I K Gujral Punjab Technical University- Jalandhar, Kapurthala
Board of Studies for Electrical Engineering (Main Campus and Constituent Campuses)

Minutes of Meeting held on 26.06.2019

The 1th meeting of Board of Studies for Electrical Engineering (Main Campus and Constituent Campuses) was held under the Chairmanship of Prof. Y S Brar in the Director (Main Campus) Office at IKG Punjab Technical University Jalandhar on 26.06.2019 at 11:45am.

The meeting started with the welcome address to the members of BoS (EE) and special invitee by the Dr Y S Brar. The following agenda items were discussed and decisions taken:

Item No.	Agenda	Discussions and Decision
1.1	To adopt the Vision and Mission statement of Department of Electrical Engineering approved the 5th Meeting of BoS (EE) of IKGPTU and make any changes so that it is in line with that of the University.	The Vision and Mission statement of Department of Electrical Engineering of Main Campus and Constituent Campuses are adopted and finalised (Annexure: A). The Members of BoS (EE) authorize Chairman BoS (EE), HOD (EE) and Coordinator BoS (EE) to sign relevant documents.
1.2	To adopt the relevant study scheme and syllabus of IKGPTU for the present batches of main campus and constituent campuses.	The study scheme and syllabus for the present batches of Main Campus and Constituent Campuses for: • *B. Tech. (EE) Batch 2016-20 and Batch 2017-21 of Main Campus and Constituent Campuses:* IKGPTU Scheme& Syllabus of B. Tech. Electrical Engineering [EE] Batch 2011 of IKGPTU are adopted. • *B. Tech. (EE) Batch 2018-22 of Main Campus and Constituent Campuses:* IKGPTU Scheme& Syllabus of B. Tech. Electrical Engineering [EE] Batch 2018 of IKGPTU are adopted. • *B. Tech. (EE) Batch 2019-23 of Main Campus and Constituent Campuses:* IKGPTU Scheme& Syllabus of B. Tech. Electrical Engineering [EE] Batch 2019 of IKGPTU are adopted. • *M. Tech EE(PS) Batch 2018-20 and Batch 2019-21 of Main Campus and Constituent Campuses:* IKGPTU Scheme& Syllabus of M. Tech. Electrical Engineering [PS] Batch 2018 of IKGPTU are adopted.
1.3	To finalise the syllabus of subject relevant to 1st/2nd year of 2019 batch.	For 1st year subjects/courses common to all branches: • BTEE-101-18 Basic Electrical Engineering • BTEE-102-18 Basic Electrical Engineering Laboratory

26.06.19

Item No.	Agenda	Discussions and Decision
		• Reference to feedback received from stakeholders on the syllabus of the above subjects/courses in the 5th meeting of BoS EE (period 2018-19) held on 26/03/2019 the changes made for IKGPTU Scheme& Syllabus Batch 2019 are adopted for Main Campus and Constituent Campuses (Annexure:B). The Members of BoS (EE) authorize Chairman BoS (EE), HOD (EE) and Coordinator BoS (EE) to sign relevant documents.
1.4	Design the study scheme and syllabus for 2019 Batch and keep it in line with the guidelines of Major and Minor degree, achievement of credits through SWAYAM/MOOCS courses.	The BoS EE (Main Campus and Constituent Campuses) approved On-line SWAYAM /MOOCs courses (for Semester July-Nov 2019) for Minor Degree in Electrical Engineering (Annexure: C). The Members of BoS (EE) authorize Chairman BoS (EE), HOD (EE) and Coordinator BoS (EE) to sign relevant documents.
1.5	To decide the PO, PEOs, Graduate Attributes for the programms offered (a) B. Tech (EE) (b) M. Tech EE(PS)	The draft of PO, PEOs of (a) B. Tech (EE) (b) M. Tech EE(PS) approved in the 2nd meeting of BoS(EE) (period 2018-19) held on 06/12/2017 are adopted for Main Campus and Constituent Campuses (Annexure: D). The Members of BoS (EE) authorize Chairman BoS (EE), HOD (EE) and Coordinator BoS (EE) to sign relevant documents.
1.6	To decide the COs of the courses and ensure their achievement through the question papers.	The COs of "IKGPTU Scheme& Syllabus of B. Tech. Electrical Engineering [EE] Batch 2011" are already defined in 2nd meeting of BoS EE (period 2018-19) held on 06.12.2017 are adopted for Main Campus and Constituent Campuses. The COs of "IKGPTU Scheme& Syllabus of B. Tech. Electrical Engineering [EE] Batch 2018" courses approved in the 5th meeting of BoS EE (period 2018-19) held on 26/03/2019 are adopted for Main Campus and Constituent Campuses. The COs of 1st year courses/subjects: BTEE-101-18 Basic Electrical Engineering and BTEE-102-18 Basic Electrical

