**I K Gujral Punjab Technical University**
**(Main campus), Kapurthala**
**Board of Studies: Electrical Engineering**

**Minutes of Meeting held on 01.11.2018**

The 4th meeting of BoS (Electrical Engg.) was held under the Chairmanship of Prof. Y S Brar in the Conference room, 2nd floor at IKG Punjab Technical University Jalandhar on 01.11.2018 at 11:00am.

The meeting started with the welcome address to the special invitees and the members of the BoS by the Dr Y S Brar, Chairman BoS(EE). The following points were discussed and deliberated upon:

1. **Action on Suggestions Received:** The suggestions received from stake holders in general and also on the draft of the Teaching Scheme and Syllabus of Under Graduate Programme and Post Graduate programme put in public view (website of University) since May/June 2018 were discussed and deliberated upon and incorporated where needed. These must be conveyed to IQAC Cell of the University.
2. **Course Code and Syllabus of Mathematics-III:** The Chairman of BOS Mathematical Science, conveyed that the Course Code and Syllabus of Mathematics-III will be decided and communicated by BoS (MS).
3. **Mandatory Courses:** The course content of Mandatory Courses was decided with the opinion of special invitees.
4. **Introduction of Minor Projects:** Minor Projects were introduced in Laboratory/Practical Courses after the opinion of Industry representative.
5. **Under Graduate Programme (Electrical Engineering):** The members discussed and approved the following:
   (i) Need based additional Lectures/Tutorials may be introduced for any Course, however, the Credits of the course will not change.
   (ii) Course codes and Course content/syllabus of Mandatory Courses
   (iii) Teaching Scheme of B. Tech. Electrical Engineering for 3rd & 4th Semester.
   (iv) Syllabus of B. Tech. Electrical Engineering for 3rd & 4th Semester.
6. **Post Graduate Programme:** The members discussed and approved the following:
   (i) Evaluation pattern of all the Post Graduate programmes to be as per the pattern of the skeleton provided by the University
   (ii) In light of 3 (i) Teaching Scheme of the following was revised and approved:
      - M. Tech. Electrical Engineering (Power System)
      - M. Tech. Electrical Engineering
      - M. Tech. Power Engineering

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- M. Tech. Power System

(iii) Syllabus of M. Tech. Electrical Engineering (Power System) 2nd to 4th semester.

(iv) Syllabus of M. Tech. Electrical Engineering 2nd to 4th semester.

(v) Syllabus of M. Tech. Power Engineering 2nd to 4th semester.

(vi) Syllabus of M. Tech. Power System 2nd to 4th semester.

7. **Suggestions Received:**

**(a) Post Graduate Programme:** Audit Course I & II, all the coursed to be kept in one common pool for 2019 Scheme.

**(b) Under Graduate Programme:** Feedback to be collected in regard with the content of Module 5 of BTEE:101-18 Basic Electrical Engineering

8. There being no further points the meeting ended with a vote of thanks to the chair.

| ***Members of BoS*** | ***Special Invitee*** |
|---|---|
| Dr Y S Brar<br>Chairman, BoS(EE) | Mr Sukhmander Singh, Addl. SE,<br>PSPCL Jalandhar |
| Dr Gagandeep Kaur | Dr Rajneesh Sachdeva |
| Dr Kanwardeep Singh | Dr Ashish Arora |
| Dr Sudhir Sharma | Dr Kultar Deep Singh |
| Dr Deepika Bhalla | Dr Chander Prakash |
| Dr Navdeep Singh Bhangu | Dr J S Bawa |
| Dr Naveen Sharma | Dr Vandana Nathani |

# IKG Punjab Technical University

**Teaching Scheme and Syllabus**

**(3rd- 4th Semester)**

**for**

**Undergraduate Degree Programme**

## Bachelor of Technology

**in**

# ELECTRICAL ENGINEERING

2018 & onwards

| Semester III [Second year] | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Branch/Course: 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-306-18 | Analog Electronics Laboratory | 0 | 0 | 2 | 2 | 30 | 20 | 50 | 1 |
| 7 | BTEE-307-18 | Electrical Machines – I Laboratory | 0 | 0 | 2 | 2 | 30 | 20 | 50 | 1 |
| 8 | BTMC-XXX-18 | Mandatory Course | 3 | 0 | 0 | 3 | 40 | 60 | 100 | Pass / fail |
| 9 | | Mentoring of Students | 0 | 1 | 0 | 1 | - | - | - | - |
| | | **Total** | **18** | **4** | **4** | **26** | **300** | **400** | **700** | **20** |

| Semester IV [Second year] | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Branch/Course: 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 | BTEE-405-18 | Biology-I | 2 | 1 | 0 | 3 | 40 | 60 | 100 | 3 |
| 6 | BTAM-XXX-18# | Mathematics-III # (Probability & Statistics) | 3 | 1 | 0 | 4 | 30 | 20 | 50 | 4 |
| 7 | BTEE-406-18 | Digital Electronics Laboratory | 0 | 0 | 2 | 2 | 30 | 20 | 50 | 1 |
| 8 | BTEE-407-18 | Electrical Machines – II Laboratory | 0 | 0 | 2 | 2 | 30 | 20 | 50 | 1 |
| 9 | BTEE-408-18 | Power Electronics Laboratory | 0 | 0 | 2 | 2 | 30 | 20 | 50 | 1 |
| 10 | BTMC XXX-18 | Mandatory Course | 3 | 0 | 0 | 3 | 40 | 60 | 100 | Pass / fail |
| 11 | - | General Fitness | - | - | - | - | 100 | - | 100 | - |
| 12 | - | Mentoring of Students | 0 | 1 | 0 | 1 | - | - | - | - |
| **# Course Code and Syllabus by BoS (MS)** | | **Total** | **20** | **3** | **6** | **29** | **460** | **440** | **900** | **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-5XX-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. Performance to be rated as Satisfactory/Un - Satisfactory (S/US). For unsatisfactory the internship to be repeated.

**Range of credits -**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 or additional Minor Engineering, if he/she completes an additional 20 credits. These could be acquired through MOOCs.

## 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. | BTEE-404-18 | Even | Signals and Systems | 2 | 1 | 0 | 3 | 3 |
| 2. | BTEE-502-18 | Odd | Control Systems | 3 | 0 | 0 | 3 | 3 |
| 3. | BTEE-503-18 | Odd | Microprocessors | 3 | 0 | 0 | 3 | 3 |
| 4. | BTEE-504A-18 | Odd | Electrical Energy Conservation & Auditing | 2 | 1 | 0 | 3 | 3 |
| 5. | BTEE-602A-18 | Even | Industrial Electrical Systems | 2 | 1 | 0 | 3 | 3 |
| 6. | BTEE-801B-18 | Even | Wind and Solar Energy Systems | 2 | 1 | 0 | 3 | 3 |

**MANDATORY COURSES (Non-Credit Courses)**

| Sr. No. | Semester | Mandatory Course | Course Code | Course Title | Hours/Week | Credits |
|---|---|---|---|---|---|---|
| 1. | III/ IV | MC-1 | BTMC-101-18 | Environmental Sciences | 3L:0T:0P | Nil |
| 2. | III/ IV | MC-2 | BTMC-102-18 | Indian Constitution | 3L:0T:0P | Nil |
| 3. | III/ IV | MC-3 | BTMC-103-18 | Essence of Indian Traditional Knowledge | 3L:0T:0P | Nil |

# 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:

i. Apply network theorems for the analysis of electrical circuits.
ii. Obtain the transient and steady-state response of electrical circuits.
iii. Analyse circuits in the sinusoidal steady-state (single-phase and three-phase). Analyse two port circuit behavior.
iv. Synthesize networks and filters.

**Module 1: Network Theorems (8 Hours)**

Superposition theorem, Thevenin theorem, Norton 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.

**Module 2: Solution of First and Second order networks (7 Hours)**

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 3: Sinusoidal steady state analysis (7 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.

**Module 4: Electrical Circuit Analysis Using Laplace Transforms (7 Hours)**

Review of Laplace Transform, Analysis of electrical circuits using Laplace Transform for standard inputs, convolution integral, inverse Laplace transform, transformed network with initial conditions. Transfer function representation. Poles and Zeros. Frequency response (magnitude and phase plots), series and parallel resonances.

**Module 5: Two Port Network and Network Functions (6 Hours)**

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 6: Network Synthesis and Filters (5 Hours)**

Network synthesis techniques for 2-terminal network, Foster and Cauer forms. Classification of filters, characteristics impedance and propagation constant of pure reactive network, Ladder network, T-section, π-section, terminating half section, Pass bands and stop bands, Design of constant-K, m-derived filters, Composite filters.

**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:

i. Understand the characteristics of transistors.
ii. Design and analyse various rectifier and amplifier circuits.
iii. Design sinusoidal and non-sinusoidal oscillators.
iv. Understand the functioning of OP-AMP and design OP-AMP based circuits.

**Module 1: Diode circuits (4 Hours)**

P-N junction diode, I-V characteristics of a diode; review of half-wave and full-wave rectifiers, Zener diodes, clamping and clipping circuits.

**Module 2: BJT circuits (8 Hours)**

Structure and I-V 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; Small signal equivalent circuits, high-frequency equivalent circuits

**Module 3: MOSFET circuits (8 Hours)**

MOSFET structure and I-V 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 4: Differential, multi-stage and operational amplifiers (8 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 5: Linear applications of op-amp (8 Hours)**

Idealized analysis of op-amp circuits. Inverting and non-inverting amplifier, differential amplifier, instrumentation amplifier, integrator, active filter, P, PI and PID controllers and lead/lag compensator using an op-amp, voltage regulator, oscillators (Wein bridge and phase shift). Analog to Digital Conversion.

**Module 6: Nonlinear applications of op-amp (6 Hours)**

Hysteretic Comparator, Zero Crossing Detector, Square-wave and triangular-wave generators. Precision rectifier, peak detector. Monoshot.

**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:

i. Understand the concepts of magnetic circuits. Understand the operation of dc machines.
ii. Analyse the differences in operation of different dc machine configurations.
iii. 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; review of Ampere Law and Biot Savart Law; 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 (10 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 (10 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 (14 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:

i. To understand the basic laws of electromagnetism.
ii. To obtain the electric and magnetic fields for simple configurations under static conditions.
iii. To analyse time varying electric and magnetic fields.
iv. To understand Maxwell's equation in different forms and different media.
v. 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 (7 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 operatordel, gradient, divergence and curl ;integral theorems of vectors. Conversion of a vector from one coordinate system to another.

**Module 2: Static Electric Field (7 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.

**Module 3: Conductors, Dielectrics and Capacitance (7 Hours)**

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 4: Magnetic Forces, Materials and Inductance (7 Hours)**

Force on a moving charge, Force on a differential current element, Force between differential current elements, Nature of magnetic materials, Magnetization and permeability, Magnetic boundary conditions, Magnetic circuits, inductances and mutual inductances.

**Module 5: Time Varying Fields and Maxwell's Equations (7 Hours)**

Faraday's law for Electromagnetic induction, Displacement current, Point form of Maxwell's equation, Integral form of Maxwell's equations, Motional Electromotive forces. Boundary Conditions.

**Module 6: Electromagnetic Waves (7 Hours)**

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. Wave

equation for a conducting medium, Plane waves in lossy dielectrics, Propagation in good conductors, Skin effect. Poynting theorem.

**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

i. Understand the concepts of co-ordinate systems.
ii. Analyse the three-dimensional motion.
iii. Understand the concepts of rigid bodies.
iv. Analyse the free-body diagrams of different arrangements.
v. 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-306-18 | Analog Electronics Laboratory | 0L:0T:2P | 1 Credit |
|---|---|---|---|

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

**Course Outcomes:**

i. Understand the use and importance of various types of equipments used in the laboratory.
ii. Ability to make circuits on bread-board
iii. Analyze, take measurements to understand circuit behavior and performance under different conditions.
iv. Troubleshoot, design and create electronic circuits meant for different applications.
v. 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 I-V characteristics of PN junction diode (Ge, Si, switching and signal).
2. To design half wave rectifier.
3. To design full wave and bridge rectifiers.
4. To study transistor characteristics in common base, common collector, and common emitter configurations.
5. To study the I-V characteristics of 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 $A_V$,$R_i$,$R_O$
10. To design and study various type of oscillators and to determine the frequency of oscillations.
11. To design a transistor series voltage regulator with current limits and observes current feedback characteristics.
12. To study the characteristics of a complementary symmetry amplifier.
13. Application of 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-307-18 | Electrical Machines – I Laboratory | 0L:0T:2P | 1 Credit |
|---|---|---|---|

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

**Course Outcomes:**

i. Analyze three-phase transformer/system connections.
ii. Evaluation of equivalent circuit parameters, efficiency and voltage regulation by performing various tests on transformer.
iii. Analyze parallel operation of transformers.
iv. Analyze performance characteristics of DC generators.
v. Evaluate various speed controls and starting methods of DC motor.
vi. Draw and analyze speed-torque and load characteristics of DC machines.

**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.

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**Suggested List of Experiments:**

1. To perform load test on a single phase transformer.
2. To perform open circuit and short circuit tests on a single phase transformer and hence find equivalent circuit, voltage regulation and efficiency.
3. To find the efficiency and voltage regulation of single phase transformer under different loading conditions.
4. To perform parallel operation of two single phase transformers.
5. To study the various connections of three phase transformer.
6. To perform Scott connections on three phase transformer to get two phase supply.
7. To study the constructional details of direct current 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 characteristics of DC shunt/series /compound generator.
11. To study DC motor starters.
12. To perform Swinburne's test (no load test) to determine losses of DC shunt motor.

# 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:

i. Understand working of logic families and logic gates.
ii. Design and implement Combinational and Sequential logiccircuits.
iii. Understand the process of Analog to Digital conversion and Digital to Analog conversion.
iv. Be able to use PLDs to implement the given logical problem.

