources
CO2: Effect of variable parameters on solar panels
CO3: Relation of wind output and load.

Syllabus

Sr. No.	List of Experiments
1.	Simulation based Power Curves
2.	Build a Wind Farm
3.	Test the capabilities of the Hydrogen Fuel Cells and Capacitors
4.	Effect of Temperature on Solar Panel Output using Simulation
5.	Variables Affecting Solar Panel Output
6.	Effect of Load on Solar Panel Output in Simulation
7.	Wind Turbine Output: The Effect of Load
8.	Test the Capabilities of Solar Panels and Wind Turbines
9.	Single phase parallel inverter with R and RL loads.
10.	Single phase bridge converter with R and RL loads
11.	Single phase dual converter with RL loads.

Course Outcomes:- Students will be able to

1. Various power curves considering different renewable sources
2. Analyze the effect of variations of parameters on solar panels
3. Analyze the wind power

PSRE-206/21	**RENEWABLE ENERGY LAB**	**L T P**
		0 0 4

Internal Marks: 60
External Marks: 40
Total Marks: 100

Course Objectives: Students will be able to:
CO1: Assess the performance of renewable sources of energy
CO2: Knowledge of the scope of tapping geothermal energy
CO3: Field visit to assess the solar lighting
CO4: Knowledge of the practical aspects of integration of renewable sources of energy to the grid

Syllabus

Sr. No.	List of Experiments
1.	Determine the efficiency of Solar PV Grid-Tied system.
2.	Determine the efficiency of Wind Energy System.
3.	Field Visit to Solar Street Lighting System.
4.	Determine the power output of a biogas plant
5.	Study of a geothermal system
6.	Determine the efficiency of a fuel cell
7.	Determine the efficiency of a mini hydro plant
8.	Study of grid integration of multiple renewable energy sources

Audit course for 2nd Semester

Type of Course	Course Code	Course Name
Audit-II	MTA-105/21	Constitution of India
	MTA-106/21	Pedagogy Studies
	MTA-107/21	Stress Management of Yoga
	MTA-108/21	Personality Development through Life Enlightenment Skills

MTA-105/21 **CONSTITUTION OF INDIA**

Internal Marks: 00
External Marks: 00
Total Marks: 00

L	T	P
2	0	0

Course Objectives: Students will be able to

1. Understand the premises informing the twin themes of liberty and freedom from a civilrights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence ofnation hood in the early years of Indian nationalism.
3. To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

Syllabus

Units	Content	Hours
1	History of Making of the Indian Constitution: History, DraftingCommittee, (Composition & Working)	4
2	Philosophy of the Indian Constitution: Preamble, Salient Features	4
3	Contours of Constitutional Rights & Duties: Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of StatePolicy, Fundamental Duties.	4
4	Organs of Governance: Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions	4
5	Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role ofElected Representative, CEO of Municipal Corporation, Pachayati raj: Introduction, PRI: Zila Pachayat, Elected officials and their roles, CEO Zila Pachayat: Position and role, Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy	4
6	Election Commission: Election Commission: Role and Functioning, Chief Election Commissioner and Election Commissioners, State Election Commission: Role and Functioning, Institute and Bodies for the welfare of SC/ST/OBC and women.	4

Suggest Reading

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Course Outcomes: Students will be able to:

CO1: Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
CO2: Discuss the intellectual origins of the framework of argument that informed theconceptualization of social reforms leading to revolution in India.
CO3: Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
CO4: Discuss the passage of the Hindu Code Bill of 1956.

MTA-106/21
Internal Marks: 00
External Marks: 00
Total Marks: 00

PEDAGOGY STUDIES

L	T	P
2	0	0

Course Objectives: Students will be able to:

1. Review existing evidence on the review topic to inform programme design and policymaking undertaken by the DfID, other agencies and researchers.
2. Identify critical evidence gaps to guide the development.

Syllabus

Units	Content	Hours
1	Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology, Theories of learning, Curriculum, Teacher education, Conceptual framework, Research questions, Overview of methodology and Searching	4
2	Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries, Curriculum, Teacher education.	2
3	Evidence on the effectiveness of pedagogical practices, Methodology for the in depth stage: quality assessment of included studies, How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change, Strength and nature of the body of evidence for effective pedagogical practices, Pedagogic theory and pedagogical approaches, Teachers' attitudes and beliefs and Pedagogic strategies.	4
4	Professional development: alignment with classroom practices and follow up support, Peer support, Support from the head teacher and the community, Curriculum and assessment, Barriers to learning: limited resources and large class sizes.	4
5	Research gaps and future directions, Research design, Contexts, Pedagogy, Teacher education, Curriculum and assessment, Dissemination and research impact.	2

Suggested reading

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools,Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation,Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

Course Outcomes: Students will be able to understand:

CO1: What pedagogical practices are being used by teachers in formal and informalclassrooms in developing countries?