26/6/19 26.06.19

Item No.	Agenda	Discussions and Decision
		Engineering Laboratory courses approved in the 5th meeting of BoS EE (period 2018-19) held on 26/03/2019 are adopted for Main Campus and Constituent Campuses. The draft of question paper pattern for Mid-Session Tests is approved (Annexure: E). The Members of BoS (EE) authorize Chairman BoS (EE), HOD (EE) and Coordinator BoS (EE) to sign relevant documents.
1.7	(Additional point) To decide On-line courses to be offered in the session July-November 2019 for credits required for Honors Degree in Electrical Engineering.	The BoS EE (Main Campus and Constituent Campuses) approved On-line SWAYAM /MOOCs courses (for Semester July-Nov 2019) for Honors Degree in Electrical Engineering (Annexure: F) The Members of BoS (EE) authorize Chairman BoS (EE), HOD (EE) and Coordinator BoS (EE) to sign relevant documents.
1.8	(Additional point) Decision on the number of credits to be assigned for the duration (per week) for SWAYAM/MOOCs undertaken for Honors Degree and For Minor Degree in other Branch/Discipline.	It was recommended that the number of credits to be assigned for the duration (per week) for SWAYAM/MOOCs undertaken for Honors Degree and for Minor Degree in other Branch/Discipline be:

Weeks	Credits
3-5 Weeks	1
6-9 Weeks	2
10-13 Weeks	3
14-16 Weeks	4

Members of BoS:EE Main & Constituent Campuses	***Special Invitee***	***Alumni and Student from Programme***
Dr Y S Brar, Chairman Dr Jagdish Kumar Dr Yog Raj Sood	Dr Naveen Sharma, IKGPTU Batala Campus	Karan Bali (Student)

Dr J S Dhillon		
Dr Gagandeep Kaur		
Dr Chakardhar Reddy		
Dr Rakesh Kumar		
Dr Akhil Gupta		
Dr Dilbagh Singh		
Er Paramjit Singh		
Dr Deepika Bhalla, Coordinator		

I.K. Gujral Punjab Technical Kapurthala

Department of Electrical Engineering (Main Campus)

Attendance Sheet

1st Meeting of BoS Electrical Engineering (Main and Constituent Campuses)

Date: 26/06/2019
Time: 11:45am
Venue: Office of Director Main Campus, IKGPTU Main Campus, Kapurthala.

Sr. No.	Name	Contact no	Signature
1.	Dr. Yadwinder Singh Brar	9478098013	
2.	Dr. Jagdish Kumar	9041389731	
3.	Dr. Yog Raj Sood	94180 58505	26/06/2019
4.	Dr. J.S. Dhillon.	97798 2883	26/6/19
5.	Dr. Gagandeep Kaur.	94780-98118	26/6/19
6.	Dr. Rakesh Kumar	94658-84835	26/6/19
7.	Dr. Archil Gupta	9855041124	26.06.19
8.	Dr. Dilbag Singh.	98884-92132	
9.	Er. Paramjit Singh.	9872203251	
10.	Er. Karan bali (Student M.Tech)	9478605232	
11	Dr. Chakradhar Reddy	9417034192	
12.	Dr. Naveen Kumar Sharma	9882281525	26/06/19
13.	Dr. Deepika Bhalla.	9465884858	26/6/19
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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.

26/6/19

ANNEXURE - B

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. 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), Miniutature Circuit Breaker (MCB), Earth Leakage Circuit Breaker (ELCB), MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup. Contactors.

Tegandeep

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

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.

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.
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

Note: A student to perform any 8-10 Experiments from the above list.