**Module 1: Fundamentals of Digital Systems and logic families (7Hours)**

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 (7Hours)**

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 (7Hours)**

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 (7Hours)**

Digital to analog converters: weighted resistor/converter, R-2R Ladder D/A converter, specifications for D/A converters, examples of D/A converter lCs, 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

**Module 5: Semiconductor memories and Programmable logic devices. (7Hours)**

Memory organization and operation, expanding memory size, classification and characteristics of memories, sequential memory, read only memory (ROM), read and write memory(RAM), content addressable memory (CAM), charge de coupled device memory (CCD), commonly used memory chips, ROM as a PLD, Programmable logic

array, Programmable array logic, complex Programmable logic devices (CPLDS), Field Programmable Gate Array (FPGA).

**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:

i. Understand the concepts of rotating magnetic fields.
ii. Understand the operation of ac machines.
iii. Analyse performance characteristics of ac 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 (4 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)**

Construction, Types (squirrel cage and slip-ring), Torque Slip Characteristics, Starting and Maximum Torque. 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.

**Module 4: Single-phase induction motors (6 Hours)**

Constructional features, double revolving field theory, equivalent circuit, determination of parameters. Split-phase starting methods and applications

**Module 5: Synchronous machines (10 Hours)**

Constructional features, cylindrical rotor synchronous machine - generated EMF, equivalent circuit and phasor diagram, armature reaction, synchronous impedance, voltage regulation. Operating characteristics of synchronous machines, V-curves. 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:

i. Understand the differences between signal level and power level devices.
ii. Analyse controlled rectifier circuits.
iii. Analyse the operation of DC-DC choppers.
iv. Analyse the operation of voltage source inverters.

**Module 1: Power switching devices (8Hours)**

Diode, Thyristor, MOSFET, IGBT: I-V Characteristics; Firing circuit for thyristor; Voltage and current commutation of a thyristor; Gate drive circuits for MOSFET and IGBT.

**Module 2: Thyristor rectifiers (7Hours)**

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 (5Hours)**

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.

**Module 4: DC-DC boost converter (5Hours)**

Power circuit of a boost converter, analysis and waveforms at steady state, relation between duty ratio and average output voltage.

**Module 5: Single-phase voltage source inverter (10Hours)**

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

**Module 6: Three-phase voltage source inverter (8Hours)**

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.

| 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:

i. Understand the concepts of continuous time and discrete time systems.
ii. Analyse systems in complex frequency domain.
iii. Understand sampling theorem and its implications.

**Module 1: Introduction to Signals and Systems (3 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 (8 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 (4 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.

| BTEE- 405-18 | Biology | 2L:1T:0P | 3 credits |
|---|---|---|---|

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

**Module 1: Introduction (2 hours)**

Purpose: To convey that Biology is as important a scientific discipline as Mathematics, Physics and Chemistry. Bring out the fundamental differences between science and engineering by drawing a comparison between eye and camera, Bird flying and aircraft. Mention the most exciting aspect of biology as an independent scientific discipline. Why we need to study biology? Discuss how biological observations of $18^{th}$ Century that lead to major discoveries. Examples from Brownian motion and the origin of thermodynamics by referring to the original observation of Robert Brown and Julius Mayor. These examples will highlight the fundamental importance of observations in any scientific inquiry.

**Module 2: Genetics (5 hours)**

Purpose: To convey that "Genetics is to biology what Newton's laws are to Physical Sciences". Mendel's laws, Concept of segregation and independent assortment. Concept of allele. Gene mapping, Gene interaction, Epistasis. Meiosis and Mitosis be taught as a part of genetics. Emphasis to be give not to the mechanics of cell division nor the phases but how genetic material passes from parent to offspring. Concepts of recessiveness and dominance. Concept of mapping of phenotype to genes. Discuss about the single gene disorders in humans. Discuss the concept of complementation using human genetics.

**Module 3: Biomolecules (5 hours)**

Purpose: To convey that all forms of life has the same building blocks and yet the manifestations are as diverse as one can imagine. Molecules of life. In this context discuss monomeric units and polymeric structures. Discuss about sugars, starch and cellulose. Amino acids and proteins. Nucleotides and DNA/RNA. Two carbon units and lipids.

**Module 4: Enzymes (5 Hours)**

Purpose: To convey that without catalysis life would not have existed on earth.

Enzymology: How to monitor enzyme catalysed reactions. How does an enzyme catalyse reactions? Enzyme classification. Mechanism of enzyme action. Discuss at least two examples. Enzyme kinetics and kinetic parameters. Why should we know these parameters to understand biology? RNA catalysis.

**Module 5: Information Transfer (5 hours)**

Purpose: The molecular basis of coding and decoding genetic information is universal. Molecular basis of information transfer. DNA as a genetic material. Hierarchy of DNA structure- from single stranded to double helix to nucleosomes. Concept of genetic code. Universality and degeneracy of genetic code. Define gene in terms of complementation and recombination.

**Module 6: Macromolecular analysis (6 hours)**

Purpose: To analyse biological processes at the reductionistic level. Proteins- structure and function. Hierarch in protein structure. Primary secondary, tertiary and quaternary structure. Proteins as enzymes, transporters, receptors and structural elements.

**Module 7: Metabolism (5 hours)**

Purpose: The fundamental principles of energy transactions are the same in physical and biological world. Thermodynamics as applied to biological systems. Exothermic and endothermic versus endergonic and exergonic reactions. Concept of $K_{eq}$ and its relation to

standard free energy. Spontaneity. ATP as an energy currency. This should include the breakdown of glucose to $CO_2$ + $H_2O$ (Glycolysis and Krebs cycle) and synthesis of glucose from $CO_2$ and $H_2O$ (Photosynthesis). Energy yielding and energy consuming reactions. Concept of Energy charge.

**Text / References:**

1. N. A. Campbell, J. B. Reece, L. Urry, M. L. Cain and S. A. Wasserman, "Biology: A global approach", Pearson Education Ltd, 2014.
2. E. E. Conn, P. K. Stumpf, G. Bruening and R. H. Doi, "Outlines of Biochemistry", John Wiley and Sons, 2009.
3. D. L. Nelson and M. M. Cox, "Principles of Biochemistry", W.H. Freeman and Company, 2012.
4. G. S. Stent and R. Calendar, "Molecular Genetics", Freeman and company, 1978.
5. L. M. Prescott, J. P. Harley and C. A. Klein, "Microbiology", McGraw Hill Higher Education, 2005.

**Course Outcomes**

After studying the course, the student will be able to:

i. Describe how biological observations of 18th Century that lead to major discoveries.
ii. Convey that classification per se is not what biology is all about but highlight the underlying criteria, such as morphological, biochemical and ecological
iii. Highlight the concepts of recessiveness and dominance during the passage of genetic material from parent to offspring.
iv. Convey that all forms of life have the same building blocks and yet the manifestations are as diverse as one can imagine.
v. Classify enzymes and distinguish between different mechanisms of enzyme action. Identify DNA as a genetic material in the molecular basis of information transfer. Analyse biological processes at the reductionistic level
vi. Apply thermodynamic principles to biological systems. Identify and classify microorganisms.

| | | | |
|---|---|---|---|
| **BTAM-XXX-18** | **Mathematics-III (Probability and Statistics** | **3L:1T:4P** | **4 credits** |

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

**To be communicated by BoS (Mathematical Sciences)**

| BTEE-406-18 | Digital Electronics Laboratory | 0L:0T:2P | 1 Credit |
|---|---|---|---|

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

Course Outcomes:

i. To understand of basic electronic components and circuits
ii. Understanding verify truth tables of TTL gates
iii. Design and fabrication and realization of all gates and basic circuits
iv. design the truthtables and basic circuits
v. 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-407-18 | Electrical Machines-II Laboratory | 0L:0T:2P | 1 Credit |
|---|---|---|---|

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

Course Outcomes:

i. Construct equivalent circuits induction motors by routine tests.
ii. Comprehend the requirement of starting and speed control methods of induction motors in the various applications of industry.
iii. Construct equivalent circuits of synchronous generator and motor.
iv. Apply knowledge to show utility of alternator, synchronous motors and synchronous condenser for various applications in power system.
v. Construct characteristic curves for induction and synchronous machines.
vi. 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-408-18 | Power Electronics Laboratory | 0L:0T:2P | 1 Credit |
|---|---|---|---|

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

**Course Outcomes:**

i. Understand the properties and characteristics of thyristors.
ii. Understand the different types of waveforms of inverter and chopper circuits
iii. Analyze speed and direction control of single phase and three phase electric motors using ac and dc drive.
iv. Understand the effect of free-wheeling diode on pf with RL load.
v. 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-5XX-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. Performance to be rated as Satisfactory/Un - Satisfactory (S/US). For unsatisfactory the internship to be repeated.

# Mandatory Courses (non-credit)

| BTMC-101-18 | Environmental Science | 3L:0T:0P | 0 credits |
|---|---|---|---|

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

*** 40 Hours are kept for various activities under the head of activities. There will be a final theory examination for the students of 50 marks but these marks will not be added to their final result as assessment will be satisfactory or non-satisfactory.**

**Course Outcomes:**

1. Students will enable to understand environmental problems at local and national level through literature and general awareness.
2. The students will gain practical knowledge by visiting wildlife areas, environmental institutes and various personalities who have done practical work on various environmental Issues.
3. The students will apply interdisciplinary approach to understand key environmental issues and critically analyze them to explore the possibilities to mitigate these problems.
4. Reflect critically about their roles and identities as citizens, consumers and environmental actors in a complex, interconnected world

We as human being are not an entity separate from the environment around us rather we are a constituent seamlessly integrated and co-exist with the environment around us. We are not an entity so separate from the environment that we can think of mastering and controlling it rather we must understand that each and every action of ours reflects on the environment and vice versa. Ancient wisdom drawn from Vedas about environment and its sustenance reflects these ethos. There is a direct application of this wisdom even in modern times. Idea of an activity based course on environment protection is to sensitize the students.

Detailed Contents

**Module 1 : Natural Resources :Renewable and non-renewable resources**

Natural resources and associated problems.

a) Forest resources : Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people.

b) Water resources : Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.

c) Mineral resources : Use and exploitation, environmental effects of extracting and using mineral resources, case studies.

d) Food resources : World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.

e) Energy resources : Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Case studies.

f) Land resources : Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

- Role of an individual in conservation of natural resources.
- Equitable use of resoureces for sustainable lifestyles.

(8 lectures)

**Module 2 : Ecosystems**

Concept of an ecosystem. Structure and function of an ecosystem.

Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of following ecosystems:

a. Forest ecosystem
b. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

(4 lectures)

**Module 3 : Biodiversity and its conservation**

a. Introduction – Definition : genetic, species and ecosystem diversity.
b. Biodiversity at global, National and local levels.
c. Inida as a mega-diversity nation
d. Hot-sports of biodiversity.
e. Threats to biodiversity : habitat loss, poaching of wildlife, man-wildlife conflicts.
f. Endangered and endemic species of India

(5 lectures)

**Module 4 : Social Issues and the Environment**

- From Unsustainable to Sustainable development
- Resettlement and rahabilitation of people; its problems and concerns.
- Environmental ethics : Issues and possible solutions.
- Climate change, global warming, acid rain, ozone layer depletion,

  Nuclear accidents and holocaust. Case Studies.
- Public awareness.

(4 lectures)

***ACTIVITIES**

**Nature club** (bird watching, recognizing plants at institute/at home, recognizing local animals, appreciating biodiversity

Impart knowledge and inculcate the habit of taking interest and understanding biodiversity in and around the college campus. The students should be encouraged to take interest in bird watching, recognizing local plants, herbs and local animals. The students should be encouraged to appreciate the difference in the local biodiversity in their hometown, in the place of their study and other places they visit for vacation/breaks etc.

Following activities must be included.

Identify a tree fruit flower peculiar to a place or having origin from the place.

Making high resolution big photographs of small creatures (bees, spiders, ants. mosquitos etc.) especially part of body so that people can recognize (games on recognizing animals/plants).

Videography/ photography/ information collections on specialties/unique features of different types of common creatures.

Search and explore patents and rights related to animals, trees etc. Studying miracles of mechanisms of different body systems.

**1** ***(A) Awareness Activities:***

a) Small group meetings about water management, promotion of recycle use, generation of less waste, avoiding electricity waste
b) Slogan making event
c) Poster making event
d) Cycle rally

e) Lectures from experts
*f)* Plantation
g) Gifting a tree to see its full growth
h) Cleanliness drive
*i)* Drive for segregation of waste
i) To live some big environmentalist for a week or so to understand his work
vi) To work in kitchen garden for mess
j) To know about the different varieties of plants
k) Shutting down the fans and ACs of the campus for an hour or so
l) Visit to a local area to document environmental assets

river/forest/grassland/hill/mountain/lake/Estuary/Wetlands

m) Visit to a local polluted site-Urban/Rural/Industrial/Agricultural
n) Visit to a Wildlife sanctuary, National Park or Biosphere Reserve

(40 Hours)

**Suggested Readings**

A. Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.
B. Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad – 380 013, India, Email:mapin@icenet.net (R)
C. Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480p
D. Clark R.S., Marine Pollution, Clanderson Press Oxford (TB)
E. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publ. House, Mumabai, 1196p
F. Hawkins R.E., Encyclopedia of Indian Natural History, Bombay Natural History Society, Bombay (R)
G. Heywood, V.H & Waston, R.T. 1995. Global Biodiversity Assessment. Cambridge Univ. Press 1140p.
H. Mhaskar A.K., Matter Hazardous, Techno-Science Publication (TB)
I. Miller T.G. Jr. Environmental Science, Wadsworth Publishing Co. (TB)
J. Odum, E.P. 1971. Fundamentals of Ecology. W.B. Saunders Co. USA, 574p
K. Townsend C., Harper J, and Michael Begon, Essentials of Ecology, Blackwell Science (TB)
L. Trivedi R.K., Handbook of Environmental Laws, Rules Guidelines, Compliances and Stadards, Vol I and II, Enviro Media (R)
M. Trivedi R. K. and P.K. Goel, Introduction to air pollution, Techno-Science Publication (TB)

N. Wanger K.D., 1998 Environmental Management. W.B. Saunders Co. Philadelphia, USA 499p

| BTMC-102-18 | 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

| BTMC-103-18 | 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.

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**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.