CO2: What is the evidence on the effectiveness of these pedagogical practices, in whatconditions, and with what population of learners?

CO3: How can teacher education (curriculum and practicum) and the school curriculum andguidance materials best support effective pedagogy?

MTA-107/21 **STRESS MANAGEMENT BY YOGA**

Internal Marks: 00
External Marks: 00
Total Marks: 00

L	T	P
2	0	0

Course Objectives: Students will be able to:
1. To achieve overall health of body and mind
2. To overcome stress

Syllabus

Units	Content	Hours
1	Definitions of Eight parts of yog. (Ashtanga)	4
2	Yam and Niyam, Do`s and Don't's in life. i) Ahinsa, satya, astheya, bramhacharya and aparigraha ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan	2
3	Asan and Pranayam i) Various yog poses and their benefits for mind & body ii)Regularization of breathing techniques and its effects-Types ofpranayama	4

Suggested reading

1. 'Yogic Asanas for Group Tarining-Part-I" : Janardan Swami Yogabhyasi Mandal,Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda,Advaita Ashrama (Publication Department), Kolkata

Course Outcomes:- Students will be able to:

CO1: Develop healthy mind in a healthy body thus improving social health also
CO2: Improve efficiency

MTA-108/21 **PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS**

L	T	P
2	0	0

Internal Marks: 00
External Marks: 00
Total Marks: 00

Course Objectives: Students will be able to:

1. To learn to achieve the highest goal happily
    a. To become a person with stable mind, pleasing personality and determination
    b. To awaken wisdom in students

Syllabus

Units	Content	Hours
1	Neetisatakam-Holistic development of personality, Verses- 19,20,21,22 (wisdom), Verses- 29,31,32 (pride & heroism), Verses- 26,28,63,65 (virtue), Verses- 52,53,59 (dont's), Verses- 71,73,75,78 (do's)	8
2	Approach to day to day work and duties, Shrimad Bhagwad Geeta :Chapter 2-Verses 41, 47,48, Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35, Chapter 18-Verses 45, 46, 48.	8
3	Statements of basic knowledge, Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68, Chapter 12 -Verses 13, 14 15, 16, 17, 18, Personality of Role model. Shrimad Bhagwad Geeta: Chapter2- Verses 17, Chapter 3-Verses 36,37,42, Chapter 4-Verses 18, 38,39, Chapter18 – Verses 37,38,63	8

Suggested reading

1. "Srimad Bhagavad Gita" by Swami Swarupananda Advaita Ashram (Publication Department), Kolkata
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

Course Outcomes: Students will be able to

CO1: Study of Shrimad-Bhagwad-Geeta will help the student in developing his personalityand achieve the highest goal in life

CO2: The person who has studied Geeta will lead the nation and mankind to peace and prosperity

CO3: Study of Neetishatakam will help in developing versatile personality of students.

Professional Electives for 3rd Semester

Professional Elective	Course Code	Course Name
PE5	PSRE-301A/21	Industrial Load Modelling and Control
	PSRE-301B/21	Power System Deregulation
	PSRE-301C/21	Solar PV Energy System
	PSRE-301D/21	Power System Generation Control

PSRE-301A/21 INDUSTRIAL LOAD MODELING AND CONTROL

L T P

3 0 0

Internal Marks: 40
External Marks: 60
Total Marks: 100

Course Objectives:- Students will be able to:		
CO1: Knowledge about load control techniques in industries and its application.		
CO2: Different types of industrial processes and optimize the process using tools like LINDO and LINGO.		
CO3: Apply load management to reduce demand of electricity during peak time.		
CO4: Apply different energy saving opportunities in industries.		
Syllabus		
Units	**Content**	**Hours**
1	Electric Energy Scenario-Demand Side Management-Industrial Load Management. Load Curves-Load Shaping Objectives-Methodologies. Barriers; Classification of Industrial Loads- Continuous and Batch processes -Load Modeling.	8
2	Electricity pricing – Dynamic and spot pricing –Models. Direct load control- Interruptible load control. Bottom up approach- scheduling- Formulation of load models-Optimization and control algorithms - Case studies.	8
3	Reactive power management in industries-controls-power quality impacts application of filters Energy saving in industries.	6
4	Cooling and heating loads- load profiling- Modeling. Cool storage-Types- Control strategies. Optimal operation-Problem formulation- Case studies. Captive power units- Operating and control strategies- Power Pooling-Operation models. Energy banking-Industrial Cogeneration	12
5	Selection of Schemes Optimal Operating Strategies. Peak load saving-Constraints-Problem formulation- Case study. Integrated Load management for Industries	8

Suggested reading:

1. C.O. Bjork "Industrial Load Management - Theory, Practice and Simulations", Elsevier, theNetherlands,1989.
2. C.W. Gellings and S.N. Talukdar, "Load management concepts," IEEE Press, New York, 1986, pp. 3-28.
3. Y. Manichaikul and F.C. Schweppe ," Physically based Industrial load", IEEE Trans. on PAS, April 1981.
4. H. G. Stoll, "Least cost Electricity Utility Planning", Wiley Interscience Publication, USA, 1989.
5. I.J.Nagarath and D.P.Kothari, .Modern Power System Engineering., Tata McGraw Hill publishers, New Delhi, 1995.
6. IEEE Bronze Book- "Recommended Practice for Energy Conservation and cost effective Planning in Industrial facilities", IEEE Inc, USA.

PSRE-301B/21 **POWER SYSTEM DEREGULATION** **L T P**
Internal Marks: 40 **3 0 0**
External Marks: 60
Total Marks: 100

Course Objectives: Students will be able to:
CO1: knowledge about the restructuring and deregulation of power sector.
CO2: Introduction to the fundamental concepts relevant to OASIS, congestion management etc.
CO3: Knowledge of power market and its mitigation techniques
CO4: Understand the factors related with deregulation of power industry in different countries

Syllabus

Units	Contents	Hours
1	Introduction: Basic concept and definitions, privatization, restructuring, transmission open access, wheeling, deregulation, components of deregulated system, advantages of competitive system. Power System Restructuring: An overview of the restructured power system, Difference between integrated power system and restructured power system. Explanation with suitable practical examples	8
2	Deregulation of Power Sector: Separation of ownership and operation, Deregulated models, pool model, pool and bilateral trades model, multilateral trade model. Competitive electricity market: Independent System Operator activities in pool market, Wholesale electricity market characteristics, central auction, single auction power pool, double auction power pool, market clearing and pricing, Market Power and its Mitigation Techniques, Bilateral trading, Ancillary services.	8
3	Competitive electricity market: Independent System Operator activities in pool market, Wholesale electricity market characteristics, central auction, single auction power pool, double auction power pool, market clearing and pricing, Market Power and its Mitigation Techniques, Bilateral trading, Ancillary services, Transmission Pricing. Open Access Same Time Information System (OASIS): Introduction, structure, functionality, implementation, posting of information, uses. Transmission Pricing: Marginal pricing of Electricity, nodal pricing, zonal pricing, embedded cost, Postage stamp method, Contract Path method, Boundary flow method, MW-mile method, MVA-mile method, Comparison of different methods.	8
4	Congestion Management: Congestion management in normal operation, explanation with suitable example, total transfer capability (TTC), Available transfer capability (ATC), Different Experiences in deregulation: England and Wales, Norway, China, California, New Zealand and Indian power system.	6
5	Different Experiences in deregulation: U.S.A, Canada, U.K, Japan, Switzerland, Australia, Sweden, Germany and Indian power system	8

Suggested Reading:
1. Power System Restructuring and Deregulation by Loi Lei Lai, John Wiley & Sons Ltd.
2. Understanding Electric Utilities and Deregulation by Lorrin Philipson and H. Lee Willis, Marcel Dekker Inc, New York, CRC Press.
3. Power System Restructuring Engineering & Economics by Marija llic by Francisco Galiana and Lestor Fink, Kulwer Academic Publisher, USA.

PSRE-301C/21
Internal Marks: 40
External Marks: 60
Total Marks: 100

SOLAR PV ENERGY SYSTEM

L	T	P
3	0	0

Course Objectives:
CO1: Understand the fundamental theory governing the photovoltaic devise
CO2: Ability of carry out preliminary system design.
CO3: Knowledge of testing and assessment of power generation by solar PV.
CO4: Analysis of solar data

Syllabus

Units	Contents	Hours
1	Solar Radiation: Sun as Energy Source, Solar Radiation at The Earth's Surface, Solar Radiation Geometry, Solar Time and Equation of Time, Sun Earth angles, Sun path diagram, Sunshine hours, Measurement of Solar Diffuse, Global and Direct Solar Radiation, Equipment's, Estimation of Solar radiation on horizontal and tilted Surfaces, Global Solar radiation data, Indian Solar Radiation data analysis	10
2	Solar Cells Conversion of Solar energy into Electricity - Photovoltaic Effect, Equivalent Circuit of the Solar Cell, Analysis of PV Cells: Dark and illumination characteristics, Figure of merits of solar cell, Efficiency limits, Variation of efficiency with band-gap and temperature, Efficiency measurements, High efficiency cells, Recent developments in Solar Cells, Role of nano-technology in Solar cells	10
3	Fabrication Technology for Solar Cells High efficiency multi-junction solar cell, Quantum well solar cell, Technology for the fabrication of thin film cells, Optical concentration, Effect of temperature on Cell performance, Thermo photovoltaic effect Solar Photovoltaic System Design Solar cell array system analysis and performance prediction, Shadow analysis: Reliability, Solar cell array design concepts, PV system design, Design process and optimization: Detailed array design, Voltage regulation, Maximum tracking, Quick sizing method, Array protection.	12
4	Solar Photo Voltaic System Testing Sun Simulator, Testing and performance assessment of Solar PV generator, Electronic Control and Regulation, Power Conditioning, Converters and inverter, Concentrating system, System design and configuration	10