Shab Gagandeep

On-line SWAYAM /MOOCs courses (July-Nov 2019) for Minor Degree in Electrical Engineering.		
1	Course	Control Engineering by Prof Ramakrishna Pasumarthy, IIT Madras
	Prerequisites	Network and Circuits, Basic Engineering Mathematics. For those who would like to refer to some material prior to this course, we suggest the NPTEL course on Networks and Systems by Dr. V.G.K. Murti. Content in Lectures 1 -6 and 20-29 will be most relevant for this course.
	Type	Core
	Duration	12 weeks
	Start date	29th July 2019
	End Date	18th October 2019
	Exam Date	17th November 2019
	Level	Undergraduate
2	Course	Analog Electronic Circuit By Prof Shouri Chatterjee, IIT Delhi
	Prerequisites	Should know basic circuit analysis
	Type	Core
	Duration	12 weeks
	Start date	29th July 2019
	End Date	18th October 2019
	Exam Date	17th November 2019
	Level	Undergraduate
3	Course	Digital Circuits By Prof Santanu Chattopadhyay, IIT Kharagpur
	Prerequisites	Basic Electronics
	Type	Core
	Duration	12 weeks
	Start date	29th July 2019
	End Date	18th October 2019
	Exam Date	16th November 2019
	Level	Undergraduate
4	Course	Electrical Machines By Prof. Bhuvaneshwari, IIT Delhi
	Prerequisites	Basic Electrical Engineering, Circuit theory
	Type	Core
	Duration	12 weeks
	Start date	29th July 2019
	End Date	18th October 2019
	Exam Date	17th November 2019
	Level	Undergraduate
5	Course	Electrical Machines - I

		By Prof. Tapas Kumar Bhattacharya | IIT Kharagpur
	Prerequisites	Basic Electrical Technology: Knowledge of elementary calculus
	Type	Core
	Duration	12 weeks
	Start date	29th July 2019
	End Date	18th October 2019
	Exam Date	17th November 2019
	Level	Undergraduate
6	Course	Electrical Measurement and Electronic Instruments By Avishek Chatterjee, IIT Kharagpur
	Prerequisites	Basic Principles of Electrical Engineering (Circuit Theory), Basic Digital and Analog Electronics
	Type	Core
	Duration	12 weeks
	Start date	29th July 2019
	End Date	18th October 2019
	Exam Date	16th November 2019
	Level	Undergraduate

26/6/19 Gagandeep

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.

26/6/19

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.

26/6/19

IK Gujral Punjab Technical University
Program Education Objectives and Program Outcomes for M. Tech. Electrical Engineering (Power Systems)
By
Board of Studies Electrical Engineering

Program Educational Objectives

I. To provide the students with ample knowledge and technical skills in Power Systems Engineering.

II. To train them for research programmes in Power Systems Engineering, placements in power research and development organisations, to offer technical work skills to electric power industries and energy sectors, and faculty positions in reputed institutions.

Program Outcomes

A student who has undergone M.Tech. programme in Electrical Engineering with specialisation in Power Systems will:

a) have capability to evaluate and analyse problems related to Power Systems (PS) and be able to synthesise the domain knowledge and incorporate the principles in the state of art systems for further enrichment.

b) be able to critically examine the prevailing complex PS scenarios and arrive at possible solutions independently, by applying the acquired theoretical and practical knowledge

c) be able to solve PS problems such as load flows, state estimation, fault analysis and stability studies.

d) be able to develop broad-based economically viable solutions for unit commitment and scheduling

e) be able to identify optimal solutions for improvising power transfer capability, enhancing power quality and reliability

f) be able to evolve new schemes based on literature survey, and propose solutions through appropriate research methodologies, techniques and tools, and also by designing and conducting experiments

g) be able to interpret power system data and work on well-defined projects with well defined goals to provide real time solutions pertaining to PS

h) be able to develop, choose, learn and apply appropriate techniques, various resources including hardware and IT tools for modern power engineering, including prediction and modelling with an understanding of the limitations

i) be able to develop dedicated software for analysing and evaluating specific power system problems

j) be able to participate in collaborative-multidisciplinary engineering / research tasks and work as a team member in such tasks related to PS domain, giving due consideration to economic and financial intricacies, and lead the team in specific spheres.

k) be able to pursue research as a career.