# Study Scheme & Syllabus of

## Master of Technology Electrical Engineering (Power Systems)/

## M. Tech. Electrical Engineering (Power Systems)

# Batch 2018 onwards

**By**

**Board of Study Electrical Engineering**

**Department of Academics**

**I.K. Gujral Punjab Technical University**

**Master of Technology in Electrical Engineering (Power System)/**

**M. Tech Electrical Engineering (Power System)**

It is a Post Graduate (PG) Programme of 2 years duration (4 semesters)

Additional Lectures/Tutorials: Need based additional Lectures/Tutorials may be introduced of any Course, however, the Credits of the course will not change.

**Courses & Examination Scheme:**

**First Semester**

| Course Code | Course Type | Course Name | Load Allocations | | | Marks Distribution | | Total Marks | Credits |
|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P | Internal | External | | |
| EEPS-101-18 | Core 1 Theory | Power System Analysis | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| EEPS-102-18 | Core 2 Theory | Power System Dynamics-I | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| EEPS-103X-18 | Elective -I | Professional Elective-I | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| EEPS-104Y-18 | Elective-II | Professional Elective-II | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| MTRM-101-18 | | Research Methodology and IPR | 2 | 0 | 0 | 40 | 60 | 100 | 2 |
| EEPS-105-18 | Practical/ Laboratory 1 | Power System Steady State Analysis Lab | 0 | 0 | 4 | 60 | 40 | 100 | 2 |
| EEPS-106Y-18 | Practical/ Laboratory 2 | Lab Elective 2 | 0 | 0 | 4 | 60 | 40 | 100 | 2 |
| MTA-10X-18 | Audit-I | Audit course-I | 2 | 0 | 0 | 00 | 00 | Satisfactory/ Non-satisfactory | Non-Credit |
| | **TOTAL** | | **16** | **0** | **8** | **320** | **380** | **700** | **18** |

| Professional Elective/ Audit | Course Code | Course Name | L | T | P | Marks Distribution | | Total Marks | Credits |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Internal | External | | |
| PE1 | EEPS-103A-18 | Renewable Energy System | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| | EEPS-103B-18 | Smart Grids | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| | EEPS-103C-18 | High Power Converters | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| | EEPS-103D-18 | Wind and Solar Systems | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| PE2 | EEPS-104A-18 | Electrical Power Distribution System | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| | EEPS-104B-18 | Mathematical Methods for Power Engineering | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| | EEPS-104C-18 | Pulse Width Modulation for PE Converters | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| | EEPS-104D-18 | Electric and Hybrid Vehicles | 3 | 0 | 0 | 40 | 60 | 150 | 3 |
| Lab2 | EEPS-106A-18 | Power System Dynamics lab | 0 | 0 | 4 | 60 | 40 | 100 | 2 |
| | EEPS-106B-18 | Renewable Energy Lab | 0 | 0 | 4 | 60 | 40 | 100 | 2 |
| Audit-I | MTA-101-18 | English for Research Paper Writing | 2 | 0 | 0 | 00 | 00 | Satisfactory/ Non-satisfactory | Non-Credit |
| | MTA-102-18 | Disaster Management | 2 | 0 | 0 | 00 | 00 | Satisfactory/ Non-satisfactory | Non-Credit |
| | MTA-103-18 | Sanskrit for Technical Knowledge | 2 | 0 | 0 | 00 | 00 | Satisfactory/ Non-satisfactory | Non-Credit |
| | MTA-104-18 | Value Education | 2 | 0 | 0 | 00 | 00 | Satisfactory/ Non-satisfactory | Non-Credit |

## Second Semester

| Course Code | Course Type | Course Name | Load Allocation | | | Marks Distribution | | Total Marks | Credits |
|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P | Internal | External | | |
| EEPS-201-18 | Core 3 Theory | Digital Protection of Power System | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| EEPS-202-18 | Core 4 Theory | Power System Dynamics-II | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| EEPS-203X-18 | Elective -I | Professional Elective-III | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| EEPS-204Y-18 | Elective-II | Professional Elective-IV | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| MTPR-101-18 | | Mini Project | 0 | 0 | 4 | 60 | 40 | 100 | 2 |
| EEPS-205X-18 | Practical/ Laboratory 3 | Lab Elective 3 | 0 | 0 | 4 | 60 | 40 | 100 | 2 |
| EEPS-206Y-18 | Practical/ Laboratory 4 | Lab Elective 4 | 0 | 0 | 4 | 60 | 40 | 100 | 2 |
| MTA-10Y-18 | Audit-II | Audit Course-II | 2 | 0 | 0 | 00 | 00 | Satisfactory/ Non-satisfactory | Non-Credit |
| | **TOTAL** | | **14** | **0** | **12** | **340** | **360** | **700** | **18** |

| Professional Elective/Audit | Course Code | Course Name | L | T | P | Marks Distribution | | Total Marks | Credits |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Internal | External | | |
| PE3 | EEPS-203A-18 | Restructured Power Systems | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| | EEPS-203B-18 | Advanced Digital Signal Processing | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| | EEPS-203C-18 | Dynamics of Electrical Machines | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| | EEPS-203D-18 | Power Apparatus Design | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| PE4 | EEPS-204A-18 | Advanced Micro-Controller Based Systems | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| | EEPS-204B-18 | SCADA Systems and Applications | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| | EEPS-204C-18 | Power Quality | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| | EEPS-204D-18 | AI Techniques | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| Lab3 | EEPS-205A-18 | Power System Protection Lab | 0 | 0 | 4 | 60 | 40 | 100 | 2 |
| | EEPS-205B-18 | Power Quality Lab | 0 | 0 | 4 | 60 | 40 | 100 | 2 |
| Lab4 | EEPS-206A-18 | Artificial Intelligence Lab | 0 | 0 | 4 | 60 | 40 | 100 | 2 |
| | EEPS-206B-18 | Power Electronics Applications to Power Systems Lab | 0 | 0 | 4 | 60 | 40 | 100 | 2 |
| | EEPS-206C-18 | Smart Grids Lab | 0 | 0 | 4 | 60 | 40 | 100 | 2 |
| Audit-II | MTA-105-18 | Constitution of India | 2 | 0 | 0 | 00 | 00 | Satisfactory/ Non-satisfactory | Non-Credit |
| | MTA-106- | Pedagogy | 2 | 0 | 0 | 00 | 00 | Satisfactory/ | Non- |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 18 | Studies | | | | | | Non-satisfactory | Credit |
| | MTA-107-18 | Stress Management by Yoga | 2 | 0 | 0 | 00 | 00 | Satisfactory/ Non-satisfactory | Non-Credit |
| | MTA-108-18 | Personality Development through Life Enlightenment Skills | 2 | 0 | 0 | 00 | 00 | Satisfactory/ Non-satisfactory | Non-Credit |

## Third Semester

| Course Code | Course Type | Course Name | Load Allocation | | | Marks Distribution | | Total Marks | Credits |
|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P | Internal | External | | |
| EEPS-301X-18 | PE5 | Professional Elective-V | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| MTOE-301X-18 | OE | Open Elective | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| EEPS-302-18 | Major Project | Phase-I Dissertation | 0 | 0 | 20 | 60 | 40 | 100 | 10 |
| | **TOTAL** | | **6** | **0** | **20** | **140** | **160** | **300** | **16** |

| Professional/ Open Elective | Course Code | Course Name | L | T | P | Marks Distribution | | Total Marks | Credits |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Internal | External | | |
| PE5 | EEPS-301A-18 | Power System Transients | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| | EEPS-301B-18 | FACTS and Custom Power Devices | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| | EEPS-301C-18 | Industrial Load Modeling and Control | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| | EEPS-301D-18 | Dynamics of Linear Systems | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| OE | MTOE-301A-18 | Business analytics | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| | MTOE-301B-18 | Industrial Safety | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| | MTOE-301C-18 | Operations Research | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| | MTOE-301D-18 | Cost Management of Engineering Projects | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| | MTOE-301E-18 | Composite Materials | 3 | 0 | 0 | 40 | 60 | 100 | 3 |
| | MTOE-301F-18 | Waste to Energy | 3 | 0 | 0 | 40 | 60 | 100 | 3 |

## Fourth Semester

| Course Code | Course Type | Course Name | L | T | P | Marks Distribution | | Total Marks | Credits |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Internal | External | | |
| EEPS-401-18 | Major Project | Phase-II Dissertation | 0 | 0 | 32 | 60 | 40 | 100 | **16** |

**Total Marks of M. Tech Program: 1800**

**Total Credits of M. Tech Program: 68**

**EEPS-101-18** **POWER SYSTEM ANALYSIS-I** **L T P**
**Internal Marks: 40** **3 0 0**
**External Marks: 60**
**Total Marks: 100**

**Course Objectives:-** Students will be able to:

1. Study various methods of load flow and their advantages and disadvantages
2. Understand how to analyze various types of faults in power system
3. Understand power system security concepts and study the methods to rank the contingencies
4. Understand need of state estimation and study simple algorithms for state estimation
5. Study voltage instability phenomenon

**Syllabus**

| Units | Content | Hours |
|---|---|---|
| 1 | Load flow: Overview of Newton-Raphson, Gauss-Siedel, fast decoupled methods, convergence properties, sparsity techniques, handling Q-max violations in constant matrix, inclusion in frequency effects, AVR in load flow, handling of discrete variable in load flow | 8 |
| 2 | Fault Analysis: Simultaneous faults, open conductors faults, generalized method of fault analysis | 6 |
| 3 | Security Analysis: Security state diagram, contingency analysis, generator shift distribution factors, line outage distribution factor, multiple line outages, overload index ranking | 6 |
| 4 | Power System Equivalents: WARD REI.equivalents, | 6 |
| 5 | State Estimation: Sources of errors in measurement Virtual and Pseudo, Measurement, Observability, Tracking state estimation, WSL method, bad data correction | 8 |
| 6 | Voltage Stability: Voltage collapse, P-V curve, multiple power flow solution, continuation power flow, optimal multiplies load flow, voltage collapse proximity indices | 8 |

**Suggested reading**

1. J.J. Grainger &W.D.Stevenson, “Power system analysis ”, McGraw Hill ,2003
2. A. R. Bergen & Vijay Vittal , “Power System Analysis” ,Pearson , 2000
3. L.P. Singh , “Advanced Power System Analysis and Dynamics”, New Age International, 2006
4. G.L. Kusic, “Computer aided power system analysis” ,Prentice Hall India, 1986
5. A.J. Wood, “ Power generation, operation and control” , John Wiley, 1994
6. P.M. Anderson, “Faulted power system analysis” , IEEE Press , 1995

**Course outcomes-** Students will be able to:

1. To calculate voltage phasors at all buses , given the data using various methods of load flow
2. Able to calculate fault currents in each phase
3. Rank various contingencies according to their severity

4. Estimate the bus voltage phasors given various quantities viz. power flow, voltages, taps , CB status etc
5. Estimate closeness to voltage collapse and calculate PV curves using continuation power flow

**EEPS-102-18** **POWER SYSTEM DYNAMICS-I** **L T P**
**Internal Marks: 40** **3 0 0**
**External Marks: 60**
**Total Marks: 100**

**Course Objectives**:- Students will be able to:
1. Study of system dynamics and its physical interpretation
2. Development of mathematical models for synchronous machine
3. Modeling of induction motor

**Syllabus**

| Unit | Content | Hours |
|---|---|---|
| 1 | Synchronous Machines: Per unit systems, Park's Transformation (modified), Flux-linkage equations | 8 |
| 2 | Voltage and current equations, Formulation of State-space equations, Equivalent circuit | 8 |
| 3 | Sub-transient and transient inductance and Time constants, Simplified models of synchronous machines | 6 |
| 4 | Small signal model: Introduction to frequency model | 8 |
| 5 | Excitation systems and Philips-Heffron model, PSS Load modeling | 8 |
| 6 | Modeling of Induction Motors, Prime mover controllers | 6 |

**Suggested reading:-**

1. P. M. Anderson & A. A. Fouad "Power System Control and Stability", Galgotia , New Delhi, 1981
2. J Machowski, J Bialek& J. R W. Bumby, "Power System Dynamics and Stability", John Wiley & Sons, 1997
3. P.Kundur, "Power System Stability and Control", McGraw Hill Inc., 1994.
4. E.W. Kimbark, "Power system stability", Vol. I & III, John Wiley & Sons, New York 2002

**Course Outcomes:** Students will be able to:
1. Understand the modeling of synchronous machine in details
2. Carry out simulation studies of power system dynamics using MATLAB-SIMULINK, MI POWER
3. Carry out stability analysis with and without power system stabilizer (PSS)
4. Understand the load modeling in power system

**EEPS-103A-18** **RENEWABLE ENERGY SYSTEM** **L T P**
**Internal Marks: 40** **3 0 0**
**External Marks: 60**
**Total Marks: 100**

**Course Objectives**:- Students will be able to:
1. Study of system dynamics and its physical interpretation
2. Development of mathematical models for synchronous machine
3. Modeling of induction motor

**Syllabus**

| Unit | Content | Hours |
|---|---|---|
| 1 | Introduction, Distributed vs Central Station Generation, Sources of Energy such as Micro-turbines, Internal Combustion Engines. | 8 |
| 2 | Introduction to Solar Energy, Wind Energy, Combined Heat and Power, Hydro Energy, Tidal Energy, Wave Energy, Geothermal Energy, Biomass and Fuel Cells. | 8 |
| 3 | Power Electronic Interface with the Grid | 6 |
| 4 | Impact of Distributed Generation on the Power System, Power Quality Disturbances | 8 |
| 5 | Transmission System Operation, Protection of Distributed Generators | 8 |
| 6 | Economics of Distributed Generation, Case Studies | 6 |

**Suggested reading**

1. RanjanRakesh, Kothari D.P, Singal K.C, "Renewable Energy Sources and Emerging Technologies", 2nd Ed. Prentice Hall of India, 2011
2. Math H.Bollen, Fainan Hassan, "Integration of Distributed Generation in the Power System", July 2011, Wiley-IEEE Press
3. Loi Lei Lai, Tze Fun Chan, "Distributed Generation: Induction and Permanent Magnet Generators", October 2007, Wiley- IEEE Press.
4. Roger A.Messenger, Jerry Ventre, "Photovoltaic System Engineering", 3rd Ed, 2010
5. James F.Manwell, Jon G.McGowan, Anthony L Rogers, "Wind energy explained: Theory Design and Application", John Wiley and Sons 2nd Ed, 2010