Suggested Reading:

1. Fundamentals of Solar Cells: PV Solar Energy Conversion by AL Fahrenbruch and RH Bube, Academic Press, New York.
2. Principles of Solar Engineering by F Kreith and JF Kreider, McGraw-Hill.
3. Solar Photovoltaic. Fundamental Technologies and Application by Chetan Singh Solanki, PHI Publications.

PSRE-301D/21 **POWER SYSTEM GENERATION CONTROL**

L T P
3 0 0

Internal Marks: 40
External Marks: 60
Total Marks: 100

Course Objectives:-Students will be able to:
CO1: Knowledge of Automatic Generation and Control
CO2: Understanding of the power system security and its analysis
CO3: Knowledge of estimation and computation
CO4: Analyze the load requirement and forecast load

Syllabus

Units	Content	Hours
1	Automatic Generation and Voltage Control: Introduction; Load Frequency Control (Single Area Case); Load Frequency Control and Economic Despatch Control; Two-Area Load Frequency Control; Optimal (Two-Area) Load Frequency Control; Automatic Voltage Control; Load Frequency Control with Generation Rate Constraints (GRCs); Speed Governor Dead-Band and Its Effect on AGC; Digital LF Controllers; Decentralized Control.	6
2	Power System Security: Introduction; System State Classification; Security Analysis; Contingency Analysis	8
3	Reactive Power and Voltage Control: Introduction; Reactive power requirement of an uncompensated line; Implication of surge impedance loading; Reactive loss characteristics of transmission line; Operation of a transmission line at no load condition; Operation of a transmission line under heavy loading condition; Voltage regulation of the transmission line and its relation with reactive power; Maximum power transfer in an uncompensated line; Line loadability. Reactive power-voltage (Q-V) coupling concept; Governing effects on reactive power flow; Relation between voltage and reactive power at a node in a power system; Reactive power requirement for control of voltage in long lines; Operational aspects in reactive power and voltage control; Basic principle of system voltage control; Reactive power flow constraints and their implications in loss of voltage; Effect of transformer tap changing in the post disturbance period; Effect of generator excitation adjustment in the post disturbance period; Practical aspects of reactive power flow problems leading to voltage collapse in EHV lines.	8
4	State Estimation: Introduction; Least Squares Estimation: The Basic Solution; Static State Estimation of Power Systems; Tracking State Estimation of Power Systems; Some Computational Considerations; External System Equivalency; Treatment of Bad Data; Network Observability and Pseudo-Measurements; Application of Power System State Estimation	8
5	Load Forecasting: Introduction; Forecasting Methodology; Estimation of Average and Trend Terms; Estimation of Periodic Components; Estimation of ys(k): Time Series Approach; Long-Term Load Predictions Using Econometric Models; Reactive Load Forecasting.	8

Suggested Reading:

1. Modern Power System Analysis – D. P. Kothari, I. J. Nagrath, TMH Publication
2. An introduction to Reactive Power Control and Voltage Stability in Power Transmission Systems – A Chakrabarti, D P Kothari, A K Mukhopadhyay, Abhinandan De, PHI
3. Electrical Power Systems – P. Venkatesh, B.V. Manikandan, S.C. Raja, A. Srinivasan, PHI
4. Power System Analysis – J. J. Grainger, W.D. Stevenson, Mc-GrawHill series publication
5. Power Generation Operation and Control – A. J. Wood, B. F. Woolenberg, John Wiley and Sons

6. Power System Analysis – Hadi Saadat, Mc-GrawHill series publication
7. Advanced Power System Analysis and Dynamics – L. P. Singh, New Age Internationa

Open Electives

Course Code	Course Name
MTOE-301A/21	Business Analysis
MTOE-301B/21	Industrial Safety
MTOE-301C/21	Operations Research
MTOE-301D/21	Cost Management of Engineering Projects
MTOE-301E/21	Composite Materials
MTOE-301F/21	Waste to Energy

MTOE -301A/21
Internal Marks: 50
External Marks: 100
Total Marks: 150

BUSINESS ANALYTICS

L	T	P
3	0	0

Course Objectives:-Students will be able to:
1. Understand the role of business analytics within an organization.
2. Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization
3. To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
4. To become familiar with processes needed to develop, report, and analyze business data.
5. Use decision-making tools/Operations research techniques.
6. Mange business process using analytical and management tools.
7. Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

Syllabus

Units	Content	Hours
1	Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics, Process and organisation, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.	9
2	Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.	8
3	Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization	9
4	Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.	10
5	Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.	8
6	Recent Trends in : Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.	4

Suggested reading

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education.

