# VISVESVARAYA TECHNOLOGICAL UNIVERSITY
# BELAGAVI

## Scheme of Teaching and Examination and Syllabus

## B.E. ELECTRICAL AND ELECTRONICS ENGINEERING

## III SEMESER

**(Effective from Academic year 2015-16)**

**BOARD OF STUDIES IN ELECTRICAL AND ELECTRONICS ENGINEERING**
**April 2016**

# VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

SCHEME OF TEACHING AND EXAMINATION - 2015-16

**B.E. ELECTRICAL AND ELECTRONICS ENGINEERING**

**CHOICE BASED CREDIT SYSTEM (CBCS)**

**III SEMESTER**

| Sl. No | Subject Code | Course (Subject) | Title | Teaching Dept. | Teaching Hours /Week | | Examination | | | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Theory | Practical/ Drawing | Duration in hours | I.A. Marks | Theory/ Practical Marks | Total Marks | |
| 1 | 15MAT31 | Core | Engineering Mathematics-III | Mathematics | 04 | -- | 03 | 20 | 80 | 100 | 4 |
| 2 | 15EE32 | Core | Electric Circuit Analysis | EEE | 04 | -- | 03 | 20 | 80 | 100 | 4 |
| 3 | 15EE 33 | Core | Transformers and Generators | EEE | 04 | -- | 03 | 20 | 80 | 100 | 4 |
| 4 | 15EE 34 | Foundation | Analog Electronic Circuits | EEE | 04 | -- | 03 | 20 | 80 | 100 | 4 |
| 5 | 15EE 35 | Foundation | Digital System Design | EEE | 04 | -- | 03 | 20 | 80 | 100 | 4 |
| 6 | 15EE 36X | Elective | Elective | EEE | 03 | -- | 03 | 20 | 80 | 100 | 3 |
| 7 | 15EE L37 | Laboratory | Electronics Laboratory | EEE | 01-Hour Instruction 02-Hour Practical | | 03 | 20 | 80 | 100 | 2 |
| 8 | 15EEL38 | Laboratory | Electrical Machines Laboratory -1 | EEE | 01-Hour Instruction 02-Hour Practical | | 03 | 20 | 80 | 100 | 2 |
| | | | | **TOTAL** | **Theory:23 hours Practical: 06 hours** | | **24** | **160** | **640** | **800** | **27** |

**Number of credits completed at the end of III semester: 24 + 24 + 27 = 75**

**Elective (3 credits)**

| | | | |
|---|---|---|---|
| 15EE361 | Power Generation and Economics | 15EE 363 | Electrical and Electronic Measurements |
| 15EE362 | Electrical Engineering Materials | 15EE 364 | Communication Systems |

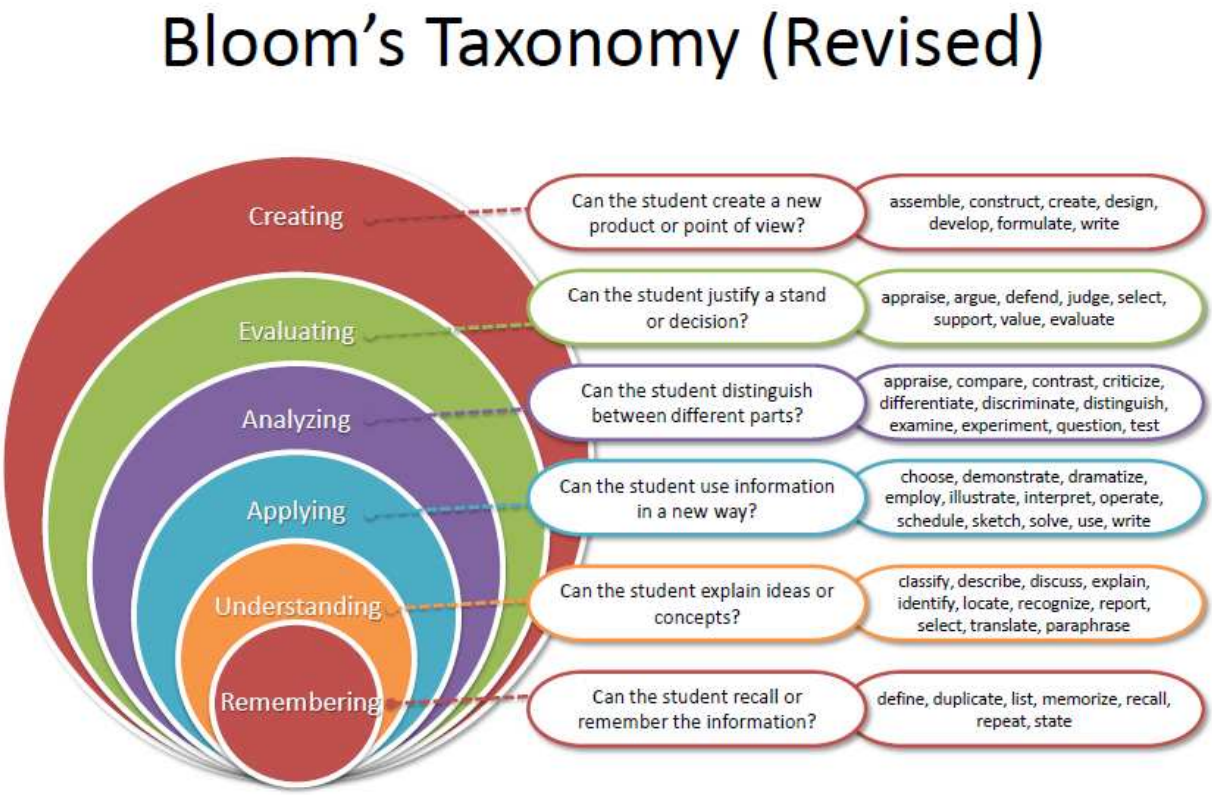
**1. Core subject:** This is the course, which is to be compulsorily studied by a student as a core requirement to complete the requirement of a programme in a said discipline of study.

**2a. Foundation Course**: The courses based upon the content that leads to Knowledge enhancement.

**2b. Foundation Elective:** Elective Foundation courses are value-based and are aimed at man-making education

**3. Elective:** This course can be selected from the pool of papers. It may be supportive to the discipline/providing extended scope/Enabling an Exposure to some other discipline/domain/nurturing student proficiency skills.

# CATEGORIZATION FOR THE THINKING PROCESS



**Bloom's Revised Taxonomy**
**Levels, Level Definitions and attributes levels**
**along with action verbs that can be used when developing learning outcomes.**

| | Level | Level Definitions and attributes | Verbs (not comprehensive ) |
|---|---|---|---|
| **Lower order thinking skills (LOTS)** | Remembering (Knowledge) $L_1 - Rembr$ | Students exhibit memory/rote memorization of previously learnt materials by recognition, recalling facts, terms, basic concepts, and simple answers. Able to remember, but not necessarily fully understanding the material. | Copy, Choose, Define, Discover, Describe, Duplicate, Enumerate, Find, How, Identify, Label, List, Locate, Listen, Memorize, Match, Name, Omit, Quote, Recall, Relate, Reproduce, Recognize, Select, Show, Spell, Tell, Tabulate, Who, When, Where etc. |
| | Understanding (Comprehension) $L_2 - Undrst$ | Students demonstrate understanding of facts and ideas by interpreting, exemplifying, classifying, inferring, summarizing, comparing and explaining main ideas with own words. | Ask, Classify, Compare, Contrast, Demonstrate, Describe, Extend, Differentiate, Distinguish, Discuss, Express, Explain, Group, Illustrate, Infer, Interpret, Outline, Paraphrase, Rephrase, Relate, Show, Summarize, Select, Translate, Restate etc. |
| | Applying (Application) $L_3 - Apply$ | Students solve problems in new situations by applying acquired knowledge, facts, techniques and rules in a different way. | Calculate, Predict, Apply, Solve, Illustrate, Use, Demonstrate, Determine, Model, Build, Construct, Develop, Experiment With, Identify, Make Use Of, Organize, Plan, Select etc. |
| **Higher order thinking skills (HOTS)** | Analysing (Analysis) $L_4 - Anlyse$ | Students are able to examine and break information into component parts by identifying motives, causes arrangement, logic and semantics. They can make inferences and find evidence to support generalization. | Analyse, Assume, Break Down, Classify, Categorize, Conclusion, Compare, Contrast, Diagram, Discover, Dissect, Distinguish, Divide, Examine, Function, Illustrate, Inference, Inspect, List, Motive, Outline, Relationships, Simplify, Survey, Take Part In, Test For etc. |
| | Evaluating (Evaluation) $L_5 - Evlute$ | Students are able to present and defend opinions by making judgments about information, validity of ideas, or quality of work based on a set of criteria. They can justify a decision or course of action. | Agree, Appraise, Assess, Award, Build, Create, Compose, Choose, Compare, Conclude, Criteria, Criticize, Design, Derive, Develop, Decide, Deduct, Determine, Disprove, Defend, Estimate, Formulate, Generate, Invent, Modify, Evaluate, Explain, Influence, Judge, Interpret, Justify, Mark, Measure, Perceive, Rate, Prioritize, Recommend, Rule On, Select, Support, Value etc. |
| | Creating (Synthesis) $L_6 - Create$ | Students are able to compile, generate or view information, ideas or products together in a different way by combining elements in a new pattern or by proposing alternative solutions. Also, use information to form a unique product. This requires creativity and originality. | Assemble, Adapt, Anticipate, Build, Change, Choose, Combine, Collaborate, Collect, Create, Compile, Compose, Construct, Delete, Design, Develop, Discuss, Develop, Devise, Elaborate, Estimate, Formulate, Happen, Hypothesize, Imagine, Improve, Invent, Imagine, Intervene, Make Up, Maximize, Modify, Originate, Plan, Predict, Propose, Rearrange, Solve, Suppose, Substitute, Test etc. |

**Graduate attributes:** Graduate attributes are the qualities, skills and understandings a university community agrees its students should develop during their time with the institution. These attributes include but go beyond the disciplinary expertise or technical knowledge that has traditionally formed the core of most university courses. They are qualities that also prepare graduates as agents of social good in an unknown future.

Bowden, Hart, King, Trigwell & Watts (2000)

**B.E ELECTRICAL AND ELECTRONICS ENGINEERING (EEE)**
**CHOICE BASED CREDIT SYSTEM (CBCS)**
**SEMESTER - III**

**ENGINEERING MATHEMATICS -III**

| | | | |
|---|---|---|---|
| Subject Code | 15MAT31 | IA Marks | 20 |
| Number of Lecture Hours/Week | 04 | Exam Hours | 03 |
| Total Number of Lecture Hours | 50 | Exam Marks | 80 |

**Credits - 04**

**Course objectives:**

| **Module-1** | **Teaching Hours** |
|---|---|
| | **10** |
| **Revised Bloom's Taxonomy Level** | |
| **Module-2** | |
| | **10** |
| **Revised Bloom's Taxonomy Level** | |
| **Module-3** | |
| | **10** |
| **Revised Bloom's Taxonomy Level** | |

| 15MAT31 ENGINEERING MATHEMATICS –III (continued)<br>CHOICE BASED CREDIT SYSTEM (CBCS) | |
|---|---|
| **Module-4** | **Teaching Hours** |
| | **10** |
| **Revised Bloom's Taxonomy Level** | |
| **Module-5** | |
| | **10** |
| **Revised Bloom's Taxonomy Level** | |
| | |
| **Course outcomes:**<br>At the end of the course the student will be able to: | |
| **Graduate Attributes (As per NBA)** | |
| **Question paper pattern:** | |
| **Text/Reference Books** | |

| | | | | |
|---|---|---|---|---|
| 1 | Title | Authors | Publisher | Edition Year |
| 2 | | | | |
| 3 | | | | |
| 4 | | | | |
| 5 | | | | |
| 6 | | | | |

**B.E ELECTRICAL AND ELECTRONICS ENGINEERING (EEE)**
**CHOICE BASED CREDIT SYSTEM (CBCS)**
**SEMESTER - III**

**ELECTRIC CIRCUIT ANALYSIS**

| | | | |
|---|---|---|---|
| Subject Code | 15EE32 | IA Marks | 20 |
| Number of Lecture Hours/Week | 04 | Exam Hours | 03 |
| Total Number of Lecture Hours | 50 | Exam Marks | 80 |