ANNEXURE: E

MST Question Paper Format
Department of Electrical Engineering

Instruction to question paper setter (Only for paper setter):

1. *The question paper should cover the syllabus as per university guidelines for the MST*
2. *40% of the questions may be numerical/Industrial application oriented. The solution of the numerical asked needs to be provided (step wise).*
3. *The question paper should cover relevant Course Objectives (COs) and for each question the CO is to be mentioned in the specified column.*
4. *The sub-parts, if any, should be of the given format (small Roman numerals: i, ii, iii, etc.) and the breakup of marks of subparts should be indicated in the mark's column separated by a comma.*

Roll no:	No of pages:

IK Gujral Punjab Technical University- Jalandhar	
Department of Electrical Engineering, _____ Campus	
Academic Session: January-May 20__ / July-November 20__	
Mid-Semester Test: I/II/III (Regular/reappear)	Date:
Programme: B. Tech. (EE)/M. Tech. EE(PS)	Semester:
Course Code:	Course:
Maximum Marks:	Time: 1 hour 30 minutes

Instruction to candidates:
SECTION A is COMPULSORY consisting of FOUR questions carrying TWO marks each
SECTION B & C have THREE questions each
Attempt any FOUR questions from SECTION B & C carrying FOUR marks each.
Select at least any ONE questions from SECTION B & C

Note: (Need based)

Section: A		**Marks**	**COs**
1		2	
2		2	
3		2	
4		2	
Section: B			
5		4	
6		4	
7		4	
Section: C			
8		4	
9		4	
10		4	

Details of Course Objectives

CO1	
CO2	
CO3	
CO4	

26/6/19 Gagandeep

On-line SWAYAM /MOOCs courses (July-Nov 2019) for Honors Degree in B. Tech. EE.		
1	Course	Advanced Linear Continuous Control Systems: Applications with MATLAB Programming and Simulink By Prof. Yogesh Vijay Hote, IIT Roorkee
	Prerequisites	Nil
	Type	Core
	Duration	8 weeks
	Start date	29th July 2019
	End Date	20th September 2019
	Exam Date	29th September 2019
	Level	Undergraduate

26/6/19 Eagandeep

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.

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1. To be a department of higher learning that offers state-of-the-art technical education and training.
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f.	Graduates will have the ability to analyze analog and digital systems/components.
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h.	Graduates will have an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
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Programme Educational Objectives

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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.

Study Scheme & Syllabus of

Bachelor of Technology

(1st and 2nd semester)

Batch 2018 onwards

By

Department of Academics

IK Gujral Punjab Technical University

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		
BTPH102-18	Basic Science Course	Optics and Modern Physics	3	1	0	40	60	100	4
BTPH112-18	Basic Science Course	Optics and Modern Physics Lab	0	0	3	30	20	50	1.5
BTAM101-18	Basic Science Course	Mathematics-I (Calculus & Linear Algebra)	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
BTAM101-18	Basic Science Course	Mathematics-I (Calculus & Linear Algebra)	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.**

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
BTAM202-18	Basic Science Course	Mathematics-II (Differential Equations & Numerical Methods)	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		
BTPH102-18	Basic Science Course	Optics and Modern Physics	3	1	0	40	60	100	4
BTPH112-18	Basic Science Course	Optics and Modern Physics Lab	0	0	3	30	20	50	1.5
BTAM202-18	Basic Science Course	Mathematics-II (Differential Equations & Numerical Methods)	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.**

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.
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

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.

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.

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.

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.

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[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)

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.

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 different 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

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.

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

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)

Semester 1st

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.

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/

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.

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

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.

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.

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.

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

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					

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)

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. 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

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.

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.
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.

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)

Module 5: Isometric Projections covering,

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

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)

Semester 2nd

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.

(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.

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

Course code	BTPS101-18				
Category	Engineering Science Course				
Course title	**Programming for Problem Solving (Theory)**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	Semester – II [The lab component should have one hour of tutorial followed or preceded by laboratory assignments.]
	3	**0**	**0**	**3**	
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)**

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.

Course code	BTPS102-18				
Category	Engineering Science Course				
Course title	**Programming for Problem Solving (Lab)**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	Semester – II [The lab component should have one hour of tutorial followed or preceded by laboratory assignments.]
	0	**0**	**4**	**2**	
Pre-requisites (if any)	**-**				

(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

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.

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.

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.