Course Outcome:-

1. Students will demonstrate knowledge of data analytics.
2. Students will demonstrate the ability of think critically in making decisions based on data and deep analytics.
3. Students will demonstrate the ability to use technical skills in predicative and prescriptive modelling to support business decision-making.
4. Students will demonstrate the ability to translate data into clear, actionable insights.

MTOE-301B/21 **INDUSTRIAL SAFETY**
Internal Marks: 50
External Marks: 100
Total Marks: 150

L	T	P
3	0	0

Course Objectives:-Students will be able to:
1. Understand about industrial safety and maintenance engineering
2. Learn possible ways of prevention from wear and tear and methods of fault tracing
3. Understand periodic maintenance

Syllabus

Units	Content	Hours
1	Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.	8
2	Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.	8
3	Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.	8
4	Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.	8
5	Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance.	8

Suggested reading:
1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

Course Outcome:- Student will be able
1. To know about industrial safety and ways of prevention of wear and tear
2. Learn about fault identification and periodic maintenance.
3. To get knowledge about all safety measures

MTOE-301C/21 **OPERATIONS RESEARCH**
Internal Marks: 50
External Marks: 100
Total Marks: 150

L	T	P
3	0	0

Course Objectives:-Students will be able to:

1. To learn the optimization techniques
2. How to formulate LPP and handling of Nonlinear programming
3. How to do the scheduling and sequencing of models

Syllabus

Units	Content	Hours
1	Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models.	8
2	Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming.	8
3	Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT.	8
4	Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.	8
5	Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation	8

Suggested reading

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

Course Outcomes: Student should be able to

1. Students should able to apply the dynamic programming to solve problems of discreet and continuous variables.
2. Students should able to apply the concept of non-linear programming
3. Students should able to carry out sensitivity analysis
4. Student should able to model the real world problem and simulate it.

MTOE-301D/21 **COST MANAGEMENT OF ENGINEERING PROJECTS** **L T P**
Internal Marks: 50 **3 0 0**
External Marks: 100
Total Marks: 150

Course Objectives:-Students will be able to
1. To get knowledge about cost concept and cost management process
2. To know about meaning and process of project execution
3. To learn quantitative techniques and cost planning

Syllabus

Units	Content	Hours
1	Introduction and Overview of the Strategic Cost Management Process	6
2	Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.	6
3	Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and non technical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team : Role of each member. Importance Project site : Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process.	10
4	Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.	10
5	Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.	8

Suggested reading:

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

Course Outcomes: Student should be able to

1. Understand cost management process
2. To execute project considering cost factor
3. To manage planning of cost and learn about the techniques

MTOE-301E/21 **COMPOSITE MATERIALS** **L T P**
3 0 0
Internal Marks: 50
External Marks: 100
Total Marks: 150

Course Objectives:-Students will be able to:

1. To understand composite materials and their reinforcement
2. Manufacturing of matrix

Syllabus

Units	Content	Hours
1	Introduction, Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.	8
2	Reinforcements: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.	8
3	Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.	8
4	Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.	8
5	Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.	8

Suggested text book reading:

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

Suggested reference reading:

1. Hand Book of Composite Materials-ed-Lubin.
2. Composite Materials – K.K.Chawla.
3. Composite Materials Science and Applications – Deborah D.L. Chung.
4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

Course Outcome:- Student will be able to

1. Learn about composite materials and their process of reinforcement
2. Understand about strength and manufacturing of matrix

MTOE-301F/21
Internal Marks: 50
External Marks: 100
Total Marks: 150

WASTE TO ENERGY

L	T	P
3	0	0

Course Objectives:-Students will be able to:

1. Understand classification of waste and about energy from waste
2. Process of biomass waste conversion to energy
3. To understand biomass waste properties

Syllabus

Units	Content	Hours
1	Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors.	8
2	Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.	8
3	Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.	8
4	Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.	8
5	Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.	8

Suggested reading:

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

Course Outcome:- Student will be able to

1. Know about the energy in biomass waste
2. Understand the biomass fuel conversion process for energy
3. Know about biomass waste properties.