**Credits - 04**

**Course objectives:**

- To familiarize the basic laws, theorems and the methods of analysing electrical circuits.
- To explain the concept of coupling in electric circuits and resonance.
- To familiarize the analysis of three-phase circuits
- To analyze the transient response of circuits with dc and sinusoidal ac input
- To impart basic knowledge on network analysis using Laplace transforms.

| **Module-1** | | **Teaching Hours** |
|---|---|---|
| **Basic Concepts:** Active and passive elements, Concept of ideal and practical sources. Magnetically coupled circuits. Source transformation and Source shifting, Concept of Super Mesh and Super node analysis. Analysis of networks by (i) Network reduction method including star – delta transformation, (ii) Mesh and Node voltage methods for ac and dc circuits with independent and dependent sources. Equilibrium equations using KCL and KVL, Duality.<br>**Resonant Circuits:** Analysis of simple series RLC and parallel RLC circuits under resonances. Resonant frequency, Bandwidth and Quality factor at resonance. Practical RL-RC circuits. ■ | | **10** |
| **Revised Bloom's Taxonomy Level** | $L_1$ – Remembering, $L_2$ – Understanding, $L_3$ – Applying, $L_4$ – Analysing. | |
| **Module-2** | | |
| **Network Theorems:** Analysis of networks, with and without dependent ac and dc sources by Thevenin's and Norton's theorems. Analysis of ac and dc circuits for maximum power transfer to resistive and complex loads. Application of Millman's theorem and Super Position theorem to multisource networks. Reciprocity theorem and its application. ■ | | **10** |
| **Revised Bloom's Taxonomy Level** | $L_1$ – Remembering, $L_2$ – Understanding, $L_3$ – Applying, $L_4$ – Analysing. | |
| **Module-3** | | |
| **Transient Analysis:** Review of ordinary linear nonhomogeneous first and second order differential equations with constant coefficients. Transient analysis of ac and dc circuits by classical method. Transient analysis of dc and ac circuits. Behaviour of circuit elements under switching action $(t = 0 \text{ and } t = \infty)$. Evaluation of initial conditions. ■ | | **10** |
| **Revised Bloom's Taxonomy Level** | $L_2$ – Understanding, $L_3$ – Applying, $L_4$ – Analysing, $L_5$ – Evaluating. | |
| **Module-4** | | |
| **Laplace Transformation:** Laplace transformation (LT), LT of Impulse, Step, Ramp, Sinusoidal signals and shifted functions. Waveform synthesis. Initial and Final value theorems. Laplace Transform of network and time domain solution for RL, RC and RLC networks for ac and dc excitations. ■ | | **10** |
| **Revised Bloom's Taxonomy Level** | $L_1$ – Remembering, $L_2$ – Understanding, $L_3$ – Applying, $L_4$ – Analysing. | |

**15EE32 ELECTRIC CIRCUIT ANALYSIS (continued)**
**CHOICE BASED CREDIT SYSTEM (CBCS)**

| **Module-5** | **Teaching Hours** |
|---|---|
| **Unbalanced Three phase systems:** Analysis of three phase systems, calculation of real and reactive powers.<br>**Two Port networks:** Definition, Open circuit impedance, Short circuit admittance and Transmission parameters and their evaluation for simple circuits. Network functions of one port and two port networks, properties of poles and zeros of network functions.<br>**Complex Wave analysis:** Analysis of simple circuits with non-sinusoidal excitation. ■ | **10** |
| **Revised Bloom's Taxonomy Level** $L_1$ – Remembering, $L_2$ – Understanding, $L_3$ – Applying, $L_4$ – Analysing. | |

**Course outcomes:**
At the end of the course the student will be able to:

- Apply knowledge of mathematics, science, and engineering to the analysis and design of electrical circuits.
- Identify, formulate, and solve engineering problems in the area circuits and systems.
- Analyze the solution and infer the authenticity of it.

**Graduate Attributes (As per NBA)**
Engineering Knowledge
Problem analysis

**Question paper pattern:**

- The question paper will have ten questions.
- Each full question is for 16 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.

**Text/Reference Books**

| | | | | |
|---|---|---|---|---|
| 1 | Engineering Circuit Analysis | William H Hayt et al | Mc Graw Hill | 8th Edition,2014 |
| 2 | Engineering Circuit Analysis | J David Irwin et al | Wiley India | 10th Edition,2014 |
| 3 | Fundamentals of Electric Circuits | Charles K Alexander<br>Matthew N O Sadiku | Mc Graw Hill | 5th Edition,2013 |
| 4 | Network Analysis | M.E. Vanvalkenburg | Pearson | 3rd Edition,2014 |
| 5 | Electric Circuits | Mahmood Nahvi | Mc Graw Hill | 5th Edition,2009 |
| 6 | Introduction to Electric Circuits | Richard C Dorf and<br>James A Svoboda | Wiley | $9^{th}$ Edition,2015 |
| 7 | Circuit Analysis; Theory and Practice | Allan H Robbins<br>Wilhelm C Miller | Cengage | $5^{th}$ Edition,2013 |

**B.E ELECTRICAL AND ELECTRONICS ENGINEERING (EEE)**
**CHOICE BASED CREDIT SYSTEM (CBCS)**
**SEMESTER - III**

**TRANSFORMERS AND GENERATORS**

| | | | |
|---|---|---|---|
| Subject Code | 15EE33 | IA Marks | 20 |
| Number of Lecture Hours/Week | 04 | Exam Hours | 03 |
| Total Number of Lecture Hours | 50 | Exam Marks | 80 |

**Credits - 04**

**Course objectives:**

- To understand the concepts of transformers and their analysis.
- To suggest a suitable three phase transformer connection for a particular operation.
- To understand the concepts of generator and to evaluate their performance.
- To explain the requirement for the parallel operation of transformers and synchronous generators.

| **Module-1** | **Teaching Hours** |
|---|---|
| **Single phase Transformers:** Review of Principle of operation, constructional details of shell type and core type single-phase transformers, EMF equation, losses and commercial efficiency, conditions for maximum efficiency (No question shall be set from the review portion). Salient features of ideal transformer, operation of practical transformer under no - load and on - load with phasor diagrams. Equivalent circuit, Open circuit and Short circuit tests, calculation of equivalent circuit parameters and predetermination of efficiency- commercial and all-day. Voltage regulation and its significance.<br>**Three-phase Transformers:** Introduction, Constructional features of three-phase transformers. Choice between single unit three-phase transformer and a bank of three single-phase transformers. Transformer connection for three phase operation – star/star, delta/delta, star/delta, zigzag/star and V/V, choice of connection. Phase conversion - Scott connection for three-phase to two-phase conversion. Labelling of three-phase transformer terminals, vector groups. Equivalent circuit of three phase transformers. ■ | **10** |
| **Revised Bloom's Taxonomy Level**: $L_1$ – Remembering, $L_2$ – Understanding, $L_3$ – Applying, $L_4$ – Analysing. | |
| **Module-2** | |
| **Parallel Operation of Transformers:** Necessity of Parallel operation, conditions for parallel operation – Single phase and three phase. Load sharing in case of similar and dissimilar transformers.<br>**Auto transformers and Tap changing transformers:** Introduction to auto transformer - copper economy, equivalent circuit, three phase auto connection and voltage regulation. Voltage regulation by tap changing – off circuit and on load.<br>**Tertiary winding Transformers:** Necessity of tertiary winding, equivalent circuit and voltage regulation, tertiary winding in star/star transformers, rating of tertiary winding. ■ | **10** |
| **Revised Bloom's Taxonomy Level**: $L_2$ – Understanding, $L_3$ – Applying, $L_4$ – Analysing. | |
| **Module-3** | |
| **Transformers (continuation):** Cause and effects of harmonics, Current inrush in transformers, noise in transformers. Objects of testing transformers, polarity test, Sumpner's test.<br>**Direct current Generator –** Review of construction, types, armature windings, relation between no load and terminal voltage (No question shall be set from the review portion). Armature reaction, Commutation and associated problems, no load and full load characteristics. Reasons for reduced dependency on dc generators. | **10** |

**15EE33 TRANSFORMERS AND GENERATORS (continued)**
**CHOICE BASED CREDIT SYSTEM (CBCS)**

| **Module-3 (continued)** | | **Teaching Hours** |
|---|---|---|
| **Synchronous generators-** Review of construction and operation of salient & non-salient pole synchronous generators (No question shall be set from the review portion). Armature windings, winding factors, emf equation. Harmonics – causes, reduction and elimination. Armature reaction, Synchronous reactance, Equivalent circuit. ■ | | |
| **Revised Bloom's Taxonomy Level** | $L_2$ – Understanding, $L_3$ – Applying, $L_4$ – Analysing, $L_5$ – Evaluating. | |
| **Module-4** | | |
| **Synchronous generators (continuation):** Generator load characteristic. Voltage regulation, excitation control for constant terminal voltage. Generator input and output. Parallel operation of generators and load sharing. Synchronous generator on infinite bus-bars – General load diagram, Electrical load diagram, mechanical load diagram, O – curves and V – curves. Power angle characteristic and synchronizing power. **Synchronous generators (continuation):** Effects of saliency, two-reaction theory, Direct and Quadrature reactance, power angle diagram, reluctance power, slip test. ■ | | **10** |
| **Revised Bloom's Taxonomy Level** | $L_1$ – Remembering, $L_2$ – Understanding, $L_3$ – Applying, $L_4$ – Analysing. | |
| **Module-5** | | |
| **Synchronous generators (continuation):** Open circuit and short circuit characteristics, Assessment of reactance- short circuit ratio, synchronous reactance, adjusted synchronous reactance and Potier reactance. Voltage regulation by EMF, MMF, ZPF and ASA methods. **Performance of synchronous generators:** Capability curve for large turbo generators and salient pole generators. Starting, synchronizing and control. Hunting and dampers. ■ | | **10** |
| **Revised Bloom's Taxonomy Level** | $L_1$ – Remembering, $L_2$ – Understanding, $L_3$ – Applying, $L_4$ – Analysing. | |

**Course outcomes:**
At the end of the course the student will be able to:

- Explain the construction and operation and performance of transformers.
- Explain different connections for the three phase operations, their advantages and applications.
- Explain the construction and operation of Synchronous machines and evaluate the regulation of synchronous machines by different methods.
- Analyze the operation of the synchronous machine connected to infinite machine.

**Graduate Attributes (As per NBA)**
Engineering Knowledge
Problem analysis

**Question paper pattern:**

- The question paper will have ten questions.
- Each full question is for 16 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module. ■

| 15EE33 TRANSFORMERS AND GENERATORS (continued)<br>CHOICE BASED CREDIT SYSTEM (CBCS) | | | | |
|---|---|---|---|---|
| **Text/Reference Books** | | | | |
| 1 | Electric Machines | D. P. Kothari,<br>I. J. Nagrath | Mc Graw Hill | 4th Edition, 2011 |
| 2 | Performance and Design of A.C. Machines | M. G. Say | CBS Publishers | 3rd Edition, 2002 |
| 3 | Principles of Electric Machines and power Electronics | P.C.Sen | Wiley | 2nd Edition, 2013 |
| 4 | Electric Machines | Mulukuntla S.Sarma, at el | Cengage Learning | 1st Edition, 2009 |
| 5 | Electrical Machines, Drives and Power systems | Theodore Wildi | Pearson | 6th Edition, 2014 |
| 6 | Electrical Machines | M.V. Deshpande | PHI Learning | 1st Edition, 2013 |
| 7 | Electrical Machines | Abhijit Chakrabarti et al | Mc Graw Hill | 1st Edition, 2015 |
| 8 | A Textbook of Electrical Machines | K.R.Siddapura D.B.Raval | Vikas Publishing House Pvt Ltd | 1st Edition, 2014 |

**B.E ELECTRICAL AND ELECTRONICS ENGINEERING (EEE)**
**CHOICE BASED CREDIT SYSTEM (CBCS)**
**SEMESTER - III**

**ANALOG ELECTRONIC CIRCUITS**

| | | | |
|---|---|---|---|
| Subject Code | 15EE34 | IA Marks | 20 |
| Number of Lecture Hours/Week | 04 | Exam Hours | 03 |
| Total Number of Lecture Hours | 50 | Exam Marks | 80 |