**Course Outcomes:-** Students will be able to:
1. Knowledge about renewable energy
2. Understand the working of distributed generation system in autonomous/grid connected modes
3. Know the Impact of Distributed Generation on Power System

**EEPS-103B-18** **SMART GRIDS** **L T P**
**Internal Marks: 40** **3 0 0**
**External Marks: 60**
**Total Marks: 100**

**Course Objectives:-** Students will be able to:
1. Study of system dynamics and its physical interpretation
2. Development of mathematical models for synchronous machine
3. Modeling of induction motor

**Syllabus**

| Unit | Content | Hours |
|---|---|---|
| 1 | Introduction to Smart Grid, Evolution of Electric Grid, Concept of Smart Grid, Definitions, Need of Smart Grid, Concept of Robust & Self Healing Grid Present development & International policies in Smart Grid | 8 |
| 2 | Introduction to Smart Meters, Real Time Prizing, Smart Appliances, Automatic Meter Reading(AMR), Outage Management System(OMS), Plug in Hybrid Electric Vehicles(PHEV), Vehicle to Grid, Smart Sensors, Home & Building Automation, Smart Substations, Substation Automation, Feeder Automation | 8 |
| 3 | Geographic Information System(GIS), Intelligent Electronic Devices(IED) & their application for monitoring, & protection, Smart storage like Battery, SMES, Pumped Hydro, Compressed Air Energy Storage, Wide Area Measurement System(WAMS), Phase Measurement Unit(PMU) | 8 |
| 4 | Concept of micro-grid, need & applications of micro-grid, formation of micro-grid, Issues of interconnection, protection & control of micro-grid. Plastic & Organic solar cells, Thin film solar cells, Variable speed wind generators, fuel-cells, micro-turbines, Captive power plants, Integration of renewable energy sources | 8 |
| 5 | Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power, Quality monitoring, Power Quality Audit | 6 |
| 6 | Advanced Metering Infrastructure (AMI), Home Area Network (HAN), Neighborhood Area Network (NAN), Wide Area Network (WAN) Bluetooth, ZigBee, GPS, Wi-Fi, Wi-Max based communication, Wireless Mesh Network, Basics of CLOUD Computing & Cyber, Security for Smart Grid, Broadband over Power line (BPL), IP based protocols | 6 |

**Suggested reading**

1. Ali Keyhani, “Design of smart power grid renewable energy systems”, Wiley IEEE, 2011
2. Clark W. Gellings, “The Smart Grid: Enabling Energy Efficiency and Demand Response”, CRC Press , 2009
3. JanakaEkanayake, Nick Jenkins, KithsiriLiyanage, “Smart Grid: Technology and Applications”, Wiley 2012

4. Stuart Borlase, “Smart Grid: Infrastructure, Technology and solutions “ CRC Press
5. A.G.Phadke, “Synchronized Phasor Measurement and their Applications”, Springer

**Course Outcomes:-**Students will be able to:

1. Appreciate the difference between smart grid & conventional grid
2. Apply smart metering concepts to industrial and commercial installations
3. Formulate solutions in the areas of smart substations, distributed generation and wide area measurements
4. Come up with smart grid solutions using modern communication technologies

**EEPS-103C-18** **HIGH POWER CONVERTERS** **L T P**
**Internal Marks: 40** **3 0 0**
**External Marks: 60**
**Total Marks: 100**

**Course Objectives:-** Students will be able to:
1. Understand the requirements of high power rated converters
2. Understand the different topologies involved for these converters
3. Able to understand the design of protection circuits for these converters

**Syllabus**

| Unit | Content | Hours |
|---|---|---|
| 1 | Power electronic systems, An overview of PSDs, multipulse diode rectifier, multipulse, SCR rectifier | 6 |
| 2 | Phase shifting transformers, multilevel voltage source inverters: two level voltage source inverter, cascaded, H bridge multilevel inverter | 8 |
| 3 | Diode clamped multilevel inverters, flying capacitor multilevel inverter | 6 |
| 4 | PWM current source inverters, DC to DC switch mode converters | 6 |
| 5 | AC voltage controllers : Cyclo-converters, matrix converter, Power conditioners and UPS | 8 |
| 6 | Design aspects of converters, protection of devices and circuits | 6 |

**Suggested reading**

1. N. Mohan, T. M. Undeland and W. P. Robbins, “Power Electronics: Converter, Applications and Design”, John Wiley and Sons, 1989
2. M.H. Rashid, “Power Electronics”, Prentice Hall of India, 1994
3. B. K .Bose, “Power Electronics and A.C. Drives”, Prentice Hall, 1986
4. Bin Wu, “High power converters and drives”, IEEE press, Wiley Enter science

**Course Outcomes:-** Students will be able to:

1. Learn the characteristics of PSDs such as SCRs, GTOs, IGBTs and use them in practical systems
2. Knowledge of working of multi-level VSIs, DC-DC switched mode converters, cyclo-converters and PWM techniques and the ability to use them properly
3. Acquire knowledge of power conditioners and their applications
4. Ability to design power circuit and protection circuit of PSDs and converters

**EEPS-103D-18** **WIND AND SOLAR SYSTEMS** **L T P**
**Internal Marks: 40** **3 0 0**
**External Marks: 60**
**Total Marks: 100**

**Course Objectives:-**Students will be able to:
1. To get exposure to wind and solar systems
2. To understand the factors involved in installation and commissioning of a Solar or Wind plant.
3. Learning the dynamics involved when interconnected with power system grid

**Syllabus**

| Unit | Content | Hours |
|---|---|---|
| 1 | Historical development and current status, characteristics of wind power generation, network integration issues | 8 |
| 2 | Generators and power electronics for wind turbines, power quality standards for wind turbines, Technical regulations for interconnections of wind farm with power systems | 8 |
| 3 | Isolated wind systems, reactive power and voltage control, economic aspects | 8 |
| 4 | Impacts on power system dynamics, power system interconnection | 8 |
| 5 | Introduction of solar systems, merits and demerits, concentrators, various applications | 6 |
| 6 | Solar thermal power generation, PV power generation, Energy Storage device, Designing the solar system for small installations | 6 |

**Suggested reading**

1. Thomas Ackermann, Editor, “Wind power in Power Systems”, John Willy and sons ltd.2005
2. Siegfried Heier, “Grid integration of wind energy conversion systems”, John Willy and sons ltd., 2006
3. K. Sukhatme and S.P. Sukhatme, “Solar Energy”. Tata MacGraw Hill, Second Edition, 1996

**Course Outcomes:-** Students will be able to:

1. Appreciate the importance of energy growth of the power generation from the renewable energy sources and participate in solving these problems
2. Demonstrate the knowledge of the physics of wind power and solar power generation and all associated issues so as to solve practical problems
3. Demonstrate the knowledge of physics of solar power generation and the associated issues
4. Identify, formulate and solve the problems of energy crises using wind and solar energy

**EEPS-104A-18 ELECTRICAL POWER DISTRIBUTION SYSTEM L T P**
**Internal Marks: 40 3 0 0**
**External Marks: 60**
**Total Marks: 100**

**Course Objectives:-**Students will be able to:
1. Learning about power distribution system
2. Learning of SCADA System
3. Understanding Distribution Automation

**Syllabus**

| Unit | Content | Hours |
|---|---|---|
| 1 | Distribution of Power, Management, Power Loads, Load Forecasting Short-term & Long-term, Power System Loading, Technological Forecasting. | 8 |
| 2 | Advantages of Distribution Management System (D.M.S.), Distribution Automation: Definition, Restoration / Reconfiguration of Distribution Network, Different Methods and Constraints, Power Factor Correction | 8 |
| 3 | Interconnection of Distribution, Control & Communication Systems, Remote Metering, Automatic Meter Reading and its implementation | 8 |
| 4 | SCADA: Introduction, Block Diagram, SCADA Applied To Distribution Automation, Common Functions of SCADA, Advantages of Distribution Automation through SCADA | 8 |
| 5 | Calculation of Optimum Number of Switches, Capacitors, Optimum Switching Device Placement in Radial, Distribution Systems, Sectionalizing Switches – Types, Benefits, Bellman's Optimality Principle, Remote Terminal Units, Energy efficiency in electrical distribution & Monitoring | 6 |
| 6 | Maintenance of Automated Distribution Systems, Difficulties in Implementing Distribution, Automation in Actual Practice, Urban/Rural Distribution, Energy Management, AI techniques applied to Distribution Automation | 6 |

**Suggested reading**

1. A.S. Pabla, " Electric Power Distribution", Tata McGraw Hill Publishing Co. Ltd., Fourth Edition.
2. M.K. Khedkar, G.M. Dhole, "A Text Book of Electrical power Distribution Automation", University Science Press, New Delhi
3. Anthony J Panseni, "Electrical Distribution Engineering", CRC Press
4. James Momoh, "Electric Power Distribution, automation, protection & control", CRC

**Course Outcomes:-**Students will be able to:
1. Knowledge of power distribution system
2. Study of Distribution automation and its application in practice
3. To learn SCADA system

**EEPS-104B-18 MATHEMATICAL METHODS FOR POWER ENGINEERING**

| | L | T | P |
|---|---|---|---|
| **Internal Marks: 40** | **3** | **0** | **0** |

**External Marks: 60**
**Total Marks: 100**

**Course Objectives: -**Students will be able to:
1. To understand the relevance of mathematical methods to solve engineering problems.
2. To understand how to apply these methods for a given engineering problem

**Syllabus**

| Unit | Content | Hours |
|---|---|---|
| 1 | Vector spaces, Linear transformations, Matrix representation of linear transformation | 6 |
| 2 | Eigen values and Eigen vectors of linear operator | 6 |
| 3 | Linear Programming Problems, Simplex Method, Duality, Non Linear Programming problems | 8 |
| 4 | Unconstrained Problems, Search methods, Constrained Problems | 8 |
| 5 | Lagrange method, Kuhn-Tucker conditions, Random Variables, Distributions | 8 |
| 6 | Independent Random Variables, Marginal and Conditional distributions, Elements of stochastic processes | 8 |

**Suggested reading**

1. Kenneth Hoffman and Ray Kunze, "Linear Algebra", 2nd Edition, PHI, 1992
2. Erwin Kreyszig, "Introductory Functional Analysis with Applications", John Wiley & Sons, 2004
3. Irwin Miller and Marylees Miller, John E. Freund's "Mathematical Statistics", 6th Edn, PHI, 2002
4. J. Medhi, "Stochastic Processes", New Age International, New Delhi., 1994
5. A Papoulis, "Probability, Random Variables and Stochastic Processes", 3rd Edition, McGraw Hill, 2002
6. John B Thomas, "An Introduction to Applied Probability and Random Processes", John Wiley, 2000
7. Hillier F S and Liebermann G J, "Introduction to Operations Research", 7th Edition, McGraw Hill, 2001
8. Simmons D M, "Non Linear Programming for Operations Research", PHI, 1975

**Course Outcomes: -** Students will be able to:

1. Knowledge about vector spaces, linear transformation, eigen values and eigenvectors of linear operators
2. To learn about linear programming problems and understanding the simplex method for solving linear programming problems in various fields of science and technology

3. Acquire knowledge about nonlinear programming and various techniques used for solving constrained and unconstrained nonlinear programming problems
4. Understanding the concept of random variables, functions of random variable and their probability distribution
5. Understand stochastic processes and their classification

**EEPS-104C-18 PULSE WIDTH MODULATION FOR PE CONVERTERS**

| | L | T | P |
|---|---|---|---|
| **Internal Marks: 40** | **3** | **0** | **0** |

**External Marks: 60**
**Total Marks: 100**

**Course Objectives:-**Students will be able to:
1. To understand Necessity and Importance of PWM techniques
2. Implementation of PWM controllers

**Syllabus**

| Unit | Content | Hours |
|---|---|---|
| 1 | Introduction to PE converters, Modulation of one inverter phase leg Modulation of single phase, VSI and 3 phase VSI | 8 |
| 2 | Zero space vector placement modulation strategies, Losses-Discontinuous modulation, Modulation of CSI | 8 |
| 3 | Over modulation of converters, programme modulation strategies | 8 |
| 4 | Pulse width modulation for multilevel inverters, Implementation of modulation controller | 8 |
| 5 | Continuing developments in modulation as random PWM, PWM for voltage unbalance | 6 |
| 6 | Effect of minimum pulse width and dead time | 6 |

**Suggested reading**

1. D. Grahame Holmes, Thomas A. Lipo, "Pulse width modulation of Power Converter: Principles and Practice", John Wiley & Sons, 03-Oct-2003
2. Bin Vew, "High Power Converter", Wiley Publication
3. Marian K. Kazimicrczuk, "Pulse width modulated dc-dc power converter", Wiley Publication

**Course Outcomes :-**Students will be able to:

1. Appreciate importance of PWM techniques
2. Implement PWM using different strategies
3. Control CSI and VSI using PWM
4. Compare performance of converter for different PWM techniques

**EEPS-104D-18** **ELECTRIC AND HYBRID VEHICLES** **L T P**
**Internal Marks: 40** **3 0 0**
**External Marks: 60**
**Total Marks: 100**

**Course Objectives:-**Students will be able to:
1. To understand upcoming technology of hybrid system
2. To understand different aspects of drives application
3. Learning the electric Traction

**Syllabus**

| Unit | Content | Hours |
|---|---|---|
| 1 | History of hybrid and electric vehicles, Social and environmental importance of hybrid and electric vehicles, Impact of modern drive-trains on energy supplies, Basics of vehicle performance, vehicle power source Characterization, Transmission characteristics, Mathematical models to describe vehicle performance | 8 |
| 2 | Basic concept of hybrid traction, Introduction to various hybrid drive-train topologies, Power flow control in hybrid drive-train topologies, Fuel efficiency analysis | 8 |
| 3 | Basic concept of hybrid traction, Introduction to various hybrid drive-train topologies, Power flow control in hybrid drive-train topologies, Fuel efficiency analysis | 8 |
| 4 | Introduction to electric components used in hybrid and electric Vehicles, Configuration and control of DC Motor drives, Configuration and control of Introduction Motor drives, configuration and control of Permanent Magnet Motor drives Configuration and control of Switch Reluctance, Motor drives, drive system efficiency | 8 |
| 5 | Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics Selecting the energy storage technology, Communications, supporting subsystems | 8 |
| 6 | Introduction to energy management and their strategies used in hybrid and electric vehicle, Classification of different energy management strategies Comparison of different energy management strategies Implementation issues of energy strategies | 6 |

**Suggest Reading**

1. Sira -Ramirez, R. Silva Ortigoza, "Control Design Techniques in Power Electronics Devices", Springer.
2. Siew-Chong Tan, Yuk-Ming Lai, Chi Kong Tse, "Sliding mode control of switching Power Converters"

**Course Outcomes :-** Students will be able to:

1. Acquire knowledge about fundamental concepts, principles, analysis and design of hybrid and electric vehicles.
2. To learn electric drive in vehicles / traction.