IKG Punjab Technical University

Teaching Scheme

for

PhD Coursework

ELECTRICAL ENGINEERING

2020 & onwards

Ph.D Course work structure and criteria for assessment

(Reference IKGPTU/REG/NF/2172, dated 27/07/2021)

Sr. No.	Nature of Course	Name of Course	Credits	Hours per Week	Maximum Marks	External Marks	Internal Marks	External Assessment	Internal Assessment
1	Core	Research Methodology	4	4	100	60	40	3 hours exam	MSTs, Assignment/ presentation
2	Core	Subject related theory paper	4	4	100	60	40	3 hours exam	MSTs, Assignment/ presentation
3	Core	Presentation/ Seminar	3	3	75	0	75	--	Seminar and technical report writing
4	Inter-disciplinary	Elective	4	4	100	60	40	3 hours exam	MSTs, Assignment/ presentation
5	For all streams	Research publication and Ethics	2	2	50	30	20	3 hours exam	MSTs, Assignment/ presentation
Total			**17**	**17**	**425**	**210**	**215**	**--**	**--**

w.e.f: Batch 2020

Core-List of Subject related theory paper	
1.	Power System Engineering
2.	Power Electronics
3.	Electrical Drives Engineering
4.	Energy Management Engineering
5.	Microelectronics and Control Systems
6.	Advanced Relaying and Protection
7.	Digital System Design
8.	Modelling and Analysis of Dynamic Systems
9.	Bio Medical Signal Processing
10.	Sensors and Applications
11.	Scientific and Analytical Instrumentation
12.	Renewable Energy Resources

w.e.f: Batch 2020

Elective-List of Interdisciplinary Course	
1.	Signal Processing
2.	Communication Systems
3.	VLSI Design and Embedded Systems
4.	Linear Algebra
5.	Sensors for Ranging and Imaging

w.e.f: Batch 2020

Program Outcomes of Ph.D-Electrical Engineering

w.e.f: Batch 2021

The scholars who successfully completes their PhD programme in Electrical Engineering will be able to:

PO 1: Perform an advanced research theory based, practiced and analyze the existing research of key thrust areas.

PO 2: Competent to undertake a novel work using modern engineering tools for creating a positive impact towards the welfare and betterment of society.

PO 3: To demonstrate the leadership skills in the chosen research domain and communicates effectively both in oral and written formats to a diverse audience.

PO 4: Knowledge enhancement, positive impact toward the welfare and betterment of society and contribute to nation building.

Course Outcomes of Ph.D Course Work	w.e.f: Batch 2021
CORE COURSES	
1.	**Research Methodology**
	CO1: for a basic framework of research process. CO2: analyze and interprets the various research designs and techniques CO3: understand and apply ethical dimensions of conducting applied research and carrying inter-disciplinary research.
2.	**Power System Engineering**
	CO1: to understand the applications of various compensation devices CO2: Apply the concept of FACTS controllers in advanced hybrid power research using modern engineering tools CO3: Study and analyze the stability under varying transient conditions
3.	**Power Electronics**
	CO1: present the concepts of typical power electronic circuits: topologies and control. CO2: converter analysis, modeling, design and control of converters to different applications using modern engineering tools. CO3: design the controller for varied systems of engineering
4.	**Electrical Drives Engineering**
	CO1: Understand the design, function, operation and control of all major components of a typical electric drive CO2: To develop the applications of multilevel inverter and its topologies in advanced research CO3: Understand the non-linear induction motor drives for various diverse applications
5.	**Energy Management Engineering**
	CO1: Apply the concept of energy audit in the industry and extend to society for energy management awareness CO2: Start the consultancy on energy management and engineering CO3: Analyze and interprets the various lighting systems and HVAC systems
6.	**Microelectronics and Control Systems**
	CO1: Design the optimal control for various diverse applications in advanced research CO2: Learn the various filtering techniques by applying digital signal processing in power system applications CO3: Interprets and compare the stability concept of various non-linear systems using engineering softwares
7.	**Advanced Relaying and Protection**
	CO1: Learn to differentiate the unit and non-unit system of protection schemes CO2: Analyze and apply the various protection schemes for under various applications of thrust areas of research