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

- 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

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

IKG Punjab Technical University

Teaching Scheme

(3rd- 4th Semester)

for

Undergraduate Degree Programme

Bachelor of Technology

in

ELECTRICAL ENGINEERING

2018 & onwards

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	Non-credit
10	BTEE-321-18	Institutional Summer Vacation Training*	-	-	-	35*	-	-		S/US
		Total	**18**	**4**	**4**	**26**	**350**	**400**	**750**	**20**

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	Non Credit
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

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) • Types of electrical wires and Cables (samples to be made available) • Classification of Insulation (samples to be made available)	30 hours
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	25 hours

Module	Content	Remarks
	identify small issues and propose requisite solutions/ remedies/ innovative solutions based on engineering) • Invited talk by Industry Expert • Expert talk on recent technologies	
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.

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. (Other 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. (other Engineering) with effect from 3rd semester onwards.
(ii) The student must clear his/her previous two semesters.
(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 two (2) courses 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.

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.	VII	EVS 102-18	Environmental Studies	3L:0T:0P	Nil

IK Gujral Punjab Technical University

Syllabus

(3rd- 4th Semester)

for

Undergraduate Degree Programme

Bachelor of Technology

in

ELECTRICAL ENGINEERING

2018 & onwards

SEMESTER: III
[Second Year]

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.

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.

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.

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.

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.

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.

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.

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.

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.

SEMESTER: IV
[Second Year]

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 lCs, 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.

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.

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

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.

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.

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.

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.

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.

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.

Mandatory Courses (non-credit)

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

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

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

- KS Subrahmanialyer ,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.

On-line SWAYAM /MOOCs courses (July-Nov 2019) for Minor Degree in Electrical Engineering.		
1	Course	Control Engineering by Prof Ramakrishna Pasumarthy, IIT Madras
	Prerequisites	Network and Circuits, Basic Engineering Mathematics. For those who would like to refer to some material prior to this course, we suggest the NPTEL course on Networks and Systems by Dr. V.G.K. Murti. Content in Lectures 1 -6 and 20-29 will be most relevant for this course.
	Type	Core
	Duration	12 weeks
	Start date	29th July 2019
	End Date	18th October 2019
	Exam Date	17th November 2019
	Level	Undergraduate
2	Course	Analog Electronic Circuit By Prof Shouri Chatterjee, IIT Delhi
	Prerequisites	Should know basic circuit analysis
	Type	Core
	Duration	12 weeks
	Start date	29th July 2019
	End Date	18th October 2019
	Exam Date	17th November 2019
	Level	Undergraduate
3	Course	Digital Circuits By Prof Santanu Chattopadhyay, IIT Kharagpur
	Prerequisites	Basic Electronics
	Type	Core
	Duration	12 weeks
	Start date	29th July 2019
	End Date	18th October 2019
	Exam Date	16th November 2019
	Level	Undergraduate
4	Course	Electrical Machines By Prof. Bhuvaneshwari, IIT Delhi
	Prerequisites	Basic Electrical Engineering, Circuit theory
	Type	Core
	Duration	12 weeks
	Start date	29th July 2019
	End Date	18th October 2019
	Exam Date	17th November 2019
	Level	Undergraduate
5	Course	Electrical Machines - I

		By Prof. Tapas Kumar Bhattacharya | IIT Kharagpur
	Prerequisites	Basic Electrical Technology: Knowledge of elementary calculus
	Type	Core
	Duration	12 weeks
	Start date	29th July 2019
	End Date	18th October 2019
	Exam Date	17th November 2019
	Level	Undergraduate
6	Course	Electrical Measurement and Electronic Instruments By Avishek Chatterjee, IIT Kharagpur
	Prerequisites	Basic Principles of Electrical Engineering (Circuit Theory), Basic Digital and Analog Electronics
	Type	Core
	Duration	12 weeks
	Start date	29th July 2019
	End Date	18th October 2019
	Exam Date	16th November 2019
	Level	Undergraduate

IKG Punjab Technical University

Teaching Scheme

(5^{th} - 8^{th} Semester)

for

Undergraduate Degree Programme

Bachelor of Technology

in

ELECTRICAL ENGINEERING

2018 & onwards

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	0	0	3	40	60	100	3
2	BTEE-502-18	Control Systems	3	0	0	3	40	60	100	3
3	BTEE-503-18	Microprocessors	3	0	0	3	40	60	100	3
4	BTEE-504X-18	Programme Elective-1	3	0	0	3	40	60	100	3
5	BTOE-XXX-18	Open Elective-1	3	0	0	3	40	60	100	3
6	BTXX-XXX-18	Humanities & Social Sciences including Mgt.	3	0	0	3	40	60	100	3
7	BTEE-511-18	Power Systems-I Laboratory	0	0	2	2	30	20	50	1
8	BTEE-512-18	Control Systems Laboratory	0	0	2	2	30	20	50	1
9	BTEE-513-18	Microprocessors Laboratory	0	0	2	2	30	20	50	1
10	BTEE-521-18	Summer Industry Internship	-	-	-	-	40	60	100	S/US
11	BMPD-501-18	Mentoring and Professional Development of Students	0	1	0	1	50	-	50	Non-credit
Total			**18**	**1**	**6**	**25**	**420**	**480**	**900**	**21**