**MTRM-101-18** **RESEARCH METHODOLOGY AND IPR** **L T P**
**Internal Marks: 40** **2 0 0**
**External Marks: 60**
**Total Marks: 100**

**Course Objectives:-**Students will be able to:
1. To understand research problem formulation and research ethics
2. To understand about control of information technology
3. To understand the need of IPR & its protection

**Syllabus**

| Unit | Content | Hours |
|---|---|---|
| 1 | Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations | 8 |
| 2 | Effective literature studies approaches, analysis Plagiarism, Research ethics, | 4 |
| 3 | Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee | 6 |
| 4 | Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT | 8 |
| 5 | Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications | 4 |
| 6 | New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs. | 6 |

**References:**

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2nd Edition , "Research Methodology: A Step by Step Guide for beginners
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
5. Mayall , "Industrial Design", McGraw Hill, 1992
6. Niebel , "Product Design", McGraw Hill, 1974.
7. Asimov , "Introduction to Design", Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.
9. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

**Course Outcomes:** At the end of this course, students will be able to

1. Understand research problem formulation. Analyze research related information
2. Follow research ethics
3. Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
4. Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
5. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

**EEPS-105-18 POWER SYSTEM STEADY STATE ANALYSIS LAB L T P**
**Internal Marks: 60 0 0 4**
**External Marks: 40**
**Total Marks: 100**

**Course Objectives:-**Students will be able :
1. To understand power system problems
2. To understand how to analyze the power system load flow studies, forecasting & unit Commitment.
3. To understand the role of power electronic devices.

**Syllabus**

| **Sr. No.** | **List of Experiments** |
|---|---|
| 1 | Power Systems & Power Electronics Lab |
| 2 | Computer Simulation Lab |
| 3 | Simulation of IGBT Inverters. |
| 4 | Simulation of Thyristor Converters. |
| 5 | Transient Stability Studies. |
| 6 | Short Circuit Studies. |
| | Load Flow Studies |
| | Load Forecasting and Unit Commitment |

**Course Outcomes:-** Students will be able to

1. Understand the power system operational problems.
2. Apply the load flow methods, fault analysis techniques and unit commitment of units.
3. Applications of power electronic devices in power system.

**EEPS-106A-18** **POWER SYSTEM DYNAMICS LAB** **L T P**
**Internal Marks: 60** **0 0 4**
**External Marks: 40**
**Total Marks: 100**

**Course Objectives:-**Students will be able :

1. To understand the stability analysis for single machine system
2. To understand the stability analysis for single machine system using models.
3. Development of simulink model for excitation system using MATLAB

.

**Syllabus**

| Sr. No. | List of Experiments |
|---|---|
| 1 | To develop a MATLAB program to study small signal stability analysis of single machine infinite bus system using classical machine model. |
| 2 | To develop a MATLAB program to study small signal stability analysis of single machine infinite bus system using Type B1 model. |
| 3 | To develop a simulink model of IEEE type 1(1968) excitation system using MATLAB. |
| 4 | To develop a MATLAB program to study small signal stability analysis of single machine infinite bus system using Type B1 –effect of excitation system. |
| 5 | To develop a MATLAB program to study small signal stability analysis of single machine infinite bus system using Type B1 machine model with simple excitation system- effect of PSS. |

**Course Outcomes:-** Students will be able to

1. Do stability analysis for small signal stability
2. Analyze the single machine system using models
3. Simulink models considering excitation systems

**EEPS-106B-18** **RENEWABLE ENERGY LAB** **L T P**
**Internal Marks: 60** **0 0 4**
**External Marks: 40**
**Total Marks: 100**

**Course Objectives:-**Students will be able :

1. To understand power curves for energy sources
2. Effect of variable parameters on solar panels
3. Relation of wind output and load.

**Syllabus**

| Sr. No. | List of Experiments |
|---|---|
| 1 | Power Curves |
| 2 | Build a Wind Farm |
| 3 | Test the capabilities of the Hydrogen Fuel Cells and Capacitors |
| 4 | Effect of Temperature on Solar Panel Output |
| 5 | Variables Affecting Solar Panel Output |
| 6 | Effect of Load on Solar Panel Output |
| 7 | Wind Turbine Output: The Effect of Load |
| 8 | Test the Capabilities of Solar Panels and Wind Turbines |

**Course Outcomes:-** Students will be able to

1. Various power curves considering different renewable sources
2. Analyze the effect of variations of parameters on solar panels
3. Analyze the wind power

**MTA-101A-18 ENGLISH FOR PAPER WRITING L T P**
**Internal Marks: 00 2 0 0**
**External Marks: 00**
**Total Marks: 00**

**Course Objectives:-** Students will be able to:

1. Understand that how to improve your writing skills and level of readability
2. Learn about what to write in each section
3. Understand the skills needed when writing a Title

**Syllabus**

| Units | Contents | Hours |
|---|---|---|
| 1 | Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing, Redundancy, Avoiding Ambiguity and Vagueness | 4 |
| 2 | Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction | 4 |
| 3 | Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check. | 4 |
| 4 | key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, | 4 |
| 5 | skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions | 4 |
| 6 | useful phrases, how to ensure paper is as good as it could possibly be the first time submission | 4 |

**Suggested Studies:**

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book .
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

**Course Outcome:-** Students will be able to learn

1. Improve writing and readability levels for English
2. How to write and what write according to section
3. Skills in title writing

**MTA-101B-18** **DISASTER MANAGEMENT** **L T P**
**Internal Marks: 00** **2 0 0**
**External Marks: 00**
**Total Marks: 00**

**Course Objectives:** -Students will be able to:
1. Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
2. Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
3. Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
4. Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in

**Syllabus**

| Units | Contents | Hours |
|---|---|---|
| 1 | Introduction, Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude. | 4 |
| 2 | Repercussions Of Disasters And Hazards: Economic Damage, Loss of Human And Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts | 4 |
| 3 | Disaster Prone Areas In India, Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics | 4 |
| 4 | Disaster Preparedness And Management Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness. | 4 |
| 5 | Risk Assessment , Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co- Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival. | 4 |
| 6 | Disaster Mitigation, Meaning, Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India. | 4 |

**Suggested readings:**

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.
2. Sahni, Pardeep Et.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.
3. Goel S. L. , Disaster Administration And Management Text And Case Studies" ,Deep &Deep Publication Pvt. Ltd., New Delhi.

**Course Outcome:-** Student will be able

1. Know, how to reduce disaster risk and humanitarian response.
2. Policy and practice for disaster risk reduction
3. Understand the practical relevance of conflict situations and standards of humanitarian response in that situation
4. Planning, programming and strength and weakness of disaster risk management

**MTA-101C-18 SANSKRIT FOR TECHNICAL EDUCATION L T P**
**Internal Marks: 00 2 0 0**
**External Marks: 00**
**Total Marks: 00**

**Course Objectives:-**Students will be able to:

1. To get a working knowledge in illustrious Sanskrit, the scientific language in the world
2. Learning of Sanskrit to improve brain functioning
3. Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power
4. The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature

**Syllabus**

| Units | Content | Hours |
|---|---|---|
| 1 | Alphabets in Sanskrit, Past/Present/Future Tense, Simple Sentences | 8 |
| 2 | Order Introduction of roots Technical information about Sanskrit Literature | 8 |
| 3 | Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics | 8 |

**Suggested reading**

1. "Abhyaspustakam" – Dr.Vishwas, Sanskrit-Bharti Publication,New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

**Course Outcome:-**Students will be able to

1. Understanding basic Sanskrit language
2. Ancient Sanskrit literature about science & technology can be understood
3. Being a logical language will help to develop logic in students

**MTA-101D-18** **VALUE EDUCATION** **L T P**
**Internal Marks: 00** **2 0 0**
**External Marks: 00**
**Total Marks: 00**

**Course Objectives:-**Students will be able to:

1. Understand value of education and self- development
2. Imbibe good values in students
3. Let the should know about the importance of character

**Syllabus**

| Units | Content | Hours |
|---|---|---|
| 1 | Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism, Moral and non- moral valuation. Standards and principles, Value judgements | 4 |
| 2 | Importance of cultivation of values, Sense of duty. Devotion, Self-reliance, Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity, Patriotism, Love for nature, Discipline | 6 |
| 3 | Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline, Punctuality, Love and Kindness, Avoid fault Thinking, Free from anger, Dignity of labour, Universal brotherhood and religious tolerance, True friendship, Happiness Vs suffering, love for truth, Aware of self-destructive habits, Association and Cooperation, Doing best for saving nature | 6 |
| 4 | Character and Competence –Holy books vs Blind faith, Self-management and Good health, Science of reincarnation, Equality, Nonviolence, Humility, Role of Women, All religions and same message, Mind your Mind, Self-control, Honesty, Studying effectively | 6 |

**Suggested reading**

1. Chakroborty , S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press ,New Delhi

**Course outcomes:-**Students will be able to

1. Knowledge of self-development
2. Learn the importance of Human values
3. Developing the overall personality

**EEPS-201-18 DIGITAL PROTECTION OF POWER SYSTEM L T P**
**Internal Marks: 40 3 0 0**
**External Marks: 60**
**Total Marks: 100**

**Course Objectives:-**Students will be able to:
1. Study of numerical relays
2. Developing mathematical approach towards protection
3. Study of algorithms for numerical protection

**Syllabus**

| Unit | Content | Hours |
|---|---|---|
| 1 | Evolution of digital relays from electromechanical relays, Performance and operational characteristics of digital protection | 6 |
| 2 | Mathematical background to protection algorithms, Finite difference techniques | 6 |
| 3 | Interpolation formulae, Forward, backward and central difference interpolation, Numerical differentiation, Curve fitting and smoothing, Least squares method, Fourier analysis, Fourier series and Fourier transform, Walsh function analysis | 8 |
| 4 | Basic elements of digital protection, Signal conditioning: transducers, surge protection, analog filtering, analog multiplexers, Conversion subsystem: the sampling theorem, signal aliasing, Error, sample and hold circuits, multiplexers, analog to digital conversion , Digital filtering concepts, The digital relay as a unit consisting of hardware and software | 8 |
| 5 | Sinusoidal wave based algorithms, Sample and first derivative (Mann and Morrison) algorithm, Fourier and Walsh based algorithms | 8 |
| 6 | Fourier Algorithm: Full cycle window algorithm, fractional cycle window algorithm, Walsh function based algorithm, Least Squares based algorithms, Differential equation based algorithms, Traveling Wave based Techniques, Digital Differential Protection of Transformers, Digital Line Differential Protection, Recent Advances in Digital Protection of Power Systems | 8 |

**Suggested reading**

1. A.G. Phadke and J. S. Thorp, “Computer Relaying for Power Systems”, Wiley/Research studies Press, 2009
2. A.T. Johns and S. K. Salman, “Digital Protection of Power Systems”, IEEE Press,1999
3. Gerhard Zeigler, “Numerical Distance Protection”, Siemens Publicis Corporate Publishing, 2006
4. S.R.Bhide “Digital Power System Protection” PHI Learning Pvt.Ltd.2014

**Course Outcomes:-** Students will be able to:

1. Learn the importance of Digital Relays
2. Apply Mathematical approach towards protection
3. Learn to develop various Protection algorithms

**EEPS-202-18** **POWER SYSTEM DYNAMICS-II** **L T P**
**Internal Marks: 40** **3 0 0**
**External Marks: 60**
**Total Marks: 100**

**Course Objectives:-**Students will be able to:
1. Study of power system dynamics
2. Interpretation of power system dynamic phenomena
3. Study of various forms of stability

**Syllabus**

| Unit | Content | Hours |
|---|---|---|
| 1 | Basic Concepts of Dynamic Systems and Stability Definition, Small Signal Stability (Low Frequency Oscillations) of Unregulated and Regulated System | 8 |
| 2 | Effect of Damper, Flux Linkage Variation and AVR | 8 |
| 3 | Large Signal Rotor Angle Stability, Dynamic Equivalents And Coherency, Direct Method of Stability Assessment, Stability Enhancing Techniques, Mitigation Using Power System Stabilizer | 8 |
| 4 | Asynchronous Operation and Resynchronization, Multi-Machine Stability | 6 |
| 5 | Dynamic Analysis of Voltage Stability, Voltage Collapse | 6 |
| 6 | Frequency Stability, Automatic Generation Control, Primary and Secondary Control, Sub-Synchronous Resonance and Counter Measures | 8 |

**Suggested reading**

1. P. Kundur, “Power System Stability and Control”, McGraw Hill Inc, 1994
2. J. Machowski, Bialek, Bumby, “Power System Dynamics and Stability”, John Wiley & Sons, 1997
3. L. Leonard Grigsby (Ed.); “Power System Stability and Control”, Second edition, CRC Press, 2007
4. V. Ajjarapu, “Computational Techniques for voltage stability assessment & control”; Springer, 2006

**Course Outcomes:-** Students will be able to:

1. Gain valuable insights into the phenomena of power system including obscure ones.
2. Understand the power system stability problem.
3. Analyze the stability problems and implement modern control strategies.
4. Simulate small signal and large signal stability problems.