	CO3: To extend the development of prototypes of supervisory control schemes in research work
8.	**Digital System Design**
	CO1: To apply concepts and methods of digital system design techniques CO2: To understand the principle of operation of sequential machines CO3: To analyze and interprets the design of combinational and sequential digital systems for diverse applications of power systems
9.	**Modelling and Analysis of Dynamic Systems**
	CO1: Perform systematic choices of ideal elements for modeling a real dynamic system with mechanical, thermal, fluid and electrical elements and their interactions CO2: Develop the differential equations that describe the input/output behavior of a dynamic system CO3: Compute the input/output transfer function of a dynamic system for its analysis
10.	**Bio Medical Signal Processing**
	CO1: To understand the concept of nervous system and apply in neural networks. CO2: To analyze the research based non-electrical parameters and use in algorithms using modern engineering tools. CO3: Understand and interprets the principle of operation of biotelemetry systems and its applications.
11.	**Sensors and Applications**
	CO1: Gain the basic idea of measurements, characteristics and the errors associated with measurements and apply in advanced research meaningful for society CO2: Demonstrate the concept of resistive sensors which can be employed for real life applications CO3: Realize the concept of reactive sensors employed for real life applications
12.	**Scientific and Analytical Instrumentation**
	CO1: learn the basic concept of qualitative and quantitative analysis of a given sample. CO2: Learn various spectroscopic techniques with its instrumentation and apply in inter-disciplinary research. CO3: impart the concept of separation science and its application.
13.	**Renewable Energy Resources**
	CO1: Apply the basic properties of different renewable sources of energy and technologies using modern engineering tools CO2: Knowledge of the main elements of technical systems designed for utilization of renewable sources of energy CO3: Understand the advantages and disadvantages of different renewable sources of energy
14.	**Presentation/ Seminar**

	CO1: To identify an area of research and demonstrate the ability to present the latest carried work and explains its societal benefits CO2: To ably link the carried study with its economic analysis and demonstrate its relative merits CO3: To ably carry forward its study using modern engineering softwares

ELECTIVE COURSE	
1.	**Signal Processing**
	CO1: Interpret, represent and process discrete/digital signals and systems CO2: Thorough understanding of frequency domain analysis of discrete time signals CO3: Ability to design & analyze DSP systems like FIR and IIR Filter
2.	**Communication Systems**
	CO1: Analyse communication systems in both the time and frequency domains. CO2: Describe the principles of amplitude modulated and angle modulated communication systems CO3: Describe the principles of various digital modulation systems and their properties
3.	**VLSI Design and Embedded Systems**
	CO1: Learn IC and ASIC Technology CO2: Understand the detailed working of combinational circuits CO3: Express the functioning of sequential circuits
4.	**Linear Algebra**
	CO1: acquire basic knowledge of matrix theory CO2 comprehend basic concept of vector space and linear transformation CO3 apply the knowledge of linear algebra in engineering problems
5.	**Sensors for Ranging and Imaging**
	CO1: Understand the constraints and limitations of a given ISM system in a given application CO2: Compare, contrast and select the most appropriate sensor modality CO3: Prepare a detailed sensor system specification

	COs w.e.f: Batch 2021	POs
1.	**Research Methodology**	
	CO1: for a basic framework of research process. CO2: analyze and interprets the various research designs and techniques CO3: understand and apply ethical dimensions of conducting applied research and carrying inter-disciplinary research.	PO 1: Perform an advanced research theory based, practiced and analyze the existing research of key thrust areas. PO 3: To demonstrate the leadership skills in the chosen research domain and communicates effectively both in oral and written formats to a diverse audience.
2.	**Power System Engineering**	
	CO1: to understand the applications of various compensation devices CO2: Apply the concept of FACTS controllers in advanced hybrid power research using modern engineering tools CO3: Study and analyze the stability under varying transient conditions	PO 2: Competent to undertake a novel work using modern engineering tools for creating a positive impact towards the welfare and betterment of society. PO 4: Knowledge enhancement, positive impact toward the welfare and betterment of society and contribute to nation building.
3.	**Power Electronics**	
	CO1: present the concepts of typical power electronic circuits: topologies and control. CO2: converter analysis, modeling, design and control of converters to different applications using modern engineering tools. CO3: design the controller for varied systems of engineering	PO 1: Perform an advanced research theory based, practiced and analyze the existing research of key thrust areas. PO 2: Competent to undertake a novel work using modern engineering tools for creating a positive impact towards the welfare and betterment of society.
4.	**Electrical Drives Engineering**	
	CO1: Understand the design, function, operation and control of all major components of a typical electric drive CO2: To develop the applications of multilevel inverter and its topologies in advanced research CO3: Understand the non-linear induction motor drives for various diverse applications	PO 2: Competent to undertake a novel work using modern engineering tools for creating a positive impact towards the welfare and betterment of society. PO 3: To demonstrate the leadership skills in the chosen research domain and communicates effectively both in oral and written formats to a diverse audience.
5.	**Energy Management Engineering**	
	CO1: Apply the concept of energy audit in the industry and extend to society for energy management awareness	PO 2: Competent to undertake a novel work using modern engineering tools for creating a positive impact towards