**Credits - 04**

**Course objectives:**

- Provide the knowledge for the analysis of transistor circuits.
- Develop skills to design the basic electronic circuits like amplifiers and oscillators.
- Highlight the importance of FET and MOSFET

| **Module-1** | **Teaching Hours** |
|---|---|
| **Diode Circuits:** Review of diodes as rectifiers (No question shall be set from review portion). Diode clipping and clamping circuits.<br>**Transistor biasing and stabilization**: Operating point, analysis and design of fixed bias circuit, self-bias circuit, Emitter stabilized bias circuit, voltage divider bias circuit, stability factor of different biasing circuits. Problems.<br>**Transistor switching circuits:** Transistor switching circuits, PNP transistors, thermal compensation techniques. ■ | **10** |
| **Revised Bloom's Taxonomy Level**: $L_1$ – Remembering, $L_2$ – Understanding, $L_3$ – Applying. | |
| **Module-2** | |
| **Transistor at low frequencies:** BJT transistor modelling, CE fixed bias configuration, voltage divider bias, emitter follower, CB configuration, collector feedback configuration, analysis using h – parameter model, relation between h – parameters model of CE, CC and CB modes, Millers theorem and its dual.<br>**Transistor frequency response:** General frequency considerations, low frequency response, Miller effect capacitance, high frequency response, multistage frequency effects. ■ | **10** |
| **Revised Bloom's Taxonomy Level**: $L_2$ – Understanding, $L_3$ – Applying, $L_4$ – Analysing, $L_5$ – Evaluating. | |
| **Module-3** | |
| **Multistage amplifiers:** Cascade and cascode connections, Darlington circuits, analysis and design.<br>**Feedback amplifiers:** Feedback concept, different types, practical feedback circuits, analysis and design of feedback circuits. ■ | **10** |
| **Revised Bloom's Taxonomy Level**: $L_1$ – Remembering, $L_2$ – Understanding, $L_3$ – Applying, $L_4$ – Analysing. | |
| **Module-4** | |
| **Power amplifiers**: Amplifier types, analysis and design of different power amplifiers, distortion in power amplifiers.<br>**Oscillators:** Principle of operation, analysis and derivation of frequency of oscillation of phase shift oscillator, Wien bridge oscillator, RF and crystal oscillator and frequency stability. ■ | **10** |
| **Revised Bloom's Taxonomy Level**: $L_1$ – Remembering, $L_2$ – Understanding, $L_3$ – Applying, $L_4$ – Analysing. | |

**15EE34 ANALOG ELECTRONIC CIRCUITS (continued)**
**CHOICE BASED CREDIT SYSTEM (CBCS)**

| **Module-5** | **Teaching Hours** |
|---|---|
| **FETs:** Construction, working and characteristics of JFET and MOSFET. Biasing of JFET and MOSFET, JFET and MOSFET amplifiers, analysis and design. ■ | **10** |
| **Revised Bloom's Taxonomy Level** | $L_1$ – Remembering, $L_2$ – Understanding, $L_3$ – Applying, $L_4$ – Analysing. |

**Course outcomes:**
At the end of the course the student will be able to:

- Utilize the characteristics of transistor for different applications.
- Design and analyze biasing circuits for transistor.
- Design, analyze and test transistor circuitry as amplifiers and oscillators.

**Graduate Attributes (As per NBA)**
Engineering Knowledge
Problem Analysis
Modern tool usage
Ethics

**Question paper pattern:**

- The question paper will have ten questions.
- Each full question is for 16 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module. ■

**Text/Reference Books**

| | | | | |
|---|---|---|---|---|
| 1 | Electronic Devices and Circuit Theory | Robert L Boylestad Louis Nashelsky | Pearson | 11th Edition, 2015 |
| 2 | Integrated Electronics, Analysis and Digital Circuits and Systems | Jacob Millman et al | Mc Graw Hill | 2nd Edition, 2009 |
| 3 | Electronic Devices and Circuits | David A Bell | Oxford University Press | 5th Edition, 2008 |
| 4 | Microelectronics Circuits Analysis and Design | Muhammad Rashid | Cengage Learning | 2nd Edition, 2014 |
| 5 | A Text Book of Electrical Technology, Electronic Devices and Circuits | B.L. Theraja, A.K. Theraja, | S. Chand | Reprint, 2013 |
| 6 | Electronic Devices and Circuits | Anil K. Maini Vasha Agarval | Wiley | 1st Edition, 2009 |
| 7 | Electronic Devices and Circuits | S.Salivahanan N.Suresh | Mc Graw Hill | 3rd Edition, 2013 |
| 8 | Fundamentals of Analog Circuits | Thomas L Floyd | Pearson | 2nd Edition, 2012 |

**B.E ELECTRICAL AND ELECTRONICS ENGINEERING (EEE)**
**CHOICE BASED CREDIT SYSTEM (CBCS)**
**SEMESTER - III**

**DIGITAL SYSTEM DESIGN**

| | | | |
|---|---|---|---|
| Subject Code | 15EE35 | IA Marks | 20 |
| Number of Lecture Hours/Week | 04 | Exam Hours | 03 |
| Total Number of Lecture Hours | 50 | Exam Marks | 80 |

**Credits - 04**

**Course objectives:**

- To impart the knowledge of combinational circuit design.
- To impart the knowledge of Sequential circuit design.
- To provide the basic knowledge about VHDL & its use.

| **Module-1** | **Teaching Hours** |
|---|---|
| **Principles of combinational logic**: Definition of combinational, canonical forms, Generation of switching equations from truth tables, Karnaugh maps-3, 4 and 5 variables. Incompletely specified functions (Don't care terms). Simplifying max - term equations. Quine -McClusky minimization technique, Quine - McClusky using don't care terms, Reduced Prime Implicant tables, Map entered variables. ■ | **10** |
| **Revised Bloom's Taxonomy Level**: $L_1$ – Remembering, $L_2$ – Understanding, $L_3$ – Applying. | |
| **Module-2** | |
| **Analysis and design of Combinational Logic:** General approach, Decoders-BCD decoders, Encoders. Digital multiplexers-using multiplexers as Boolean function generators. Adders and Subtractors-Cascading full adders, Look ahead carry, Binary comparators. Design methods of building blocks of combinational logics.■ | **10** |
| **Revised Bloom's Taxonomy Level**: $L_1$ – Remembering, $L_2$ – Understanding, $L_3$ – Applying, $L_4$ – Analysing. | |
| **Module-3** | |
| **Sequential Circuits**: Basic Bistable element, Latches, SR latch, application of SR latch, A Switch debouncer, The SR latch, The gated SR latch. The gated D Latch, The Master-Slave Flip-Flops (Pulse-Triggered Flip-Flops): The master-slave SR Flip-Flops, The master-slave JK Flip-Flop, Edge Triggered Flip-flop: The Positive Edge-Triggered D Flip-Flop, Negative-Edge Triggered D Flip-Flop. Characteristic equations, Registers, Counters-Binary Ripple Counter, Synchronous Binary counters, Counters based on Shift Registers, Design of a Synchronous counters, Design of a Synchronous Mod-6 counters using clocked JK Flip-Flops Design of a Synchronous Mod-6 counter using clocked D, T, or SR Flip-Flops. ■ | **10** |
| **Revised Bloom's Taxonomy Level**: $L_1$ – Remembering, $L_2$ – Understanding, $L_3$ – Applying, $L_4$ – Analysing. | |
| **Module-4** | |
| **Sequential Design:** Introduction, Mealy and Moore models, State machine notation, synchronous sequential circuit analysis and design. Construction of state Diagrams, Counters Design. ■ | **10** |
| **Revised Bloom's Taxonomy Level**: $L_1$ – Remembering, $L_2$ – Understanding, $L_3$ – Applying, $L_4$ – Analysing. | |

**15EE35 DIGITAL SYSTEM DESIGN (continued)**
**CHOICE BASED CREDIT SYSTEM (CBCS)**

| **Module-5** | **Teaching Hours** |
|---|---|
| **HDL:** Introduction, A brief history of HDL, Structure of HDL Module, Operators, Data types, Types of Descriptions, Simulation and synthesis, Brief comparison of VHDL and Verilog.<br>**Data-Flow Descriptions**: Highlights of Data flow descriptions, Structure of data-flow description, Data type-vectors. ■ | **10** |
| **Revised Bloom's Taxonomy Level** $L_1$ – Remembering, $L_2$ – Understanding, $L_3$ – Applying. | |

**Course outcomes:**
At the end of the course the student will be able to:
- Design and analyze combinational & sequential circuits
- Design circuits like adder, sub tractor, code converter etc.
- Understand counters and sequence generators.

**Graduate Attributes (As per NBA)**
Engineering Knowledge
Problem Analysis
Modern tool usage
Ethics

**Question paper pattern:**
- The question paper will have ten questions.
- Each full question is for 16 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module. ■

**Text/Reference Books**

| | | | | |
|---|---|---|---|---|
| 1 | Digital Logic Applications and Design | John M Yarbrough | Cengage Learning | 2011 |
| 2 | Digital Principles and Design | Donald D Givone | McGraw Hill Education | 1st Edition, |
| 3 | Logic and computer design Fundamentals | M. Morries Mano and Charles Kime | Pearson Learning | 4th Edition, 2014 |
| 4 | Fundamentals of logic design | Charles H Roth, JR and Larry L. Kinney | Cengage Learning | 6th Edition, |
| 5 | Fundamentals of Digital Circuits | A. Anand Kumar | PHI | 3rd Edition, |
| 6 | Digital Logic Design and VHDL | A.A.Phadke S.M.Deokar | Wiley India | 1st Edition, |
| 7 | Digital Circuits and Design | D.P.Kothari J.S.Dhillon | Pearson | First Print |
| 8 | HDL Programming (VHDL and Verilog) | Nazeih M. Botros | Cengage Learning | 1st Edition, |
| 9 | Circuit Design and Simulation with VHDL | Volnei A Pedroni | PHI | 2nd Edition, |

**B.E ELECTRICAL AND ELECTRONICS ENGINEERING (EEE)**
**CHOICE BASED CREDIT SYSTEM (CBCS)**
**SEMESTER - III**

**POWER GENERATION AND ECONOMICS (ELECTIVE)**

| | | | |
|---|---|---|---|
| Subject Code | 15EE361 | IA Marks | 20 |
| Number of Lecture Hours/Week | 03 | Exam Hours | 03 |
| Total Number of Lecture Hours | 40 | Exam Marks | 80 |

**Credits - 03**

**Course objectives:**

- Explain the arrangement and operation of hydroelectric, steam, diesel, gas turbine and nuclear power plants and working of major equipment in the plants.
- Classification of substation and explain the operation of different substation equipment.
- Explain the importance of grounding and different grounding methods used in practice.

| **Module-1** | **Teaching Hours** |
|---|---|
| **Hydroelectric Power Plants:** Hydrology, run off and stream flow, hydrograph, flow duration curve, Mass curve, reservoir capacity, dam storage. Hydrological cycle, merits and demerits of hydroelectric power plants, Selection of site. General arrangement of hydel plant, elements of the plant, Classification of the plants based on water flow regulation, water head and type of load the plant has to supply. Water turbines – Pelton wheel, Francis, Kaplan and propeller turbines. Characteristic of water turbines Governing of turbines, selection of water turbines. Underground, small hydro and pumped storage plants. Choice of size and number of units, plant layout and auxiliaries. ■ | **08** |
| **Revised Bloom's Taxonomy Level**: $L_1$ – Remembering, $L_2$ – Understanding. | |
| **Module-2** | |
| **Steam Power Plants:** Introduction, Efficiency of steam plants, Merits and demerits of plants, selection of site. Working of steam plant, Power plant equipment and layout, Steam turbines, Fuels and fuel handling, Fuel combustion and combustion equipment , Coal burners, Fluidized bed combustion, Combustion control, Ash handling, Dust collection, Draught systems, Feed water, Steam power plant controls, plant auxiliaries.<br>**Diesel Power Plant:** Introduction, Merits and demerits, selection site, elements of diesel power plant, applications.<br>**Gas Turbine Power Plant**: Introduction, Merits and demerits, selection site, Fuels for gar turbines, Elements of simple gas turbine power plant, Methods of improving thermal efficiency of a simple steam power plant, Closed cycle gas turbine power plants. Comparison of gas power plant with steam and diesel power plants. ■ | **08** |
| **Revised Bloom's Taxonomy Level**: $L_1$ – Remembering, $L_2$ – Understanding. | |
| **Module-3** | |
| **Nuclear Power Plants:** Introduction, Economics of nuclear plants, Merits and demerits, selection of site, Nuclear reaction, Nuclear fission process, Nuclear chain reaction, Nuclear energy, Nuclear fuels, Nuclear plant and layout, Nuclear reactor and its control, Classification of reactors, power reactors in use, Effects of nuclear plants, Disposal of nuclear waste and effluent, shielding. ■ | **08** |
| **Revised Bloom's Taxonomy Level**: $L_1$ – Remembering, $L_2$ – Understanding. | |