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 Systems – II (Operation and Control)	3	0	0	3	40	60	100	3
2	BTEE-602X-18	Programme Elective-2	3	0	0	3	40	60	100	3
3	BTEE-603X-18	Programme Elective-3	3	0	0	3	40	60	100	3
4	BTEE-604-18	Power System Protection	3	0	0	3	40	60	100	3
5	BTOE-XXX-18	Open Elective-2	3	0	0	3	40	60	100	3
6	BTXX-XXX-18	Humanities & Social Sciences including Mgt.	3	0	0	3	40	60	100	3
7	BTEE-621-18	Seminar	0	0	2	2	100	-	100	1
8	BTEE-611-18	Electronic Design Laboratory	1	0	4	5	30	20	50	3
9	BTEE-612-18	Power Systems-II Laboratory	0	0	2	2	30	20	50	1
10	BMPD-601-18	Mentoring and Professional Development of Students	0	1	0	1	50	-	50	Non-credit

Total			**19**	**1**	**8**	**28**	**450**	**400**	**850**	**23**
Semester VII [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-XXX-18	Open Elective-3	3	0	0	3	40	60	100	3
4	BTEE-XXX-18	Open Elective-4	3	0	0	3	40	60	100	3
5	BTXX-XXX-18	Humanities & Social Sciences including Management	3	0	0	3	40	60	100	3
6	EVS-102-18	Environmental Studies	3	0	0	3	40	60	100	3
7	BTEE-703-18	Project Stage-I	0	0	6	6	60	40	100	3
8	BMPD-701-18	Mentoring and Professional Development of Students		1	0	1	50	-	50	Non-credit
Total			**18**	**1**	**6**	**25**	**350**	**400**	**750**	**21**

Semester 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-801X-18	Programme Elective-6	3	0	0	3	40	60	100	3
2	BTOE-XXX-18	Open Elective-5	3	0	0	3	40	60	100	3
3	BTOE-XXX-18	Open Elective-6	3	0	0	3	40	60	100	3
4	BTEE-802-18	Project Stage-II	0	0	16	16	40	60	100	8
5	BMPD-801-18	Mentoring and Professional Development of Students	0	1	0	1	50	-	50	Non-credit
Total			**9**	**1**	**16**	**26**	**210**	**240**	**450**	**17**

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	0	0	3	40	60	100	3
Odd	BTEE-511-18	Power Systems-I Laboratory	0	0	2	2	30	20	50	1
Odd	BTEE-502-18	Control Systems	3	0	0	3	40	60	100	3
Odd	BTEE-512-18	Control Systems Laboratory	0	0	2	2	30	20	50	1
Odd	BTEE-503-18	Microprocessors	3	0	0	3	40	60	100	3
Odd	BTEE-513-18	Microprocessors Laboratory	0	0	2	2	30	20	50	1
Even	BTEE-601-18	Power Systems – II (Operation and Control)	3	0	0	3	40	60	100	3
Even	BTEE-612-18	Power Systems-II Laboratory	0	0	2	2	30	20	50	1
Even	BTEE-611-18	Electronic Design Laboratory	1	0	4	5	30	20	50	3
Even	BTEE-604-18	Power System Protection	3	0	0	3	40	60	100	3