**EEPS-203A-18** **RESTRUCTURED POWER SYSTEMS** **L T P**
**Internal Marks: 40** **3 0 0**
**External Marks: 60**
**Total Marks: 100**

**Course Objectives:** -Students will be able to:
1. Understand what is meant by restructuring of the electricity market
2. Understand the need behind requirement for deregulation of the electricity market
3. Understand the money, power & information flow in a deregulated power system

**Syllabus**

| Unit | Content | Hours |
|---|---|---|
| 1 | Fundamentals of restructured system, Market architecture, Load elasticity Social welfare maximization | 8 |
| 2 | OPF: Role in vertically integrated systems and in restructured markets, congestion management | 8 |
| 3 | Optimal bidding, Risk assessment, Hedging, Transmission pricing, Tracing of power | 8 |
| 4 | Ancillary services, Standard market design, Distributed generation in restructured markets | 8 |
| 5 | Developments in India, IT applications in restructured markets | 6 |
| 6 | Working of restructured power systems, PJM, Recent trends in Restructuring at national and international level. | 6 |

**Suggested reading**

1. Lorrin Philipson, H. Lee Willis, "Understanding electric utilities and de-regulation", Marcel Dekker Pub.,1998.
2. Steven Stoft, "Power system economics: designing markets for electricity", John Wiley and Sons, 2002.
3. Kankar Bhattacharya, Jaap E. Daadler, Math H.J. Boolen, "Operation of restructured power systems", Kluwer Academic Pub., 2001.
4. Mohammad Shahidehpour, MuwaffaqAlomoush, "Restructured electrical power systems: operation, trading and volatility", Marcel Dekker.

**Course Outcomes:** -Students will be able to:

1. Describe various types of regulations in power systems.
2. Identify the need of regulation and deregulation.
3. Define and describe the Technical and Non-technical issues in Deregulated Power Industry.
4. Identify and give examples of existing electricity markets.
5. Classify different market mechanisms and summarize the role of various entities in the market.

**EEPS-203B-18 ADVANCED DIGITAL SIGNAL PROCESSING L T P**
**Internal Marks: 40 3 0 0**
**External Marks: 60**
**Total Marks: 100**

**Course Objectives:** -Students will be able to:
1. To understand the difference between discrete-time and continuous-time signals
2. To understand and apply Discrete Fourier Transforms (DFT)

**Syllabus**

| Unit | Content | Hours |
|---|---|---|
| 1 | Discrete time signals, Linear shift invariant systems- Stability and causality, Sampling of continuous time signals- Discrete time Fourier transform- Discrete Fourier series- Discrete Fourier transform, Z transform-Properties of different transforms | 8 |
| 2 | Linear convolution using DFT, Computation of DFT Design of IIR digital filters from analog filters, Impulse invariance method, Bilinear transformation method | 8 |
| 3 | FIR filter design using window functions, Comparison of IIR and FIR digital filters, Basic IIR and FIR filter realization structures, Signal flow graph representations Quantization process and errors, Coefficient quantisation effects in IIR and FIR filters | 8 |
| 4 | A/D conversion noise- Arithmetic round-off errors, Dynamic range scaling, Overflow oscillations and zero Input limit cycles in IIR filters, Linear Signal Models | 8 |
| 5 | All pole, All zero and Pole-zero models, Power spectrum estimation- Spectral analysis of deterministic signals, Estimation of power spectrum of stationary random signals | 6 |
| 6 | Optimum linear filters, Optimum signal estimation, Mean square error estimation, Optimum FIR and IIR Filters | 6 |

**Suggested reading**

1. Sanjit K Mitra, "Digital Signal Processing: A computer-based approach ",TataMc Grow-Hill Edition1998
2. Dimitris G .Manolakis, Vinay K. Ingle and Stephen M. Kogon, "Statistical and Adaptive Signal Processing", Mc Grow Hill international editions. -2000

**Course Outcomes:-** Students will be able to:

1. Knowledge about the time domain and frequency domain representations as well analysis of discrete time signals and systems
2. Study the design techniques for IIR and FIR filters and their realization structures.
3. Acquire knowledge about the finite word length effects in implementation of digital filters.
4. Knowledge about the various linear signal models and estimation of power spectrum of stationary random signals
5. Design of optimum FIR and IIR filters

**EEPS-203C-18 DYNAMICS OF ELECTRICAL MACHINES L T P**
**Internal Marks: 40 3 0 0**
**External Marks: 60**
**Total Marks: 100**

**Course objective:** -Students will be able to-
1. Learn performance characteristics of machine
2. To understand the dynamics of the machine
3. To understand how to determine stability of machine
4. Learn the synchronous machine

**Syllabus**

| Unit | Content | Hours |
|---|---|---|
| 1 | Stability, Primitive 4 Winding Commutator Machine, Commutator Primitive Machine, Complete Voltage Equation of Primitive 4 Winding, Commutator Machine | 8 |
| 2 | Torque Equation Analysis of Simple DC Machines using the Primitive Machine Equations, The Three Phase Induction Motor, Transformed Equations, Different Reference Frames for Induction Motor Analysis Transfer, Function Formulation | 8 |
| 3 | Three Phase Salient Pole Synchronous Machine, Parks Transformation, Steady State Analysis | 8 |
| 4 | Large Signal Transient, Small Oscillation Equations in State Variable form, Dynamical Analysis of Interconnected Machines | 8 |
| 5 | Large Signal Transient Analysis using Transformed Equations, DC Generator /DC Motor System | 6 |
| 6 | Alternator /Synchronous Motor System | 6 |

**Suggested reading**

1. D.P. Sengupta& J.B. Lynn," Electrical Machine Dynamics", The Macmillan Press Ltd. 1980
2. R Krishnan "Electric Motor Drives, Modeling, Analysis, and Control", Pearson Education., 2001
3. P.C. Kraus, "Analysis of Electrical Machines", McGraw Hill Book Company,1987
4. I. Boldia& S.A. Nasar,,"Electrical Machine Dynamics", The Macmillan Press Ltd. 1992
5. C.V. Jones, "The Unified Theory of Electrical Machines", Butterworth, London. 1967

**Course Outcomes:** - Students will be able to:

1. Formulation of electro-dynamic equations of all electric machines and analyze the performance characteristics
2. Knowledge of transformations for the dynamic analysis of machines
3. Knowledge of determination of stability of the machines under small signal and transient conditions
4. Study about synchronous machine

**EEPS-203D-18** **POWER APPARATUS DESIGN** **L T P**
**Internal Marks: 40** **3 0 0**
**External Marks: 60**
**Total Marks: 100**

**Course Objectives:** -Students will be able to:
1. Study the modeling analysis of rotating machine.
2. Learning electromagnetic energy conversion
3. To know about rating of machines.

**Syllabus**

| Unit | Content | Hours |
|---|---|---|
| 1 | Principles of Design of Machines -Specific loadings, choice of magnetic and electric loadings, Real and apparent flux densities, temperature rise calculation, Separation of main dimension for DC machines, Induction machines and synchronous machines, Design of Transformers-General considerations, output equation, emf per turn, choice of flux density and current density, main dimensions, leakage reactance and conductor size, design of tank and cooling | 8 |
| 2 | Specific loadings, choice of magnetic and electric loadings Real and apparent flux -densities, temperature rise calculation, Separation of main dimension for DC machines, Induction machines and synchronous machines, Heating and cooling of machines, types of ventilation, continuous and intermittent rating | 8 |
| 3 | General considerations, output equation, emf per turn, choice of flux density and current density, main dimensions, leakage reactance and conductor size, design of tank and cooling tubes, Calculation of losses, efficiency and regulation, Forces winding during short circuit | 8 |
| 4 | General considerations, output equation, Choice of specific electric and magnetic loadings, efficiency, power factor, Number of slots in stator and rotor, Elimination of harmonic torques | 8 |
| 5 | Design of stator and rotor winding, slot leakage flux, Leakage reactance, equivalent resistance of squirrel cage rotor, Magnetizing current, efficiency from design data | 6 |
| 6 | Types of alternators, comparison, specific loadings, output co-efficient, design of main dimensions, Introduction to Computer Aided Electrical Machine Design Energy efficient machines | 6 |

**Suggested reading**

1. Clayton A.E, "The Performance and Design of D.C. Machines", Sir I. Pitman & sons, Ltd.
2. M.G. Say, "The Performance and Design of A.C. Machines", Pitman
3. Sawhney A.K, "A course in Electrical Machine Design", DhanpatRai & Sons, 5th Edition

**Course Outcomes:** - Students will be able to:

1. To give a systematic approach for modeling and analysis of all rotating machines under both transient and steady state conditions with the dimensions and material used
2. Ability to model and design all types of rotation machines including special machines

**EEPS-204A-18 ADVANCED MICRO-CONTROLLER BASED SYSTEMS** **L T P**
**Internal Marks: 40** **3 0 0**
**External Marks: 60**
**Total Marks: 100**

**Course Objectives:-**Students will be able to:
1. To understand the architecture of advance microcontrollers
2. To understand the applications of these controllers
3. To get some introduction to FPGA.

**Syllabus**

| Unit | Content | Hours |
|---|---|---|
| 1 | Basic Computer Organization, Accumulator based Processes-Architecture, Memory Organization-I/O Organization | 8 |
| 2 | Micro-Controllers-Intel 8051, Intel 8056- Registers, Memories, I/O Ports, Serial Communication, Timers, Interrupts, Programming | 8 |
| 3 | Intel 8051 – Assembly language programming, Addressing-Operations, Stack & Subroutines, Interrupts-DMA | 8 |
| 4 | PIC 16F877- Architecture Programming, Interfacing Memory/ I/O Devices, Serial I/O and data communication | 8 |
| 5 | Digital Signal Processor (DSP), Architecture – Programming, Introduction to FPGA | 6 |
| 6 | Microcontroller development for motor control applications, Stepper motor control using micro controller | 6 |

**Suggested reading**

1. John.F.Wakerly: "Microcomputer Architecture and Programming", John Wiley and Sons 1981
2. Ramesh S.Gaonker: "Microprocessor Architecture, Programming and Applications with the 8085",Penram International Publishing (India), 1994
3. Raj Kamal: "The Concepts and Features of Microcontrollers", Wheeler Publishing, 2005
4. Kenneth J. Ayala, "The 8051 microcontroller", Cengage Learning, 2004
5. John Morton," The PIC microcontroller: your personal introductory course", Elsevier, 2005

**Course Outcomes: -** Students will be able to learn

1. A processor in assembly language and develop an advanced processor based system
2. To learn configuring and using different peripherals in a digital system
3. To compile and debug a Program
4. To generate an executable file and use it

**EEPS-204B-18** **SCADA SYSTEMS AND APPLICATIONS** **L T P**
**Internal Marks: 40** **3 0 0**
**External Marks: 60**
**Total Marks: 100**

**Course Objectives:** Students will be able to:
1. To understand what is meant by SCADA and its functions.
2. To know SCADA communication.
3. To get an insight into its application.

**Syllabus**

| Unit | Content | Hours |
|---|---|---|
| 1 | Introduction to SCADA: Data acquisition systems, Evolution of SCADA, Communication technologies | 6 |
| 2 | Monitoring and supervisory functions, SCADA applications in Utility Automation, Industries SCADA | 8 |
| 3 | Industries SCADA System Components: Schemes- Remote Terminal Unit (RTU), Intelligent Electronic Devices (IED), Programmable Logic Controller (PLC), Communication Network, SCADA Server, SCADA/HMI Systems | 6 |
| 4 | SCADA Architecture: Various SCADA architectures, advantages and disadvantages of each system - single unified standard architecture -IEC 61850. | 6 |
| 5 | SCADA Communication: various industrial communication technologies -wired and wireless methods and fiber optics. open standard communication protocols. | 6 |
| 6 | SCADA Applications: Utility applications- Transmission and Distribution sector- operations, monitoring, analysis and improvement. Industries - oil, gas and water, Case studies, Implementation, Simulation Exercises | 8 |

**Suggested reading**

1. Stuart A. Boyer: "SCADA-Supervisory Control and Data Acquisition", Instrument Society of America Publications, USA, 2004
2. Gordon Clarke, Deon Reynders: "Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems", Newnes Publications, Oxford, UK,2004
3. William T. Shaw, "Cybersecurity for SCADA systems", PennWell Books, 2006
4. David Bailey, Edwin Wright, "Practical SCADA for industry", Newnes, 2003
5. Michael Wiebe, "A guide to utility automation: AMR, SCADA, and IT systems for electric power", PennWell 1999

**Course Outcomes:-** Student will be able to

1. Describe the basic tasks of Supervisory Control Systems (SCADA) as well as their typical applications
2. Acquire knowledge about SCADA architecture, various advantages and disadvantages of each system
3. Knowledge about single unified standard architecture IEC 61850
4. Describe the basic tasks of Supervisory Control Systems (SCADA) as well as their typical applications
5. Acquire knowledge about SCADA architecture, various advantages and disadvantages of each system
6. Knowledge about single unified standard architecture IEC 61850
7. To learn about SCADA system components: remote terminal units, PLCs, intelligent electronic devices, HMI systems, SCADA server
8. Learn and understand about SCADA applications in transmission and distribution sector, industries etc

**EEPS-204C-18** **POWER QUALITY** **L T P**
**Internal Marks: 40** **3 0 0**
**External Marks: 60**
**Total Marks: 100**

**Course Objectives: -**Students will be able to:
1. Understand the different power quality issues to be addressed
2. Understand the recommended practices by various standard bodies like IEEE,IEC, etc on voltage& frequency, harmonics
3. Understanding STATIC VAR Compensators

**Syllabus**

| Unit | Content | Hours |
|---|---|---|
| 1 | Introduction-power quality-voltage quality-overview of power quality Phenomena, classification of power quality issues-power quality measures and standards-THD-TIF-DIN-C message weights-flicker factor transient phenomena-occurrence of power quality problems, power acceptability curves-IEEE guides, standards and recommended practices. | 8 |
| 2 | Harmonics-individual and total harmonic distortion, RMS value of a harmonic waveform- Triplex harmonics-important harmonic introducing devices-SMPS-Three phase power converters- arcing devices saturable devices-harmonic distortion of fluorescent lamps-effect of power system harmonics on power system equipment and loads. | 8 |
| 3 | Modeling of networks and components under non-sinusoidal conditions transmission and distribution systems, Shunt capacitors-transformers-electric machines-ground systems loads that cause power quality problems, power quality problems created by drives and its impact on drive | 8 |
| 4 | Power factor improvement- Passive Compensation, Passive Filtering , Harmonic, Resonance, Impedance Scan Analysis- Active Power Factor Corrected Single Phase Front End, Control Methods for Single Phase APFC, Three Phase APFC and Control Techniques, PFC Based on Bilateral Single Phase and Three Phase Converter | 8 |
| 5 | Static VAR compensators-SVC and STATCOM Active Harmonic Filtering-Shunt Injection , Filter for single phase, three-phase three-wire and three-phase four wire systems, d-q domain control of three phase shunt active filters uninterruptible power supplies constant voltage transformers, series active power filtering techniques for harmonic cancellation and isolation. | 8 |
| 6 | Dynamic Voltage Restorers for sag, swell and flicker problems. Grounding and wiring introduction , NEC grounding requirements- | 8 |

| | | |
|---|---|---|
| | reasons for grounding, typical grounding and wiring problems solutions to grounding and wiring problems | |

**Suggested readings:-**

1. G.T. Heydt, "Electric power quality", McGraw-Hill Professional, 2007
2. Math H. Bollen, "Understanding Power Quality Problems", IEEE Press, 2000
3. J. Arrillaga, "Power System Quality Assessment", John wiley, 2000
4. J. Arrillaga, B.C. Smith, N.R. Watson & A. R.Wood ,"Power system Harmonic Analysis", Wiley, 1997

**Course Outcomes: -** Students will be able to:

1. Acquire knowledge about the harmonics, harmonic introducing devices and effect of harmonics on system equipment and loads
2. To develop analytical modeling skills needed for modeling and analysis of harmonics in networks and components
3. To introduce the student to active power factor correction based on static VAR compensators and its control techniques
4. To introduce the student to series and shunt active power filtering techniques for harmonics.