**15EE361 POWER GENERATION AND ECONOMICS (ELECTIVE) (continued)**
**CHOICE BASED CREDIT SYSTEM (CBCS)**

| **Module-4** | **Teaching Hours** |
|---|---|
| **Substations:** Introduction to Substation equipment; Transformers, High Voltage Fuses, High Voltage Circuit Breakers and Protective Relaying, High Voltage Disconnect Switches, Lightning Arresters, High Voltage Insulators and Conductors, Voltage Regulators, Storage Batteries, Reactors, Capacitors, Measuring Instruments, and power line carrier communication equipment. Classification of substations – indoor and outdoor, Selection of site for substation, Busbar arrangement schemes and single line diagrams of substations. Interconnection of power stations. Introduction to gas insulated substation, Advantages and economics of Gas insulated substation.<br>**Grounding:** Introduction, Difference between grounded and ungrounded system. System grounding – ungrounded, solid grounding, resistance grounding, reactance grounding, resonant grounding. Earthing transformer. Neutral grounding and neutral grounding transformer. ■ | **08** |
| **Revised Bloom's Taxonomy Level**: $L_1$ – Remembering, $L_2$ – Understanding. | |

| **Module-5** | |
|---|---|
| **Economics:** Introduction, Effect of variable load on power system, classification of costs, Cost analysis. Interest and Depreciation, Methods of determination of depreciation, Economics of Power generation, different terms considered for power plants and their significance, load sharing. Choice of size and number of generating plants. Tariffs, objective, factors affecting the tariff, types. Types of consumers and their tariff. Power factor, disadvantages, causes, methods of improving power factor, Advantages of improved power factor, economics of power factor improvement and comparison of methods of improving the power factor. Choice of equipment. ■ | **08** |
| **Revised Bloom's Taxonomy Level**: $L_1$ – Remembering, $L_2$ – Understanding, $L_3$ – Applying, $L_4$ – Analysing. | |

**Course outcomes:**
At the end of the course the student will be able to:

- Describe the working of hydroelectric, steam, nuclear power plants and state functions of major equipment of the power plants
- Classify various substations and explain the importance of grounding.
- Understand the economic aspects of power system operation and its effects.
- Explain the importance of power factor improvement.

**Graduate Attributes (As per NBA)**
Engineering Knowledge
Problem analysis
Engineers and Society
Environment and Sustainability

**Question paper pattern:**

- The question paper will have ten questions.
- Each full question is for 16 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module. ■

| 15EE361 POWER GENERATION AND ECONOMICS (ELECTIVE) (continued)<br>CHOICE BASED CREDIT SYSTEM (CBCS) | | | | |
|---|---|---|---|---|
| **Text/Reference Books** | | | | |
| 1 | A Course in Power Systems | J.B. Gupta | Katson | 2008 |
| 2 | Generation of Electrical Energy | B.R.Gupta | S. Chand | 2015 |
| 3 | Electrical power Generation, Transmission and Distribution | S.N. Singh | PHI | 2nd Edition, 2009 |
| 4 | Power Plant Engineering | P.K. Nag | Mc Graw Hill | 4th Edition, 2014 |
| 5 | Electrical Power Distribution Systems | V. Kamaraju | Mc Graw Hill | 1st Edition, 2009 |
| 6 | Electrical Distribution Engineering | Anthony J. Pansini | CRC Press | 3rd Edition, 2006 |
| 7 | Electrical Distribution Systems | Dale R Patrick Et al | CRC Press | 2nd Edition, 2009 |
| 8 | A Text Book on Power System Engineering | A.Chakrabarti, et al | Dhanpath Rai | 2nd Edition, 2010 |

| B.E ELECTRICAL AND ELECTRONICS ENGINEERING (EEE)<br>CHOICE BASED CREDIT SYSTEM (CBCS)<br>SEMESTER - III | | | |
|---|---|---|---|
| **ELECTRICAL ENGINEERING MATERIALS (ELECTIVE)** | | | |
| Subject Code | 15EE362 | IA Marks | 20 |
| Number of Lecture Hours/Week | 03 | Exam Hours | 03 |
| Total Number of Lecture Hours | 40 | Exam Marks | 80 |
| **Credits - 03** | | | |

**Course objectives:**

- To impart the knowledge of conducting, dielectric, insulating and magnetic materials and their applications.
- To impart the knowledge of superconducting materials and their applications
- To impart the knowledge of plastics and materials for Opto - Electronic devices

| **Module-1** | **Teaching Hours** |
|---|---|
| **Introduction to Electrical and Electronic Materials:** Importance of materials, Classification of electrical and electronic materials, Scope of electrical and electronic materials, Requirement of Engineering materials, Operational requirements of electrical and electronic materials, Classification of solids on the basis of energy gap, Products – working principle and materials, Types of engineering materials, Levels of material structure. Spintronics and Spintronic materials, Ferromagnetic semiconductors, Left handed materials.<br>**Conductors:** Conductor materials, Factors affecting conductivity, Thermal conductivity, Heating effect of current, Thermoelectric effect, Seebeck effect, Thomson effect, Wiedemann – Franz law and Lorentz relation, Problems. | **08** |
| **Revised Bloom's Taxonomy Level** $L_1$ – Remembering, $L_2$ – Understanding. | |
| **Module-2** | |

| | | |
|---|---|---|
| **Conductive Materials and Applications:** Mechanically processed forms of electrical materials, Types of conducting materials, Low resistivity materials, High resistivity materials, Contact materials, Fusible materials, Filament materials, Carbon as filamentary and brush material, Material for conductors, cables, wires, solder, sheathing and sealing. **Dielectrics:** Introduction to dielectric materials, classification of dielectric materials, Dielectric constant, Dielectric strength and Dielectric loss. Polarization, Mechanisms of polarization, Comparison of different polarization process, Factors affecting polarization, Spontaneous polarization, Behaviour of polarization under impulse and frequency switching, Decay and build-up of polarization under ac field, Complex dielectric constant. ■ | | **08** |
| **Revised Bloom's Taxonomy Level** | $L_1$ – Remembering, $L_2$ – Understanding. | |
| **Module-3** | | |
| **Insulating Materials:** Insulating materials and applications – Ceramic, Mica, Porcelain, Glass, Micanite and Glass bonded mica. Polymeric materials – Bakelite, Polyethylene. Natural and synthetic rubber. Paper. Choice of solid insulating material for different applications, Liquid insulating materials – Requirements, Transformer oil, Bubble theory, Aging of mineral insulating oils. Gaseous insulating Materials – Air, Nitrogen, Vacuum. | | **08** |

**15EE362 ELECTRICAL ENGINEERING MATERIALS (ELECTIVE) (continued)**
**CHOICE BASED CREDIT SYSTEM (CBCS)**

| **Module-3 (continued)** | | **Teaching Hours** |
|---|---|---|
| **Magnetic Materials:** Origin of permanent magnetic dipole, Magnetic terminology, Relation between relative permeability and magnetic susceptibility. Classification of magnetic materials, Diamagnetic, Paramagnetism, Ferromagnetism, Antiferromagnetism and the corresponding materials. Ferrimagnetism and ferrites – properties and applications, Soft and hard ferrites. Curie temperature, Laws of magnetic materials. Magnetization curve, Initial and maximum permeability. Hysteresis loop and loss, Eddy current loss. ■ | | |
| **Revised Bloom's Taxonomy Level** | $L_1$ – Remembering, $L_2$ – Understanding. | |
| **Module-4** | | |
| **Magnetic Materials (continued):** Types of magnetic materials, Soft and hard magnetic materials, High energy magnetic materials, Commercial grade soft and hard magnetic materials.<br>**Superconductive Materials:** Concept of superconductors, Meaning of phenomenon of superconductivity, Properties of superconductors, Types of superconductors, Critical magnetic field and critical temperature, Effects of Isotopic mass on critical temperature, Silsbee rule, Depth of penetration and coherence length. Ideal and Hard superconductors, Mechanism of superconduction, London's theory for Type I superconductors, GLAG theory for Type I superconductors, BCS theory, Applications and limitations. Applications of high temperature superconductors, Superconducting solenoids and magnets, MRI for medical diagnostics. ■ | | **08** |
| **Revised Bloom's Taxonomy Level** | $L_1$ – Remembering, $L_2$ – Understanding. | |
| **Module-5** | | |
| **Plastics:** Introduction, Thermoplastics, Rubbers, Thermosets, DC and AC properties, Mechanical properties and processing of plastic.<br>**Materials for Opto – Electronic Devices:** Introduction, Optical phenomena, Reflection, Refraction, Transmittivity, Scattering, Optical absorption, Optical properties of non-metals, Optical properties of metals, Optical properties of semiconductors, Optical properties of insulators. Luminescence, Opto – Electronic devices, Photoconductivity, Photoconductive cell. ■ | | **08** |
| **Revised Bloom's Taxonomy Level** | $L_1$ – Remembering, $L_2$ – Understanding. | |

**Course outcomes:**
At the end of the course the student will be able to:

- Explain the properties of conducting materials, semi conducting materials and insulating materials
- Explain the materials used for special applications
- Explain the properties of and applications of Piezoelectric materials , ceramics and plastics

**Graduate Attributes (As per NBA)**
Engineering Knowledge

**Question paper pattern:**

- The question paper will have ten questions.
- Each full question is for 16 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.

- Students will have to answer 5 full questions, selecting one full question from each module.

**15EE362 ELECTRICAL ENGINEERING MATERIALS (ELECTIVE) (continued)**
**CHOICE BASED CREDIT SYSTEM (CBCS)**

**Text/Reference Books**

| | | | | |
|---|---|---|---|---|
| 1 | Advanced Electrical and Electronics Materials; Processes and Applications | K.M. Gupta<br>Nishu Gupta | Wiley | 1st Edition,2015 |
| 2 | Electronic Engineering Materials | R.K. Shukla<br>Archana Singh | Mc Graw Hill | 2012 |
| 3 | Electrical Properties of Materials | L Solymar et al | Oxford | 9th Edition,2014 |
| 4 | Electrical Engineering Materials | A.J. Dekker | pearson | 2016 |
| 5 | An Introduction to Engineering Materials | C.S. Indulkar<br>S. Thruvengadam | S. Chand | 2007, Reprint |
| 6 | Electrical and Electronics Engineering Materials | C.K.Banerjee | PHI | 1st Edition, 2015 |
| 7 | Principle of Electronic Materials and Devices | S.O. Kasap | Mc Graw Hill | 3rd Edition,2010 |

**B.E ELECTRICAL AND ELECTRONICS ENGINEERING (EEE)**
**CHOICE BASED CREDIT SYSTEM (CBCS)**
**SEMESTER - III**

**ELECTRICAL AND ELECTRONIC MEASUREMENTS (ELECTIVE)**

| | | | |
|---|---|---|---|
| Subject Code | 15EE363 | IA Marks | 20 |
| Number of Lecture Hours/Week | 03 | Exam Hours | 03 |
| Total Number of Lecture Hours | 40 | Exam Marks | 80 |

**Credits - 03**

**Course objectives:**

- To understand the concept of units and dimensions.
- To measure resistance, inductance, capacitance by use of different bridges.
- To study the construction and working of various meters used for measurement.