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 Energy Conservation & Auditing	3L:0T:0P	3
2.	V (odd)	PE-1	BTEE-504B-18	Electrical Machine Design	3L:0T:0P	3
3.	V (odd)	PE-1	BTEE-504C-18	Optimisation Techniques	3L:0T:0P	3
4.	V (odd)	PE-1	BTEE-504D-18	Materials in Electrical Engineering	3L:0T:0P	3
5.	VI (even)	PE-2	BTEE-602A-18	Industrial Electrical Systems	3L:0T:0P	3
6.	VI (even)	PE-2	BTEE-602B-18	Microcontroller and PLC	2L:0T:2P	3
7.	VI (even)	PE-2	BTEE-602C-18	Electrical Drives	3L:0T:0P	3
8.	VI (even)	PE-2	BTEE-602D-18	Electromagnetic Waves	3L:0T:0P	3
9.	VI (even)	PE-3	BTEE-603A-18	Digital Signal Processing	3L:0T:0P	3
10.	VI (even)	PE-3	BTEE-603B-18	High Voltage Engineering	3L:0T:0P	3
11.	VI (even)	PE-3	BTEE-603C-18	Line-Commutated and Active PWM Rectifiers	3L:0T:0P	3
12.	VI (even)	PE-3	BTEE-603D-18	Artificial Intelligence	3L:0T:0P	3
13.	VII (odd)	PE-4	BTEE-701A-18	Power System Economics	3L:0T:0P	~~3~~
14.	VII (odd)	PE-4	BTEE-701B-18	Wind and Solar Energy Systems	3L:0T:0P	3
15.	VII (odd)	PE-4	BTEE-701C-18	Electrical and Hybrid Vehicles	3L:0T:0P	3
16.	VII (odd)	PE-4	BTEE-701D-18	Computational Electromagnetics	3L:0T:0P	3
17.	VII (odd)	PE-5	BTEE-702A-18	Control Systems Design	3L:0T:0P	3
18.	VII (odd)	PE-5	BTEE-702B-18	Computer Aided Power System Analysis	2L:0T:2P	3
19.	VII (odd)	PE-5	BTEE-702C-18	Digital Control Systems	3L:0T:0P	3
20.	VII	PE-5	BTEE-702D-18	Power Quality and FACTS	3L:0T:0P	3

	(odd)					
21.	VIII (even)	PE-6	BTEE-801A-18	Advanced Electric Drives	3L:0T:0P	3
22.	VIII (even)	PE-6	BTEE-801B-18	HVDC Transmission Systems	3L:0T:0P	3
23.	VIII (even)	PE-6	BTEE-801C-18	Power System Dynamics and Control	3L:0T:0P	3
24.	VIII (even)	PE-6	BTEE-801D-18	Smart Grid	3L:0T:0P	3

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.	OECEE-01	Odd	Control Systems	3	0	0	3	3
2.	OECEE-02	Odd-	Power Electronics	3	0	0	3	3
3.	OECEE-03	Odd	Electrical Energy Conservation & Auditing	3	0	0	3	3
4.	OECEE-04	Even	Electric Machines	3	0	0	3	3
5.	OECEE-05	Even	Industrial Electrical Systems	3	0	0	3	3
6.	OECEE-06	Even	Wind and Solar Energy Systems	3	0	0	3	3

HUMANITIES & SOCIAL SCIENCES INCLUDING MANAGEMENT

Sr. No.	Course Code	Course Title	Hrs. /Week L: T: P	Credits	Semester
1	BTXX-XXX-18	English	2:0:2	3	II
2	BTXX-XXX-18	To be selected by Individual Institutions from the given list of Humanities & Social Sciences including Management	3:0:0	3	V
3	BTXX-XXX-18		3:0:0	3	VI
4	BTXX-XXX-18		3:0:0	3	VII
		Total		12	

List of Humanities & Social Sciences including Management

Sr. No.	AICTE Course Code	Course Code	Course Title	Hours/ week	Credits
1.	HSMC (HED-314)	BTXX-XXX-18	Education, Technology and Society	3L:0T:0P	3
2.	HSMC (HHI-305)	BTXX-XXX-18	History of Science and Technology in India	3L:0T:0P	3
3.	HSMC (HVE-310)	BTXX-XXX-18	Values and Ethics	3L:0T:0P	3

Sr. No.	AICTE Course Code	Course Code	Course Title	Hours/ week	Credits
4.	HSMC (HSL-317)	BTXX-XXX-18	Introduction to Women's and Gender Studies	3L:0T:0P	3
5.	HSMC (LLG-305)	BTXX-XXX-18	Sanskrit Bhasa	3L:0T:0P	3
6.	HSMC (HPY-306)	BTXX-XXX-18	Human Relations at Work	3L:0T:0P	3
7.	HSMC (MME-303)	BTXX-XXX-18	Law and Engineering	3L:0T:0P	3