**EEPS-204D-18 ARTIFICIAL INTELLIGENCE TECHNIQUES L T P**
**Internal Marks: 40 3 0 0**
**External Marks: 60**
**Total Marks: 100**

**Course Objectives:-**Students will be able to:
1.Understanding fuzzy logic, ANN
2.Understanding GA & EP

**Syllabus**

| Units | Content | Hours |
|---|---|---|
| 1 | Biological foundations to intelligent Systems, Artificial Neural Networks, Single layer and Multilayer Feed Forward NN LMS and Back Propagation Algorithm, Feedback networks and Radial Basis Function Networks | 8 |
| 2 | Fuzzy Logic, Knowledge Representation and Inference Mechanism Defuzzification Methods | 8 |
| 3 | Fuzzy Neural Networks, some algorithms to learn the parameters of the network like GA | 8 |
| 4 | System Identification using Fuzzy and Neural Network | 6 |
| 5 | Genetic algorithm, Reproduction cross over, mutation, Introduction to evolutionary program | 8 |
| 6 | Applications of above mentioned techniques to practical problems | 6 |

**Suggested reading**

1. J M Zurada , "An Introduction to ANN",Jaico Publishing House
2. Simon Haykins, "Neural Networks", Prentice Hall
3. Timothy Ross, "Fuzzy Logic with Engg. Applications", McGraw. Hill
4. Driankov, Dimitra, "An Introduction to Fuzzy Control", Narosa Publication
5. Golding, "Genetic Algorithms", Addison-Wesley Publishing Com

**Course Outcomes: -** Students will be able to:

1. Learn the concepts of biological foundations of artificial neural networks
2. Learn Feedback networks and radial basis function networks and fuzzy logics
3. Identifications of fuzzy and neural network
4. Acquire the knowledge of GA

**EEPS-205A-18** **POWER SYSTEM PROTECTION LAB** **L T P**
**Internal Marks: 60** **0 0 4**
**External Marks: 40**
**Total Marks: 100**

**Course Objectives:-**Students will be able :

1. To understand power system protection through feeders.
2. To understand the transformer protection, reverse power and induction relay.

**Syllabus**

| **Sr. No.** | **List of Experiments** |
|---|---|
| 1 | Introduction to Power System Protection |
| 2 | Impact of Induction Motor Starting on Power System |
| 3 | Modelling of Differential Relay using MATLAB |
| 4 | Radial Feeder Protection |
| 5 | Parallel Feeder Protection |
| 6 | Principle of Reverse Power Protection |
| 7 | Differential Protection of Transformer |
| 8 | To the study time Vs. voltage characteristics of over voltage induction relay |

**Course Outcome;-** Student will be able

1. Understand the performance of protection relays with feeders
2. Modelling of relay and understand principle of different relays.

**EEPS-205B-18** **POWER QUALITY LAB** **L T P**
**Internal Marks: 60** **0 0 4**
**External Marks: 40**
**Total Marks: 100**

**Course Objectives:-**Students will be able :

1. To understand phenomena of power quality
2. To study and analyze the harmonics distortion
3. Understand the grounding and wiring techniques.

**Syllabus**

| **Sr. No.** | **List of Experiments** |
|---|---|
| 1 | To understand power quality phenomena |
| 2 | To monitor the power quality for current and power transformers |
| 3 | To obtain the current harmonics drawn by power electronics interface |
| 4 | To analyze the harmonic distortion |
| 5 | To study and analyze the grounding and wiring techniques |

**Course Outcome;-** Student will be able

1. Understand and analyze power quality
2. Performance and analysis of occurrence of harmonics
3. Knowledge of grounding techniques

**EEPS-206A-18** **ARTIFICIAL INTELLIGENCE LAB** **L T P**
**Internal Marks: 60** **0 0 4**
**External Marks: 40**
**Total Marks: 100**

**Course Objectives:-**Students will be able :

1. To write programs for AI techniques
2. Application of AI in power system.

**Syllabus**

| **Sr. No.** | **List of Experiments** |
|---|---|
| 1 | Write a program for best first search |
| 2 | Write a program to generate the output for AI Algorithm. |
| 3 | Write a program to show the Tic Tac Toe Game for 0 and X. |
| 4 | Write a program for expert system by using forward chaining. |
| 5 | Comparing the search methods |
| 6 | Implement the greedy search algorithm |
| 7 | Implement the min-max algorithm |
| 8 | Adding a heuristic |

**Course Outcome:-** Student will be able to

1. Write programs using AI techniques
2. Learn AI oriented power applications

**EEPS-206B-18** **POWER ELECTRONICS APPLICATIONS TO POWER SYSTEMS LAB** **L T P**

**Internal Marks: 60** **0 0 4**
**External Marks: 40**
**Total Marks: 100**

**Course Objectives:-**Students will be able :

1. To understand and analyze the performance of thyristor, converters and inverters
2. Applications of power electronics in operation of power system.

**Syllabus**

| **Sr. No.** | **List of Experiments** |
|---|---|
| 1 | Study of three phase line commutated thyristor converter circuit |
| 2 | To study the performance of three phase variable frequency drive |
| 3 | Switching characteristics of MOSFET and IGBT |
| 4 | Performance analysis of Buck and Boost converter |
| 5 | Study of three phase PWM and non PWM inverter |

**Course Outcome:-** Student will be able to

1. Understand and analyze the performance of converters and inverters as power electronics application.
2. Performance analysis of drive

**EEPS-206C-18** **SMART GRIDS LAB** **L T P**
**Internal Marks: 60** **0 0 4**
**External Marks: 40**
**Total Marks: 100**

**Course Objectives:-**Students will be able :

1. To understand smart grid structure
2. Understand the microgrid
3. Understand power quality issues in smart grid.

**Syllabus**

| **Sr. No.** | **List of Experiments** |
|---|---|
| 1 | To study the components of smart grid. |
| 2 | To analyze the geographic information system for smart grid. |
| 3 | Formation of microgrid and protection and control of grid. |
| 4 | Understand power quality issues in grid connected renewable energy sources |
| 5 | Performance analysis of smart meters |

**Course Outcome:-** Student will be able

1. To understand structure of smart grid and micro grid
2. Power quality issues for grid connected renewable sources

**MTA-105-18 CONSTITUTION OF INDIA L T P**
**Internal Marks: 00 2 0 0**
**External Marks: 00**
**Total Marks: 00**

**Course Objectives:** Students will be able to

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nation hood in the early years of Indian nationalism.
3. To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

**Syllabus**

| Units | Content | Hours |
|---|---|---|
| 1 | History of Making of the Indian Constitution: History, Drafting Committee, ( Composition & Working) | 4 |
| 2 | Philosophy of the Indian Constitution: Preamble, Salient Features | 4 |
| 3 | Contours of Constitutional Rights & Duties: Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties. | 4 |
| 4 | Organs of Governance: Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions | 4 |
| 5 | Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation, Pachayati raj: Introduction, PRI: Zila Pachayat, Elected officials and their roles, CEO Zila Pachayat: Position and role, Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy | 4 |
| 6 | Election Commission: Election Commission: Role and Functioning, Chief Election Commissioner and Election Commissioners, State Election Commission: Role and Functioning, Institute and Bodies for the welfare of SC/ST/OBC and women. | 4 |

**Suggest Reading**

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

**Course Outcomes:** Students will be able to:

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
4. Discuss the passage of the Hindu Code Bill of 1956.

**MTA-106-18** **PEDAGOGY STUDIES** **L T P**
**Internal Marks: 00** **2 0 0**
**External Marks: 00**
**Total Marks: 00**

**Course Objectives:** Students will be able to:

1. Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
2. Identify critical evidence gaps to guide the development.

**Syllabus**

| Units | Content | Hours |
|---|---|---|
| 1 | Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology, Theories of learning, Curriculum, Teacher education, Conceptual framework, Research questions**,** Overview of methodology and Searching | 4 |
| 2 | Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries, Curriculum, Teacher education. | 2 |
| 3 | Evidence on the effectiveness of pedagogical practices, Methodology for the in depth stage: quality assessment of included studies, How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change, Strength and nature of the body of evidence for effective pedagogical practices, Pedagogic theory and pedagogical approaches, Teachers' attitudes and beliefs and Pedagogic strategies. | 4 |
| 4 | Professional development: alignment with classroom practices and follow up support, Peer support, Support from the head teacher and the community, Curriculum and assessment, Barriers to learning: limited resources and large class sizes | 4 |
| 5 | Research gaps and future directions, Research design, Contexts, Pedagogy, Teacher education, Curriculum and assessment, Dissemination and research impact | 2 |

**Suggested reading**

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379

3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.

6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

**Course Outcomes:** Students will be able to understand:

1. What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
2. What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
3. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

**MTA-107-18** **STRESS MANAGEMENT BY YOGA** **L T P**
**Internal Marks: 00** **2 0 0**
**External Marks: 00**
**Total Marks: 00**

**Course Objectives:** Students will be able to:

1. To achieve overall health of body and mind
2. To overcome stress

**Syllabus**

| Units | Content | Hours |
|---|---|---|
| 1 | Definitions of Eight parts of yog. ( Ashtanga ) | 4 |
| 2 | Yam and Niyam, Do`s and Don't's in life.<br>i) Ahinsa, satya, astheya, bramhacharya and aparigraha<br>ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan | 2 |
| 3 | Asan and Pranayam<br>i) Various yog poses and their benefits for mind & body<br>ii)Regularization of breathing techniques and its effects-Types of pranayam | 4 |

**Suggested reading**

1. 'Yogic Asanas for Group Tarining-Part-I" : Janardan Swami Yogabhyasi Mandal, Nagpur

2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

**Course Outcomes:-** Students will be able to:

1. Develop healthy mind in a healthy body thus improving social health also
2. Improve efficiency

**MTA-108-18 PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS**

| L | T | P |
|---|---|---|
| 2 | 0 | 0 |

**Internal Marks: 00**
**External Marks: 00**
**Total Marks: 00**

**Course Objectives:** Students will be able to:

1. To learn to achieve the highest goal happily
   a. To become a person with stable mind, pleasing personality and determination
   b. To awaken wisdom in students

**Syllabus**

| Units | Content | Hours |
|---|---|---|
| 1 | Neetisatakam-Holistic development of personality, Verses- 19,20,21,22 (wisdom), Verses- 29,31,32 (pride & heroism), Verses- 26,28,63,65 (virtue), Verses- 52,53,59 (dont's), Verses- 71,73,75,78 (do's) | 8 |
| 2 | Approach to day to day work and duties, Shrimad Bhagwad Geeta : Chapter 2-Verses 41, 47,48, Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35, Chapter 18-Verses 45, 46, 48. | 8 |
| 3 | Statements of basic knowledge, Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68, Chapter 12 -Verses 13, 14 15, 16, 17, 18, Personality of Role model. Shrimad Bhagwad Geeta: Chapter2-Verses 17, Chapter 3-Verses 36,37,42, Chapter 4-Verses 18, 38,39, Chapter18 – Verses 37,38,63 | 8 |

**Suggested reading**

1. "Srimad Bhagavad Gita" by Swami Swarupananda Advaita Ashram (Publication Department), Kolkata
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

**Course Outcomes:** Students will be able to

1. Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
2. The person who has studied Geeta will lead the nation and mankind to peace and prosperity
3. Study of Neetishatakam will help in developing versatile personality of students.