| **Module-1** | **Teaching Hours** |
|---|---|
| **Units and Dimensions:** Review of fundamental and derived units. SI units (No question shall be set from the review portion). Dimensional equations, problems.<br>**Measurement of Resistance:** Wheatstone's bridge, sensitivity, limitations. Kelvin's double bridge. Earth resistance measurement by fall of potential method and by using Megger.<br>**Measurement of Inductance and Capacitance:** Sources and detectors, Maxwell's inductance bridge, Maxwell's inductance and capacitance bridge, Hay's bridge, Anderson's bridge, Desauty's bridge, Schering bridge. Shielding of bridges. Problems. ■ | **08** |
| **Revised Bloom's Taxonomy Level**: $L_1$ – Remembering, $L_2$ – Understanding, $L_3$ – Applying. | |
| **Module-2** | |
| **Measurement of Power, Energy, Power factor and Frequency:** Review of Dynamometer wattmeter construction and operation (No question shall be set from the review portions), Torque expression, Errors and minimization, UPF and LPF wattmeters. Measurement of real and reactive power in 3 phase circuits. Review of Induction type energy meter construction and operation (No question shall be set from the review portions)]. Errors, adjustments and calibration of single and three phase energy meters, Problems. Construction and operation of single-phase and three phase dynamometer type power factor meter. Weston frequency meter and phase sequence indicator. ■ | **08** |
| **Revised Bloom's Taxonomy Level**: $L_1$ – Remembering, $L_2$ – Understanding, $L_3$ – Applying, $L_4$ – Analysing. | |
| **Module-3** | |
| **Extension of Instrument Ranges:** Desirable features of ammeters and voltmeters. Shunts and multipliers. Construction and theory of instrument transformers, Desirable characterises, Errors of CT and PT. Turns compensation, Illustrative examples, Silsbee's method of testing CT.<br>**Magnetic measurements:** Introduction, measurement of flux/ flux density, magnetising force and leakage factor. Hopkinson permeameter. Measurement of iron loss by wattmeter method. A brief discussion on measurement of air gap flux and field strength. ■ | **08** |
| **Revised Bloom's Taxonomy Level**: $L_1$ – Remembering, $L_2$ – Understanding, $L_3$ – Applying, $L_4$ – Analysing. | |

**15EE363 ELECTRICAL AND ELECTRONIC MEASUREMENTS (ELECTIVE) (continued) CHOICE BASED CREDIT SYSTEM (CBCS)**

| **Module-4** | **Teaching Hours** |
|---|---|
| **Electronic and digital Instruments:** Introduction. Essentials of electronic instruments, Advantages of electronic instruments. True rms reading voltmeter. Electronic multimeters. Digital voltmeters (DVM) - Ramp type DVM, Integrating type DVM, Continuous – balance DVM and Successive - approximation DVM. Q meter. Principle of working of electronic energy meter (block diagram treatment), extra features offered by present day meters and their significance in billing. ■ | **08** |
| **Revised Bloom's Taxonomy Level** $L_1$ – Remembering, $L_2$ – Understanding. | |
| **Module-5** | |
| **Display Devices:** Introduction, character formats, segment displays, Dot matrix displays, Bar graph displays. Cathode ray tubes, Light emitting diodes, Liquid crystal displays, Nixes, Incandescent, Fluorescent, Liquid vapour and Visual displays. Display multiplexing and zero suppression.<br>**Recording Devices:** Introduction, Strip chart recorders, Galvanometer recorders, Null balance recorders, Potentiometer type recorders, Bridge type recorders, LVDT type recorders, Circular chart and [illegible] recorders. Magnetic tape recorders, Direct recording, Frequency modulation recording, Pulse duration modulation recording, Digital tape recording, Ultraviolet recorders. Biomedical recorders, Electro Cardio Graph (ECG),Electroencephalograph, Electromyograph. Noise in reproduction. ■ | **08** |
| **Revised Bloom's Taxonomy Level** $L_1$ – Remembering, $L_2$ – Understanding. | |

**Course outcomes:**

At the end of the course the student will be able to:

- Explain the importance of units and dimensions.
- Measure resistance, inductance and capacitance by different methods.
- Explain the working of various meters used for measurement of power and energy.
- Explain the working of different electronic instruments and display devices.

**Graduate Attributes (As per NBA)**

Engineering Knowledge

**Question paper pattern:**

- The question paper will have ten questions.
- Each full question is for 16 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module. ■

| 15EE363 ELECTRICAL AND ELECTRONIC MEASUREMENTS (ELECTIVE) (continued) CHOICE BASED CREDIT SYSTEM (CBCS) | | | | |
|---|---|---|---|---|
| **Text/Reference Books** | | | | |
| 1 | Electrical and electronic Measurements and Instrumentation | A.K. Sawhney | Dhanpat Rai and Co | 10th Edition |
| 2 | A Course in Electronics and Electrical Measurements and Instrumentation | J. B. Gupta | Katson Books | 2013 Edition |
| 3 | Electrical and electronic Measurements and Instrumentation | Er.R.K. Rajput | S Chand | 5th Edition 2012 |
| 4 | Electrical Measuring Instruments and Measurements | S.C. Bhargava | BS Publications | 2013 |
| 5 | Modern Electronic Instrumentation and Measuring Techniques | Cooper D and A.D. Heifrick | Pearson | First Edition 2015 |
| 6 | Electronic Instrumentation and Measurements | David A Bell | Oxford University | 3rd Edition 2013 |
| 7 | Electronic Instrumentation | H.S.Kalsi | Mc Graw Hill | 3rd Edition 2010 |

**B.E ELECTRICAL AND ELECTRONICS ENGINEERING (EEE)**
**CHOICE BASED CREDIT SYSTEM (CBCS)**
**SEMESTER - III**

**COMMUNICATION SYSTEMS(ELECTIVE)(ELECTIVE)**

| | | | |
|---|---|---|---|
| Subject Code | 15EE364 | IA Marks | 20 |
| Number of Lecture Hours/Week | 03 | Exam Hours | 03 |
| Total Number of Lecture Hours | 40 | Exam Marks | 80 |

**Credits - 03**

**Course objectives:**

- To explain the fundamental concepts of communication systems.
- To explain and compare different analog modulation schemes.
- To understand the concept of information.
- Learn about practical communication systems.

| **Module-1** | **Teaching Hours** |
|---|---|
| **Introduction to Communication Systems:** Block diagram, modulation and demodulation, need for modulation, transmission considerations and decibel ratios. Amplitude modulation (AM), generation of AM waves, concept of single sideband and double sideband modulation, vestigial sideband transmission, power-relationships, AM receivers, Signal to noise ratio. ■ | **08** |
| **Revised Bloom's Taxonomy Level** $L_1$ – Remembering, $L_2$ – Understanding, $L_3$ – Applying. | |
| **Module-2** | |
| Phase and frequency modulation, pre-and de-emphasis, generation of FM waves, CW modulation systems, narrowband FM, FM detectors and super heterodyne receivers, Signal to noise ratio.<br>Concepts of information, Shannon-Hartley theorem, bandwidth- Signal to noise ratio trade-off, coding, codes for error detection and correction, convolution codes, block and trellis codes. ■ | **08** |
| **Revised Bloom's Taxonomy Level** $L_1$ – Remembering, $L_2$ – Understanding, $L_3$ – Applying. | |
| **Module-3** | |
| Pulse modulation, Pulse Amplitude Modulation (PAM), Pulse Position Modulation (PPM), Pulse Width Modulation (PWM) systems. Concept of Pulse Code Modulation (PCM), basic coding and quantization, sample and hold, quantization noise, signal to noise ratio, Companding, Time-Division Multiplexing (TDM) , Delta modulation, adaptive delta modulation, Signal to noise ratio, comparison of PCM, delta and adaptive delta modulation. ■ | **08** |
| **Revised Bloom's Taxonomy Level** $L_1$ – Remembering, $L_2$ – Understanding, $L_3$ – Applying. | |
| **Module-4** | |
| Amplitude Shift Keying (ASK), Phase Shift Keying (PSK), Frequency Shift Keying (FSK), differential PSK and quadriphase shift keying, synchronization concepts and phase locked loops.<br>Block diagram of Fibre optic communication systems, light propagation in optical fibres, numerical aperture and acceptance cones of output factors, losses in optical fibres. Multiplexing in optic Fibre links. ■ | **08** |
| **Revised Bloom's Taxonomy Level** $L_1$ – Remembering, $L_2$ – Understanding, $L_3$ – Applying. | |

**15EE364 COMMUNICATION SYSTEMS(ELECTIVE) (continued)**
**CHOICE BASED CREDIT SYSTEM (CBCS)**

| **Module-5** | **Teaching Hours** |
|---|---|
| An introduction to telephone exchange systems. Telecommunication traffic, circuit switching, message switching and packet switching. Resource sharing and multiple access techniques.<br>An introduction to microwave, radar and satellite communication. ■ | **08** |
| **Revised Bloom's Taxonomy Level** $L_1$ – Remembering, $L_2$ – Understanding, $L_3$ – Applying. | |

**Course outcomes:**
At the end of the course the student will be able to:

- Explain analog communication systems and different modulation techniques.
- Evaluate fundamental communication system parameters, such as bandwidth, power, signal to quantization noise ratio, and data rate.
- Explain different pulse modulation techniques used in the communication.
- Explain different shift Keying methods.
- Explain the working of fiber optic communication and Telephone exchange systems.

**Graduate Attributes (As per NBA)**
Engineering Knowledge

**Question paper pattern:**

- The question paper will have ten questions.
- Each full question is for 16 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module. ■

**Text/Reference Books**

| | | | | |
|---|---|---|---|---|
| 1 | Electronic Communication Systems | George Kennedy at el | McGraw-Hill | 5th Edition, 2013 |
| 2 | Principles of Communication Systems | H.Taub and D.L. Schilling | McGraw-Hill | 4th Edition, |
| 3 | Electronic Communication Systems | Wayne Tomasi | Pearson | 5th Edition,2013 |
| 4 | Fundamentals of Communication Systems | Jhon G Proakis Masoud Salehi | Pearson | 2013 |
| 5 | Communication Systems | V.Chandrasekar | Oxford | 2013 |
| 6 | Electronic Communication: Analog, Digital and Wireless | Sanjeeva Gupta | Khanna Publishers | 3rd Edition, 2012 |

**B.E ELECTRICAL AND ELECTRONICS ENGINEERING (EEE)**
**CHOICE BASED CREDIT SYSTEM (CBCS)**
**SEMESTER - III**

**ELECTRONICS LABORATORY**

| | | | |
|---|---|---|---|
| Subject Code | 15EEL37 | IA Marks | 20 |
| Number of Practical Hours/Week | 03 | Exam Hours | 03 |
| Total Number of Practical Hours | 42 | Exam Marks | 80 |

**Credits - 02**

## Course objectives:

- To design and test half wave and full wave rectifier circuits
- To design and test different amplifier and oscillator circuits using BJT
- To study the simplification of Boolean expressions using logic gates
- To realize different Adders and Subtractors circuits
- To design and test counters and sequence generators.

| Sl. No | Experiments |
|---|---|
| 1 | Design and Testing of Full wave – centre tapped transformer type and Bridge type rectifier circuits with and without Capacitor filter. Determination of ripple factor, regulation and efficiency. |
| 2 | Static Transistor characteristics for CE, CB and CC modes and determination of h parameters. |
| 3 | Frequency response of single stage BJT and FET RC coupled amplifier and determination of half power points, bandwidth, input and output impedances. |
| 4 | Design and testing of BJT - RC phase shift oscillator for given frequency of oscillation. |
| 5 | Determination of gain, input and output impedance of BJT Darlington emitter follower with and without bootstrapping. |
| 6 | Simplification, realization of Boolean expressions using logic gates/Universal gates. |
| 7 | Realization of half/Full adder and Half/Full Subtractors using logic gates. |
| 8 | Realization of parallel adder/Subtractors using 7483 chip- BCD to Excess-3 code conversion & Vice -Versa. |
| 9 | Realization of Binary to Gray code conversion and vice versa. |
| 10 | Design and testing Ring counter/Johnson counter. |
| 11 | Design and testing of Sequence generator. |
| 12 | Realization of 3 bit counters as a sequential circuit and MOD – N counter design using 7476, 7490, 74192, 74193. |
| **Revised Bloom's Taxonomy Level** | $L_3$ – Applying, $L_4$ – Analysing, $L_5$ – Evaluating, $L_6$ – Creating |

## Course outcomes:

At the end of the course the student will be able to:

- Design and test different diode circuits.
- Design and test amplifier and oscillator circuits and analyse their performance.
- Use universal gates and ICs for code conversion and arithmetic operations.