	CO2: Start the consultancy on energy management and engineering CO3: Analyze and interprets the various lighting systems and HVAC systems	the welfare and betterment of society. PO 3: To demonstrate the leadership skills in the chosen research domain and communicates effectively both in oral and written formats to a diverse audience. PO 4: Knowledge enhancement, positive impact toward the welfare and betterment of society and contribute to nation building.
6.	**Microelectronics and Control Systems**	
	CO1: Design the optimal control for various diverse applications in advanced research CO2: Learn the various filtering techniques by applying digital signal processing in power system applications CO3: Interprets and compare the stability concept of various non-linear systems using engineering softwares	PO 1: Perform an advanced research theory based, practiced and analyze the existing research of key thrust areas. PO 2: Competent to undertake a novel work using modern engineering tools for creating a positive impact towards the welfare and betterment of society. PO 4: Knowledge enhancement, positive impact toward the welfare and betterment of society and contribute to nation building.
7.	**Advanced Relaying and Protection**	
	CO1: Learn to differentiate the unit and non-unit system of protection schemes CO2: Analyze and apply the various protection schemes for under various applications of thrust areas of research CO3: To extend the development of prototypes of supervisory control schemes in research work	PO 1: Perform an advanced research theory based, practiced and analyze the existing research of key thrust areas. PO 2: Competent to undertake a novel work using modern engineering tools for creating a positive impact towards the welfare and betterment of society.
8.	**Digital System Design**	
	CO1: To apply concepts and methods of digital system design techniques CO2: To understand the principle of operation of sequential machines CO3: To analyze and interprets the design of combinational and sequential digital systems for diverse applications of power systems	PO 2: Competent to undertake a novel work using modern engineering tools for creating a positive impact towards the welfare and betterment of society. PO 3: To demonstrate the leadership skills in the chosen research domain and communicates effectively both in oral and written formats to a diverse audience.

9.	**Modelling and Analysis of Dynamic Systems**	
	CO1: Perform systematic choices of ideal elements for modeling a real dynamic system with mechanical, thermal, fluid and electrical elements and their interactions CO2: Develop the differential equations that describe the input/output behavior of a dynamic system CO3: Compute the input/output transfer function of a dynamic system for its analysis	PO 2: Competent to undertake a novel work using modern engineering tools for creating a positive impact towards the welfare and betterment of society.
10.	**Bio Medical Signal Processing**	
	CO1: To understand the concept of nervous system and apply in neural networks. CO2: To analyze the research based non-electrical parameters and use in algorithms using modern engineering tools. CO3: Understand and interprets the principle of operation of biotelemetry systems and its applications.	PO 1: Perform an advanced research theory based, practiced and analyze the existing research of key thrust areas. PO 2: Competent to undertake a novel work using modern engineering tools for creating a positive impact towards the welfare and betterment of society.
11.	**Sensors and Applications**	
	CO1: Gain the basic idea of measurements, characteristics and the errors associated with measurements and apply in advanced research meaningful for society CO2: Demonstrate the concept of resistive sensors which can be employed for real life applications CO3: Realize the concept of reactive sensors employed for real life applications	PO 1: Perform an advanced research theory based, practiced and analyze the existing research of key thrust areas. PO 2: Competent to undertake a novel work using modern engineering tools for creating a positive impact towards the welfare and betterment of society. PO 4: Knowledge enhancement, positive impact toward the welfare and betterment of society and contribute to nation building.
12.	**Scientific and Analytical Instrumentation**	
	CO1: learn the basic concept of qualitative and quantitative analysis of a given sample. CO2: Learn various spectroscopic techniques with its instrumentation and apply in inter-disciplinary research. CO3: impart the concept of separation science and its application.	PO 1: Perform an advanced research theory based, practiced and analyze the existing research of key thrust areas. PO 4: Knowledge enhancement, positive impact toward the welfare and betterment of society and contribute to nation building.
13.	**Renewable Energy Resources**	

	CO1: Apply the basic properties of different renewable sources of energy and technologies using modern engineering tools CO2: Knowledge of the main elements of technical systems designed for utilization of renewable sources of energy CO3: Understand the advantages and disadvantages of different renewable sources of energy	PO 1: Perform an advanced research theory based, practiced and analyze the existing research of key thrust areas. PO 2: Competent to undertake a novel work using modern engineering tools for creating a positive impact towards the welfare and betterment of society. PO 4: Knowledge enhancement, positive impact toward the welfare and betterment of society and contribute to nation building.
14.	**Presentation/ Seminar**	
	CO1: To identify an area of research and demonstrate the ability to present the latest carried work and explains its societal benefits CO2: To ably link the carried study with its economic analysis and demonstrate its relative merits CO3: To ably carry forward its study using modern engineering softwares	PO 1: Perform an advanced research theory based, practiced and analyze the existing research of key thrust areas. PO 3: To demonstrate the leadership skills in the chosen research domain and communicates effectively both in oral and written formats to a diverse audience. PO 4: Knowledge enhancement, positive impact toward the welfare and betterment of society and contribute to nation building.