**EEPS-301A-18** **POWER SYSTEM TRANSIENTS** **L T P**
**Internal Marks: 40** **3 0 0**
**External Marks: 60**
**Total Marks: 100**

**Course Objectives:** -Students will be able to:
1. Learn the reasons for occurrence of transients in a power system
2. Understand the change in parameters like voltage & frequency during transients
3. To know about the lightning phenomenon and its effect on power system

**Syllabus**

| Unit | Content | Hours |
|---|---|---|
| 1 | Fundamental circuit analysis of electrical transients, Laplace Transform method of solving simple Switching transients, Damping circuits -Abnormal switching transients, Three-phase circuits and transients, Computation of power system transients | 8 |
| 2 | Principle of digital computation – Matrix method of solution, Modal analysis- Z transform- Computation using EMTP, Lightning, switching and temporary over voltages, Lightning , Physical phenomena of lightning | 8 |
| 3 | Interaction between lightning and power system, Influence of tower footing resistance and Earth Resistance, Switching: Short line or kilometric fault, Energizing transients - closing and re-closing of lines, line dropping, load rejection – over voltages induced by faults | 8 |
| 4 | Switching HVDC line, Travelling waves on transmission line, Circuits with distributed Parameters, Wave Equation, Reflection, Refraction, Behaviour of Travelling waves at the line terminations, Lattice Diagrams – Attenuation and Distortion, Multi-conductor system and Velocity wave | 8 |
| 5 | Insulation co-ordination: Principle of insulation co-ordination in Air Insulated substation (AIS) and Gas Insulated Substation (GIS) Coordination between insulation and protection level, Statistical approach | 6 |
| 6 | Protective devices, Protection of system against over voltages, lightning arresters, substation earthling | 6 |

**Suggested reading**

1. Allan Greenwood, “Electrical Transients in Power System”, Wiley & Sons Inc. New York, 1991.

**Course Outcomes: -** Students will be able to:

1. Knowledge of various transients that could occur in power system and their mathematical formulation
2. Ability to design various protective devices in power system for protecting equipment and personnel
3. Coordinating the insulation of various equipments in power system
4. Modelling the power system for transient analysis

**EEPS-301B-18 FACTS AND CUSTOM POWER DEVICES L T P**
**Internal Marks: 40 3 0 0**
**External Marks: 60**
**Total Marks: 100**

**Course Objectives:** Students will be able to:
1. To learn the active and reactive power flow control in power system
2. To understand the need for static compensators
3. To develop the different control strategies used for compensation

**Syllabus**

| Unit | Content | Hours |
|---|---|---|
| 1 | Reactive power flow control in Power Systems – Control of dynamic power unbalances in Power System, Power flow control -Constraints of maximum transmission line loading –Benefits of FACTS Transmission line compensation, Uncompensated line -Shunt compensation - Series compensation –Phase angle control. Reactive power compensation, Shunt and Series compensation principles – Reactive compensation at transmission and distribution level. | 6 |
| 2 | Static versus passive VAR compensator, Static shunt compensators: SVC and STATCOM - Operation and control of TSC, TCR and STATCOM - Compensator control, Comparison between SVC and STATCOM. | 8 |
| 3 | Static series compensation: TSSC, SSSC -Static voltage and phase angle regulators – TCVR and TCPAR Operation and Control – Applications, Static series compensation – GCSC, TSSC, TCSC and Static synchronous series compensators and their Control. | 6 |
| 4 | SSR and its damping Unified Power Flow Controller: Circuit Arrangement, Operation and control of UPF, Basic Principle of P and Q control- Independent real and reactive power flow control- Applications. | 6 |
| 5 | Introduction to interline power flow controller. Modeling and analysis of FACTS Controllers – Simulation of FACTS controllers Power quality problems in distribution systems, harmonics, Loads that create harmonics, modeling, harmonic propagation, series and parallel resonances, mitigation of harmonics, passive filters, active filtering – shunt , series and hybrid and their control. | 6 |
| 6 | Voltage swells, sags, flicker, unbalance and mitigation of these problems by power line conditioners- IEEE standards on power quality. | 6 |

**Suggest Reading**

1. K R Padiyar, "FACTS Controllers in Power Transmission and Distribution", New Age InternationalPublishers, 2007
2. X P Zhang, C Rehtanz, B Pal, "Flexible AC Transmission Systems- Modelling and Control",
3. N.G. Hingorani, L. Gyugyi, "Understanding FACTS: Concepts and Technology of Flexible ACTransmission Systems", IEEE Press Book, Standard Publishers and Distributors, Delhi, 2001.
4. K.S.Sureshkumar ,S.Ashok , "FACTS Controllers & Applications", E-book edition, Nalanda DigitalLibrary, NIT Calicut,2003
5. G T Heydt , "Power Quality", McGraw-Hill Professional, 2007
6. T J E Miller, "Static Reactive Power Compensation", John Wiley and Sons, Newyork, 1982.

**Course Outcomes: -** Students will be able to:

1. Acquire knowledge about the fundamental principles of Passive and Active Reactive Power Compensation Schemes at Transmission and Distribution level in Power Systems.
2. Learn various Static VAR Compensation Schemes like Thyristor/GTO Controlled Reactive Power Systems, PWM_Inverter based Reactive Power Systems and their controls.
3. To develop analytical modeling skills needed for modeling and analysis of such Static VAR Systems.

**EEPS-301C-18 INDUSTRIAL LOAD MODELING AND CONTROL L T P**
**Internal Marks: 40 3 0 0**
**External Marks: 60**
**Total Marks: 100**

**Course Objectives:-** Students will be able to
1. Understand the energy demand scenario
2. Understand the modeling of load and its ease to study load demand industrially
3. Know Electricity pricing models
4. Study Reactive power management in Industries

**Syllabus**

| Unit | Content | Hours |
|---|---|---|
| 1 | Electric Energy Scenario-Demand Side Management-Industrial Load Management, Load Curves-Load Shaping Objectives-Methodologies-Barriers, Classification of Industrial Loads-Continuous and Batch processes -Load Modelling | 4 |
| 2 | Electricity pricing – Dynamic and spot pricing –Models, Direct load control- Interruptible load control, Bottom up approach-scheduling- Formulation of load models, Optimization and control algorithms, Case studies | 6 |
| 3 | Reactive power management in industries-controls, Power quality impacts-application of filters Energy saving in Industries | 4 |
| 4 | Cooling and heating loads, Load profiling- Modeling, Cool storage-Types-Control strategies, Optimal operation, Problem formulation, Case studies | 4 |
| 5 | Captive power units- Operating and control strategies, Power Pooling- Operation models, Energy banking, Industrial Cogeneration | 4 |
| 6 | Selection of Schemes Optimal Operating Strategies-Peak load Saving, Constraints, Problem formulation- Case study, Integrated Load management for Industries | 4 |

**Suggest Reading**

1. C.O. Bjork " Industrial Load Management - Theory, Practice and Simulations", Elsevier, the Netherlands,1989
2. C.W. Gellings and S.N. Talukdar,. Load management concepts. IEEE Press, New York, 1986, pp. 3-28
3. Y. Manichaikul and F.C. Schweppe ," Physically based Industrial load", IEEE Trans. on PAS, April 1981
4. H. G. Stoll, "Least cost Electricity Utility Planning", Wiley Interscience Publication, USA, 1989.

5. I.J.Nagarath and D.P.Kothari, .Modern Power System Engineering., Tata McGraw Hill publishers, NewDelhi, 1995
6. IEEE Bronze Book- "Recommended Practice for Energy Conservation and cost effective planning in Industrial facilities", IEEE Inc, USA

**Course Outcomes:-** Student will be able to:

1. Knowledge about load control techniques in industries and its application
2. Learn different types of industrial processes and optimize the process using tools like LINDO and LINGO
3. Apply load management to reduce demand of electricity during peak time
4. Apply different energy saving opportunities in industries

**EEPS-301D-18** **DYNAMICS OF LINEAR SYSTEMS** **L T P**
**Internal Marks: 40** **3 0 0**
**External Marks: 60**
**Total Marks: 100**

**Course Objectives:-**Students will be able to:
1. To understand the linear system and its functions
2. To understand the stability analysis of linear systems and implement the same in MATLAB

**Syllabus**

| Units | Content | Hours |
|---|---|---|
| 1 | State variable representations of systems, transfer function and transfer function matrix, solutions of state equations | 8 |
| 2 | Observability and controllability, minimal realization of MIMO systems, analysis of linear time varying systems, the concepts of stability | 8 |
| 3 | Lyapunov stability analysis, Lyapunov function and its properties, controllability by state variable feedback | 6 |
| 4 | Ackerman's Formula - stabilisation by output feedback, asymptotic observers for state measurement, observer design | 6 |
| 5 | State space representation of discrete systems, solution of state equations, controllability and observabilty stability analysis using Lyapunov method | 6 |
| 6 | State feedback of linear discrete time systems, design of observers - MATLAB Exercises | 8 |

**Suggested reading**

1. Thomas Kailath, "Linear Systems", Prentice Hall Inc., Englewood Cliffs, N.J. 1980.
2. K. Ogata, "State Space Analysis of Control Systems", Prentice Hall Inc., Englewood Cliffs, N.J., 1965.
3. K. Ogata, "Modern Control Engineering, (second edition)" , Prentice Hall Inc., Englewood Cliffs, N.J., 1990
4. M.Gopal, "Digital Control and State Variable Methods", Tata McGraw Hill Publishing Company Ltd., New Delhi, 1997
5. C.T. Chen, "Linear System Theory and Design", New York: Holt Rinehart and Winston ,1984
6. R.C. Dorf, and R. T. "Bishop, Modern Control Systems", Addison Wesley Longman Inc., 1999.

**Course Outcomes:-** Students will be able to:

1. To learn linear system modeling, analysis and design so as to obtain the ability to apply the same to engineering problems in a global perspective
2. Knowledge on carrying out detailed stability analysis of both linear and nonlinear systems
3. Design observers and controllers for linear systems
4. Acquire knowledge of discrete time linear systems modeling, analysis and design
5. Develop and utilize modern software tools for analysis and design of linear continuous and discrete time systems

**MTOE-301A-18** **BUSINESS ANALYTICS** **L T P**
**Internal Marks: 40** **3 0 0**
**External Marks: 60**
**Total Marks: 100**

**Course Objectives:-**Students will be able to:
1. Understand the role of business analytics within an organization.
2. Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization
3. To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
4. To become familiar with processes needed to develop, report, and analyze business data.
5. Use decision-making tools/Operations research techniques.
6. Mange business process using analytical and management tools.
**7.** Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

**Syllabus**

| Units | Content | Hours |
|---|---|---|
| 1 | Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics, Process and organisation, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview. | 9 |
| 2 | Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology. | 8 |
| 3 | Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization | 9 |
| 4 | Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: | 10 |

| | | |
|---|---|---|
| | Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model | |
| 5 | Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making. | 8 |
| 6 | Recent Trends in : Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism. | 4 |

**Suggested reading**

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education.

**Course Outcome:-**

1. Students will demonstrate knowledge of data analytics.
2. Students will demonstrate the ability of think critically in making decisions based on data and deep analytics.
3. Students will demonstrate the ability to use technical skills in predicative and prescriptive modelling to support business decision-making.
4. Students will demonstrate the ability to translate data into clear, actionable insights.

**MTOE-301B-18** **INDUSTRIAL SAFETY** **L T P**
**Internal Marks: 40** **3 0 0**
**External Marks: 60**
**Total Marks: 100**

**Course Objectives:-**Students will be able to:

1. Understand about industrial safety and maintenance engineering
2. Learn possible ways of prevention from wear and tear and methods of fault tracing
3. Understand periodic maintenance

**Syllabus**

| Units | Content | Hours |
|---|---|---|
| 1 | Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods. | 8 |
| 2 | Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment. | 8 |
| 3 | Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods. | 8 |
| 4 | Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes. | 8 |
| 5 | Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair | 8 |

| | | |
|---|---|---|
| | complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance | |

**Suggested reading:**

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

**Course Outcome:-** Student will be able

1. To know about industrial safety and ways of prevention of wear and tear
2. Learn about fault identification and periodic maintenance
3. To get knowledge about all safety measures

**MTOE-301C-18** **OPERATIONS RESEARCH** **L T P**
**Internal Marks: 40** **3 0 0**
**External Marks: 60**
**Total Marks: 100**

**Course Objectives:-**Students will be able to:

1. To learn the optimization techniques
2. How to formulate LPP and handling of Nonlinear programming
3. How to do the scheduling and sequencing of models

**Syllabus**

| Units | Content | Hours |
|---|---|---|
| 1 | Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models | 8 |
| 2 | Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming | 8 |
| 3 | Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT | 8 |
| 4 | Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming. | 8 |
| 5 | Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation | 8 |

**Suggested reading**

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

**Course Outcomes: S**tudent should be able to

1. Students should able to apply the dynamic programming to solve problems of discreet and continuous variables.
2. Students should able to apply the concept of non-linear programming
3. Students should able to carry out sensitivity analysis
4. Student should able to model the real world problem and simulate it.

**MTOE-301D-18 COST MANAGEMENT OF ENGINEERING PROJECTS** **L T P**
**Internal Marks: 40** **3 0 0**
**External Marks: 60**
**Total Marks: 100**

**Course Objectives:-**Students will be able to

1. To get knowledge about cost concept and cost management process
2. To know about meaning and process of project execution
3. To learn quantitative techniques and cost planning

**Syllabus**

| Units | Content | Hours |
|---|---|---|
| 1 | Introduction and Overview of the Strategic Cost Management Process | 6 |
| 2 | Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making. | 6 |
| 3 | Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and non technical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team : Role of each member. Importance Project site : Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process | 10 |
| 4 | Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing. | 10 |
| 5 | Quantitative techniques for cost management, Linear Programming, | 8 |

| | | |
|---|---|---|
| | PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory. | |

**Suggested reading:**

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

**Course Outcomes:** Student should be able to

1. Understand cost management process
2. To execute project considering cost factor
3. To manage planning of cost and learn about the techniques

**MTOE-301E-18** **COMPOSITE MATERIALS** **L T P**
**Internal Marks: 40** **3 0 0**
**External Marks: 60**
**Total Marks: 100**

**Course Objectives:-**Students will be able to:

1. To understand composite materials and their reinforcement
2. Manufacturing of matrix

**Syllabus**

| Units | Content | Hours |
|---|---|---|
| 1 | Introduction, Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance. | 8 |
| 2 | Reinforcements: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions. | 8 |
| 3 | Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications. | 8 |
| 4 | Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications. | 8 |
| 5 | Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations. | 8 |

**Suggested text book reading:**

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

**Suggested reference reading:**

1. Hand Book of Composite Materials-ed-Lubin.
2. Composite Materials – K.K.Chawla.
3. Composite Materials Science and Applications – Deborah D.L. Chung.
4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

**Course Outcome:-** Student will be able to

1. Learn about composite materials and their process of reinforcement
2. Understand about strength and manufacturing of matrix