**15EEL37 ELECTRONICS LABORATORY (continued)**
**CHOICE BASED CREDIT SYSTEM (CBCS)**

**Graduate Attributes (As per NBA)**

Engineering Knowledge
Problem Analysis
Individual and Team work
Communication

**Conduct of Practical Examination:**

1. All laboratory experiments are to be included for practical examination.
2. Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the examiners.
3. Students can pick one experiment from the questions lot prepared by the examiners.
4. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero. ■

**B.E ELECTRICAL AND ELECTRONICS ENGINEERING (EEE)**
**CHOICE BASED CREDIT SYSTEM (CBCS)**
**SEMESTER - III**

**ELECTRICAL MACHINES LABORATORY - 1**

| | | | |
|---|---|---|---|
| Subject Code | 15EEL38 | IA Marks | 20 |
| Number of Practical Hours/Week | 03 | Exam Hours | 03 |
| Total Number of Practical Hours | 42 | Exam Marks | 80 |

**Credits - 02**

## Course objectives:

- Conducting of different tests on transformers and synchronous machine and evaluation of their performance.
- Verify the parallel operation of two single phase transformers of different KVA rating.
- Study the connection of single phase transformers for three phase operation and phase conversion.
- Study of synchronous generator connected to infinite bus.

| Sl. NO | Experiments |
|---|---|
| 1 | Open Circuit and Short circuit tests on single phase step up or step down transformer and predetermination of<br>(i) Efficiency and regulation (ii) Calculation of parameters of equivalent circuit. |
| 2 | Sumpner's test on similar transformers and determination of combined and individual transformer efficiency. |
| 3 | Parallel operation of two dissimilar single-phase transformers of different kVA and determination of load sharing and analytical verification given the Short circuit test data. |
| 4 | Polarity test and connection of 3 single-phase transformers in star – delta and determination of efficiency and regulation under balanced resistive load. |
| 5 | Comparison of performance of 3 single-phase transformers in delta – delta and V – V (open delta) connection under load. |
| 6 | Scott connection with balanced and unbalanced loads. |
| 7 | Separation of hysteresis and eddy current losses in single phase transformer. |
| 8 | Voltage regulation of an alternator by EMF and MMF methods. |
| 9 | Voltage regulation of an alternator by ZPF method. |
| 10 | Slip test – Measurement of direct and quadrature axis reactance and predetermination of regulation of salient pole synchronous machines. |
| 11 | Performance of synchronous generator connected to infinite bus, under constant power and variable excitation & vice - versa. |
| 12 | Power angle curve of synchronous generator. |

| | |
|---|---|
| **Revised Bloom's Taxonomy Level** | $L_3$ – Applying, $L_4$ – Analysing, $L_5$ – Evaluating, $L_6$ – Creating |

## Course outcomes:

At the end of the course the student will be able to:

- Conduct different tests on transformers and synchronous generators and evaluate their performance.
- Connect and operate two single phase transformers of different KVA rating in parallel.
- Connect single phase transformers for three phase operation and phase conversion.

- Assess the performance of synchronous generator connected to infinite bus.

**15EEL38 ELECTRICAL MACHINES LABORATORY – 1 (continued)**
**CHOICE BASED CREDIT SYSTEM (CBCS)**

**Graduate Attributes (As per NBA)**

Engineering Knowledge
Problem Analysis
Individual and Team work
Communication

**Conduct of Practical Examination:**

1. All laboratory experiments are to be included for practical examination.
2. Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the examiners.
3. Students can pick one experiment from the questions lot prepared by the examiners.
4. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero. ■

****** END ******

# VISVESVARAYA TECHNOLOGICAL UNIVERSITY
# BELAGAVI

Scheme of Teaching and Examination and Syllabus

B.E. ELECTRICAL AND ELECTRONICS ENGINEERING

IV SEMESTER

**BOARD OF STUDIES IN ELECTRICAL AND ELECTRONICS ENGINEERING**
**April 2016**

# VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

SCHEME OF TEACHING AND EXAMINATION - 2015-16

**B.E. ELECTRICAL AND ELECTRONICS ENGINEERING**

**CHOICE BASED CREDIT SYSTEM (CBCS)**

**IVSEMESTER**

| Sl. No | Subject Code | Course (Subject) | Title | Teaching Dept. | Teaching Hours /Week | | Examination | | | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Theory | Practical/ Drawing | Duration in hours | I.A. Marks | Theory/ Practical Marks | Total Marks | |
| 1 | 15MAT41 | Core | Engineering Mathematics-IV | Math - matics | 04 | -- | 03 | 20 | 80 | 100 | 4 |
| 2 | 15EE42 | Core | Generation, Transmission and Distribution | EEE | 04 | -- | 03 | 20 | 80 | 100 | 4 |
| 3 | 15EE 43 | Core | Electric Motors | EEE | 04 | -- | 03 | 20 | 80 | 100 | 4 |
| 4 | 15EE 44 | Foundation | Electromagnetic Field Theory | EEE | 04 | -- | 03 | 20 | 80 | 100 | 4 |
| 5 | 15EE 45 | Foundation | Operational Amplifiers and Linear ICs | EEE | 04 | -- | 03 | 20 | 80 | 100 | 4 |
| 6 | 15EE 46X | Elective | Elective | EEE | 03 | -- | 03 | 20 | 80 | 100 | 3 |
| 7 | 15EE L47 | Laboratory | Op- amp and Linear ICs Laboratory | EEE | 01-Hour Instruction 02-Hour Practical | | 03 | 20 | 80 | 100 | 2 |
| 8 | 15EEL48 | Laboratory | Electrical Machines Laboratory -2 | EEE | 01-Hour Instruction 02-Hour Practical | | 03 | 20 | 80 | 100 | 2 |
| | | | **TOTAL** | | **Theory:23 hours Practical: 06 hours** | | **24** | **160** | **640** | **800** | **27** |

**Number of credits completed at the end of IV semester: 24 + 24 + 27 +27 = 102**

**Elective (3 credits)**

| | | | |
|---|---|---|---|
| 15EE461 | Instrumentation Engineering | 15EE 463 | Renewable Energy |
| 15EE462 | Fundamentals of HDL | 15EE 464 | Operation Research |

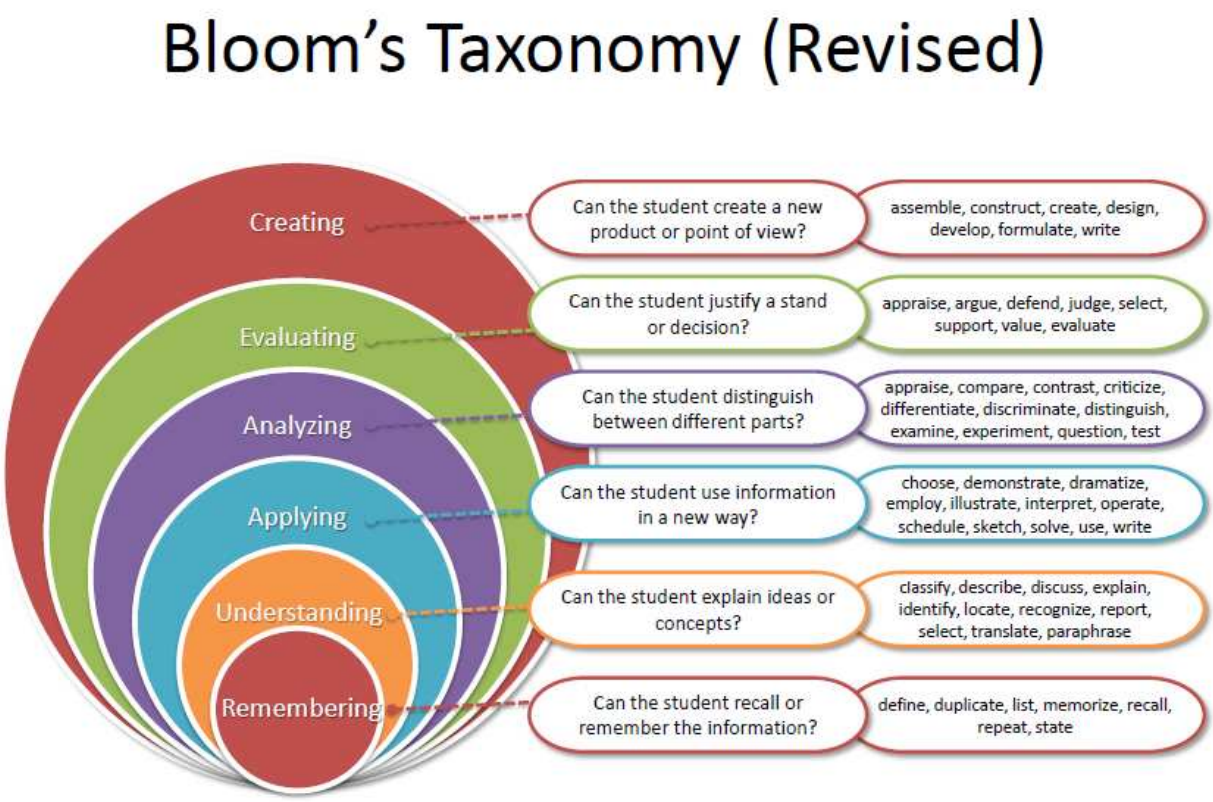
**1. Core subject:** This is the course, which is to be compulsorily studied by a student as a core requirement to complete the requirement of a programme in a said discipline of study.

**2a. Foundation Course**: The courses based upon the content that leads to Knowledge enhancement.

**2b. Foundation Elective:** Elective Foundation courses are value-based and are aimed at man-making education

**3. Elective:** This course can be selected from the pool of papers. It may be supportive to the discipline/providing extended scope/Enabling an Exposure to some other discipline/domain/nurturing student proficiency skills.

# CATEGORIZATION FOR THE THINKING PROCESS



**Bloom's Revised Taxonomy**
**Levels, Level Definitions and attributes levels**
**along with action verbs that can be used when developing learning outcomes.**

| | Level | Level Definitions and attributes | Verbs (not comprehensive ) |
|---|---|---|---|
| **Lower order thinking skills (LOTS)** | Remembering (Knowledge) $L_1 - Rembr$ | Students exhibit memory/rote memorization of previously learnt materials by recognition, recalling facts, terms, basic concepts, and simple answers. Able to remember, but not necessarily fully understanding the material. | Copy, Choose, Define, Discover, Describe, Duplicate, Enumerate, Find, How, Identify, Label, List, Locate, Listen, Memorize, Match, Name, Omit, Quote, Recall, Relate, Reproduce, Recognize, Select, Show, Spell, Tell, Tabulate, Who, When, Where etc. |
| | Understanding (Comprehension) $L_2 - Undrst$ | Students demonstrate understanding of facts and ideas by interpreting, exemplifying, classifying, inferring, summarizing, comparing and explaining main ideas with own words. | Ask, Classify, Compare, Contrast, Demonstrate, Describe, Extend, Differentiate, Distinguish, Discuss, Express, Explain, Group, Illustrate, Infer, Interpret, Outline, Paraphrase, Rephrase, Relate, Show, Summarize, Select, Translate, Restate etc. |
| | Applying (Application) $L_3 - Apply$ | Students solve problems in new situations by applying acquired knowledge, facts, techniques and rules in a different way. | Calculate, Predict, Apply, Solve, Illustrate, Use, Demonstrate, Determine, Model, Build, Construct, Develop, Experiment With, Identify, Make Use Of, Organize, Plan, Select etc. |
| **Higher order thinking skills (HOTS)** | Analysing (Analysis) $L_4 - Anlyse$ | Students are able to examine and break information into component parts by identifying motives, causes arrangement, logic and semantics. They can make inferences and find evidence to support generalization. | Analyse, Assume, Break Down, Classify, Categorize, Conclusion, Compare, Contrast, Diagram, Discover, Dissect, Distinguish, Divide, Examine, Function, Illustrate, Inference, Inspect, List, Motive, Outline, Relationships, Simplify, Survey, Take Part In, Test For etc. |
| | Evaluating (Evaluation) $L_5 - Evlute$ | Students are able to present and defend opinions by making judgments about information, validity of ideas, or quality of work based on a set of criteria. They can justify a decision or course of action. | Agree, Appraise, Assess, Award, Build, Create, Compose, Choose, Compare, Conclude, Criteria, Criticize, Design, Derive, Develop, Decide, Deduct, Determine, Disprove, Defend, Estimate, Formulate, Generate, Invent, Modify, Evaluate, Explain, Influence, Judge, Interpret, Justify, Mark, Measure, Perceive, Rate, Prioritize, Recommend, Rule On, Select, Support, Value etc. |
| | Creating (Synthesis) $L_6 - Create$ | Students are able to compile, generate or view information, ideas or products together in a different way by combining elements in a new pattern or by proposing alternative solutions. Also, use information to form a unique product. This requires creativity and originality. | Assemble, Adapt, Anticipate, Build, Change, Choose, Combine, Collaborate, Collect, Create, Compile, Compose, Construct, Delete, Design, Develop, Discuss, Develop, Devise, Elaborate, Estimate, Formulate, Happen, Hypothesize, Imagine, Improve, Invent, Imagine, Intervene, Make Up, Maximize, Modify, Originate, Plan, Predict, Propose, Rearrange, Solve, Suppose, Substitute, Test etc. |

**Graduate attributes:** Graduate attributes are the qualities, skills and understandings a university community agrees its students should develop during their time with the institution. These attributes include but go beyond the disciplinary expertise or technical knowledge that has traditionally formed the core of most university courses. They are qualities that also prepare graduates as agents of social good in an unknown future.

Bowden, Hart, King, Trigwell & Watts (2000)

**B.E ELECTRICAL AND ELECTRONICS ENGINEERING (EEE)**
**CHOICE BASED CREDIT SYSTEM (CBCS)**
**SEMESTER - IV**

**ENGINEERING MATHEMATICS -IV**

| | | | |
|---|---|---|---|
| Subject Code | 15MAT41 | IA Marks | 20 |
| Number of Lecture Hours/Week | 04 | Exam Hours | 03 |
| Total Number of Lecture Hours | 50 | Exam Marks | 80 |

**Credits - 04**

**Course Objectives:**

| **Module-1** | **Teaching Hours** |
|---|---|
| | **10** |
| **Revised Bloom's Taxonomy Level** | |
| **Module-2** | |
| | **10** |
| **Revised Bloom's Taxonomy Level** | |
| **Module-3** | |
| | **10** |
| **Revised Bloom's Taxonomy Level** | |

| 15MAT41 ENGINEERING MATHEMATICS - IV | | |
|---|---|---|
| **Module-4** | | **Teaching Hours** |
| | | **10** |
| **Revised Bloom's Taxonomy Level** | | |
| **Module-5** | | |
| | | **10** |
| **Revised Bloom's Taxonomy Level** | | |
| | | |
| **Course outcomes:** | | |
| **Graduate Attributes (As per NBA)** | | |
| **Question paper pattern:** | | |
| **Text/Reference Books:** | | |

| | | | | |
|---|---|---|---|---|
| 1 | Title | Authors | Publisher | Edition Year |
| 2 | | | | |
| 3 | | | | |
| 4 | | | | |
| 5 | | | | |

**B.E ELECTRICAL AND ELECTRONICS ENGINEERING (EEE)**
**CHOICE BASED CREDIT SYSTEM (CBCS)**
**SEMESTER - IV**

**GENERATION,TRANSMISSION AND DISTRIBUTION**

| | | | |
|---|---|---|---|
| Subject Code | 15EE42 | IA Marks | 20 |
| Number of Lecture Hours/Week | 04 | Exam Hours | 03 |
| Total Number of Lecture Hours | 50 | Exam Marks | 80 |

**Credits - 04**

**Course Objectives:**

- To understand the concepts of various methods of generation of power.
- To understand the importance of HVAC, EHVAC, UHVAC and HVDC transmission.
- To design insulators for a given voltage level.
- To calculate the parameters of the transmission line for different configurations and assess the performance of the line.
- To study underground cables for power transmission and evaluate different types of distribution systems

| **Module-1** | **Teaching Hours** |
|---|---|
| **Hydro power plant:** Introduction, Classification of hydel plants, General arrangement and operation, station structure and control. Selection of site.<br>**Thermal power plant:** Introduction, Main parts of the plant. Working. Plant layout. Selection of site.<br>**Nuclear power plant:** Introduction, Components of reactors, Description of fuel sources. Merits and demerits. Selection of site.<br>**Distributed energy resource systems**: Introduction, a brief discussion on cogeneration, solar power, wind power, mini and micro hydro power generation, waste to energy and energy storage. Benefits and challenges. ■ | **10** |
| **Revised Bloom's Taxonomy Level**: $L_1$ – Remembering, $L_2$ – Understanding. | |

| **Module-2** | |
|---|---|
| **Introduction to power system:** Structure of electric power system: generation, transmission and distribution. Advantages of higher voltage transmission: HVAC, EHVAC, UHVAC and HVDC. Interconnection. Feeders, distributors and service mains.<br>**Overhead transmission lines:** A brief introduction to types of supporting structures and line conductors-Conventional conductors; Aluminium Conductor steel reinforced (ACSR), All –aluminium alloy conductor (AAAC) and All –aluminium conductor (AAC). High temperature conductors; Thermal resistant aluminium alloy (ATI),Super thermal resistant aluminium alloy (ZTAI), Gap type thermal resistant aluminium alloy conductor steel reinforced (GTACSR), Gap type super thermal resistant aluminium alloy conductor steel reinforced (GZTACSR). Bundle conductor and its advantages. Importance of sag, Sag calculation – supports at same and different levels, effect of wind and ice. Line vibration and vibration dampers.<br>**Overhead line Insulators:** A brief introduction to types of insulators, material used-porcelain, toughened glass and polymer (composite). Potential distribution over a string of suspension insulators. String efficiency, Methods of increasing string efficiency. Arcing horns. ■ | **10** |
| **Revised Bloom's Taxonomy Level**: $L_1$ – Remembering, $L_2$ – Understanding, $L_3$ – Applying. | |

**15EE42 GENERATION,TRANSMISSION AND DISTRIBUTION (continued)**
**CHOICE BASED CREDIT SYSTEM (CBCS)**

| **Module-3** | | **Teaching Hours** |
|---|---|---|
| **Line parameters:** Introduction to line parameters- resistance, inductance and capacitance. Calculation of inductance of single phase and three phase lines with equilateral spacing, unsymmetrical spacing, double circuit and transposed lines. Inductance of composite – conductors, geometric mean radius (GMR) and geometric mean distance (GMD). Calculation of capacitance of single phase and three phase lines with equilateral spacing, unsymmetrical spacing, double circuit and transposed lines. Capacitance of composite – conductor, geometric mean radius (GMR) and geometric mean distance (GMD). ■ | | **10** |
| **Revised Bloom's Taxonomy Level** | $L_1$ – Remembering, $L_2$ – Understanding, $L_3$ – Applying, $L_4$ – Analysing. | |
| **Module-4** | | |
| **Performance of transmission lines:** Classification of lines – short, medium and long. Current and voltage relations, line regulation and Ferranti effect in short length lines, medium length lines considering Nominal T and nominal $\pi$ circuits, and long lines considering hyperbolic form equations. Equivalent circuit of a long line. ABCD constants in all cases.<br>**Corona:** Phenomena, disruptive and visual critical voltages, corona loss. Advantages and disadvantages of corona. ■ | | **10** |
| **Revised Bloom's Taxonomy Level** | $L_1$ – Remembering, $L_2$ – Understanding, $L_3$ – Applying, $L_4$ – Analysing. | |
| **Module-5** | | |
| **Underground cable:** Types of cables, constructional features, insulation resistance, thermal rating, charging current, grading of cables – capacitance and intersheath. Dielectric loss.<br>**Distribution:** Primary AC distribution systems – Radial feeders, parallel feeders, loop feeders and interconnected network system. Secondary AC distribution systems – Three phase 4 wire system and single phase 2 wire distribution, AC distributors with concentrated and uniform loads. Effect of disconnection of neutral in a 3 phase four wire system. ■ | | **10** |
| **Revised Bloom's Taxonomy Level** | $L_1$ – Remembering, $L_2$ – Understanding, $L_3$ – Applying, $L_4$ – Analysing. | |

**Course Outcomes:**

At the end of the course the student will be able to:

- Explain the concepts of various methods of generation of power.
- Explain the importance of HVAC, EHVAC, UHVAC and HVDC transmission.
- Design and analyze overhead transmission system for a given voltage level.
- Calculate the parameters of the transmission line for different configurations and assess the performance of line.
- Explain the use of underground cables and evaluate different types of distribution systems.

**Graduate Attributes (As per NBA)**

Engineering Knowledge
Problem Analysis
Design / development of solutions
Engineers and society
Ethics

**15EE42 GENERATION,TRANSMISSION AND DISTRIBUTION (continued)**
**CHOICE BASED CREDIT SYSTEM (CBCS)**

**Question paper pattern:**

- The question paper will have ten questions.
- Each full question is for 16 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.

**Text/Reference Books:**

| | | | | |
|---|---|---|---|---|
| 1 | A Course in Electrical Power | Soni Gupta and Bhatnagar | Dhanpat Rai | |
| 2 | Power System Analysis and Design | J. Duncan Glover at el | Cengage Learning | 4th Edition 2008 |
| 3 | Principles of Power System | V.K. Mehta Rohit Mehta | S. Chand Publishers | 1st Edition 2013 |
| 3 | Electrical power Generation, Transmission and Distribution | S.N. Singh | PHI | 2nd Edition,2009 |
| 4 | Electrical Power | S.L.Uppal | Khanna Publication | |
| 5 | Electrical power systems | C. L. Wadhwa | New Age International | 5th Edition, 2009 |
| 6 | Electrical power systems | Ashfaq Hussain | CBS Publication | |
| 7 | For High temperature conductors refer www.jpowers.co.jp/english/product/pdf/gap_c1.pdf and Power System Analysis and Design, J. Duncan Glover at el | | | |

**B.E ELECTRICAL AND ELECTRONICS ENGINEERING (EEE)**
**CHOICE BASED CREDIT SYSTEM (CBCS)**
**SEMESTER - IV**

**ELECTRIC MOTORS**

| | | | |
|---|---|---|---|
| Subject Code | 15EE43 | IA Marks | 20 |
| Number of Lecture Hours/Week | 04 | Exam Hours | 03 |
| Total Number of Lecture Hours | 50 | Exam Marks | 80 |

**Credits - 04**

**Course Objectives:**

- To study the constructional features of Motors and select a suitable drive for specific application.
- To study the constructional features of Three Phase and Single phase induction Motors.
- To study different test to be conducted for the assessment of the performance characteristics of motors.
- To study the speed control of motor by a different methods.
- Explain the construction and operation of Synchronous motor and special motors.

| **Module-1** | **Teaching Hours** |
|---|---|
| **DC Motors:** Classification, Back emf, Torque equation, and significance of back emf, Characteristics of shunt, series & compound motors. Speed control of shunt, series and compound motors. Application of motors. DC motor starters – 3 point and 4 point.<br>**Losses and efficiency-** Losses in DC motors, power flow diagram, efficiency, condition for maximum efficiency. ■ | **10** |
| **Revised Bloom's Taxonomy Level** $L_1$ – Remembering, $L_2$ – Understanding, $L_3$ – Applying. | |

| **Module-2** | |
|---|---|
| **Testing of dc motors:** Direct & indirect methods of testing of DC motors-Brake test, Swinburne's test, Retardation test, Hopkinson's test, Field's test, merits and demerits of tests.<br>**Three phase Induction motors:** Review of concept and generation of rotating magnetic field, Principle of operation, construction, classification and types; squirrel-cage, slip-ring (No question shall be set from the review portion). Slip, Torque equation, torque-slip characteristic covering motoring, generating and braking regions of operation. Maximum torque, significance of slip. ■ | **10** |
| **Revised Bloom's Taxonomy Level** $L_1$ – Remembering, $L_2$ – Understanding, $L_3$ – Applying, $L_4$ – Analysing. | |

| **Module-3** | |
|---|---|
| **Performance of three-phase Induction Motor:** Phasor diagram of induction motor on no-load and on load, equivalent circuit, losses, efficiency, No-load and blocked rotor tests. Performance of the motor from the circle diagram and equivalent circuit. Cogging and crawling.<br>High torque rotors-double cage and deep rotor bars. Equivalent circuit and performance evaluation of double cage induction motor. Induction motor working as induction generator; standalone operation and grid connected operation**.** ■ | **10** |
| **Revised Bloom's Taxonomy Level** $L_1$ – Remembering, $L_2$ – Understanding, $L_3$ – Applying, $L_4$ – Analysing. | |

**15EE43 ELECTRIC MOTORS (continued)**
**CHOICE BASED CREDIT SYSTEM (CBCS)**

| **Module-4** | | **Teaching Hours** |
|---|---|---|
| **Starting and speed Control of Three-phase Induction Motors:** Need for starter. Direct on line, Star-Delta and autotransformer starting. Rotor resistance starting. Speed control by voltage, frequency, and rotor resistance methods<br>**Single-phase Induction Motor:** Double revolving field theory and principle of operation. Construction and operation of split-phase, capacitor start, capacitor run, and shaded pole motors. Comparison of single phase motors and applications. ■ | | **10** |
| **Revised Bloom's Taxonomy Level** | $L_1$ – Remembering, $L_2$ – Understanding, $L_3$ – Applying, $L_4$ – Analysing. | |
| **Module-5** | | |
| **Synchronous motor:** Principle of operation, phasor diagrams, torque and torque angle, Blondel diagram, effect of change in load, effect of change in excitation, V and inverted V curves. Synchronous condenser, hunting and damping. Methods of starting synchronous motors.<br>**Other motors:** Construction and operation of Universal motor, AC servomotor, Linear induction motor and stepper motors. ■ | | **10** |
| **Revised Bloom's Taxonomy Level** | $L_1$ – Remembering, $L_2$ – Understanding, $L_3$ – Applying, $L_4$ – Analysing. | |

**Course Outcomes:**

At the end of the course the student will be able to:

- Explain the constructional features of Motors and select a suitable drive for specific application.
- Analyze and assess the performance characteristics of DC motors by conducting suitable tests and control the speed by suitable method.
- Explain the constructional features of Three Phase and Single phase induction Motors and assess their performance.
- Control the speed of induction motor by a suitable method.
- Explain the operation of Synchronous motor and special motors.

**Graduate Attributes (As per NBA)**

Engineering Knowledge
Problem Analysis
Conduct investigations of complex Problems

**Question paper pattern:**

- The question paper will have ten questions.
- Each full question is for 16 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module. ■

| 15EE43 ELECTRIC MOTORS (continued)<br>CHOICE BASED CREDIT SYSTEM (CBCS) | | | | |
|---|---|---|---|---|
| **Text/Reference Books:** | | | | |
| 1 | Electric Machines | D. P. Kothari,<br>I. J. Nagrath | Mc Graw Hill | 4th edition, 2011 |
| 2 | Principles of Electric Machines and power Electronics | P.C.Sen | Wiley | 2nd Edition, 2013 |
| 3 | Electric Machines | R.K. Srivastava | Cengage Learning | 2nd Edition,2013 |
| 4 | Electrical Machines, Drives and Power systems | Theodore Wildi | Pearson | 6th Edition, 2014 |
| 5 | Electrical Machines | M.V. Deshpande | PHI Learning | 2013 |
| 6 | Electric Machinery and Transformers | Bhag S Guru<br>at el | Oxford University Press | 3rd Edition, 2012 |
| 7 | Electric Machinery and Transformers | Irving Kosow | Pearson | 2rd Edition, 2012 |
| 8 | Theory of Alternating Current Machines | Alexander Langsdorf | Mc Graw Hill | 2nd Edition, 2001 |

**B.E ELECTRICAL AND ELECTRONICS ENGINEERING (EEE)**
**CHOICE BASED CREDIT SYSTEM (CBCS)**
**SEMESTER - IV**

**ELECTROMAGNETIC FIELD THEORY**

| | | | |
|---|---|---|---|
| Subject Code | 15EE44 | IA Marks | 20 |
| Number of Lecture Hours/Week | 04 | Exam Hours | 03 |
| Total Number of Lecture Hours | 50 | Exam Marks | 80 |

**Credits - 04**

**Course Objectives:**

- To study different coordinate systems for understanding the concept of gradient, divergence and curl of a vector.
- To study the application of Coulomb's Law and Gauss Law for electric fields produced by different charge configurations.
- To evaluate the energy and potential due to a system of charges.
- To study the behavior of electric field across a boundary between a conductor and dielectric and between two different dielectrics.
- To study the magnetic fields and magnetic materials.
- To study the time varying fields and propagation of waves in different media.

| **Module-1** | **Teaching Hours** |
|---|---|
| **Vector Analysis:** Scalars and Vectors**,** Vector algebra, Cartesian co-ordinate system, Vector components and unit vectors. Scalar field and Vector field. Dot product and Cross product, Gradient of a scalar field. Divergence and Curl of a vector field. Co – ordinate systems: cylindrical and spherical, relation between different coordinate systems. Expression for gradient, divergence and curl in rectangular, cylindrical and spherical co-ordinate systems. Problems.<br>**Electrostatics:** Coulomb's law, Electric field intensity and its evaluation for (i) point charge (ii) line charge (iii) surface charge (iv) volume charge distributions. Electric flux density, Gauss law and its applications. Maxwell's first equation (Electrostatics). Divergence theorem. Problems. ■ | **10** |
| **Revised Bloom's Taxonomy Level** $L_1$ – Remembering, $L_2$ – Understanding, $L_3$ – Applying. | |
| **Module-2** | |
| **Energy and Potential:** Energy expended in moving a point charge in an electric field. The line integral. Definition of potential difference and potential. The potential field of a point charge and of a system of charges. Potential gradient. The dipole. Energy density in the electrostatic field. Problems.<br>**Conductor and Dielectrics:** Current and current density. Continuity of current. Metallic conductors, conductor's properties and boundary conditions. Perfect dielectric materials, capacitance calculations. Parallel plate capacitor with two dielectrics with dielectric interface parallel to the conducting plates. Capacitance of two wire line. Problems. ■ | **10** |
| **Revised Bloom's Taxonomy Level** $L_1$ – Remembering, $L_2$ – Understanding, $L_3$ – Applying. | |
| **Module-3** | |
| **Poisson's and Laplace equations:** Derivations and problems, Uniqueness theorem.<br>**Steady magnetic fields:** Biot - Savart's law, Ampere's circuital law. The Curl. Stokes theorem. Magnetic flux and flux density. Scalar and vector magnetic potentials. Problems. ■ | **10** |
| **Revised Bloom's Taxonomy Level** $L_1$ – Remembering, $L_2$ – Understanding, $L_3$ – Applying. | |

**15EE44 ELECTROMAGNETIC FIELD THEORY (continued)**
**CHOICE BASED CREDIT SYSTEM (CBCS)**

| **Module-4** | **Teaching Hours** |
|---|---|
| **Magnetic forces:** Force on a moving charge and differential current element. Force between differential current elements. Force and torque on a closed circuit. Problems. **Magnetic materials and magnetism:** Nature of magnetic materials, magnetisation and permeability. Magnetic boundary conditions. Magnetic circuit, inductance and mutual inductance. Problems. ■ | **10** |
| **Revised Bloom's Taxonomy Level** $L_1$ – Remembering, $L_2$ – Understanding, $L_3$ – Applying. | |
| **Module-5** | |
| **Time varying fields and Maxwell's equations:** Faraday's law, Displacement current. Maxwell's equations in point form and integral form. Problems. **Uniform plane wave:** Wave propagation in free space and in dielectrics. Pointing vector and power considerations. Propagation in good conductors, skin effect. Problems. ■ | **10** |
| **Revised Bloom's Taxonomy Level** $L_1$ – Remembering, $L_2$ – Understanding, $L_3$ – Applying, $L_4$ – Analysing. | |

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

- Use different coordinate systems to explain the concept of gradient, divergence and curl of a vector.
- Use Coulomb's Law and Gauss Law for the evaluation of electric fields produced by different charge configurations.
- Calculate the energy and potential due to a system of charges.
- Explain the behavior of electric field across a boundary between a conductor and dielectric and between two different dielectrics.
- Explain the behavior of magnetic fields and magnetic materials.
- Assess time varying fields and propagation of waves in different media.

**Graduate Attributes (As per NBA)**
Engineering Knowledge
Problem Analysis
Conduct investigations of complex Problems

**Question paper pattern:**

- The question paper will have ten questions.
- Each full question is for 16 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module. ■

| 15EE44 ELECTROMAGNETIC FIELD THEORY (continued)<br>CHOICE BASED CREDIT SYSTEM (CBCS) | | | | |
|---|---|---|---|---|
| **Text/Reference Books:** | | | | |
| 1 | Engineering Electromagnetics | William H Hayt et al | Mc Graw Hill | 8th Edition, 2014 |
| 2 | Principles of Electromagnetics | Matthew N. O. Sadiku | Oxford University Press | 6th Edition, 2015 |
| 3 | Fundamentals of Engineering Electromagnetics | David K. Cheng | Pearson | 2014 |
| 4 | Electromagnetism<br>- Theory (Volume -1)<br>-Applications (Volume-2) | Ashutosh Pramanik | PHI Learning | 2014 |
| 5 | Electromagnetic Field Theory Fundamentals | Bhag Guru et al | Cambridge University press | 2005 |
| 6 | Electromagnetic Field Theory | Rohit Khurana | Vikas Publishing | 1st Edition,2014 |
| 7 | Electromagnetics | J. A. Edminister | Mc Graw Hill | 3rd Edition, 2010 |
| 8 | Electromagnetic Field Theory and Transmission Lines | Gottapu Sasibhushana Rao | Wiley | 1st Edition, 2013 |

**B.E ELECTRICAL AND ELECTRONICS ENGINEERING (EEE)**
**CHOICE BASED CREDIT SYSTEM (CBCS)**
**SEMESTER - IV**

**OPERATIONAL AMPLIFIERS AND LINEAR ICs**

| | | | |
|---|---|---|---|
| Subject Code | 15EE45 | IA Marks | 20 |
| Number of Lecture Hours/Week | 04 | Exam Hours | 03 |
| Total Number of Lecture Hours | 50 | Exam Marks | 80 |

**Credits - 04**

**Course Objectives:**

- To understand the basics of Linear ICs such as Op-amp, Regulator, Timer & PLL.
- To learn the designing of various circuits using linear ICs.
- To use these linear ICs for specific applications.
- To understand the concept and various types of converters.
- To use these ICs, in Hardware projects.

| **Module-1** | **Teaching Hours** |
|---|---|
| **Operational amplifiers:** Introduction, Block diagram representation of a typical Op-amp, schematic symbol, characteristics of an Op-amp, ideal op-amp, equivalent circuit, ideal voltage transfer curve, open loop configuration, differential amplifier, inverting & non – inverting amplifier, Op-amp with negative feedback ; voltage series feedback amplifier- gain, input resistance, output resistance, voltage shunt feedback amplifier- gain, input resistance, output resistance.<br>**General Linear Applications:** D.C. & A.C amplifiers, peaking amplifier, summing, scaling & averaging amplifier, inverting and non-inverting configuration, differential configuration, instrumentation amplifier. ■ | **10** |
| **Revised Bloom's Taxonomy Level** $L_1$ – Remembering, $L_2$ – Understanding, $L_3$ – Applying, $L_4$ – Analysing. | |
| **Module-2** | |
| **Active Filters:** First & Second order high pass & low pass Butterworth filters, higher order filters Band pass filters, Band reject filters & all pass filters.<br>**DC Voltage Regulators:** voltage regulator basics, voltage follower regulator, adjustable output regulator, LM317 & LM337 Integrated circuits regulators. ■ | **10** |
| **Revised Bloom's Taxonomy Level** $L_1$ – Remembering, $L_2$ – Understanding, $L_3$ – Applying, $L_4$ – Analysing. | |
| **Module-3** | |
| **Signal generators:** Triangular / rectangular wave generator, phase shift oscillator, Wien bridge oscillator, oscillator amplitude stabilization, signal generator output controls.<br>**Comparators & Converters:** Basic comparator, zero crossing detector, inverting & non-inverting Schmitt trigger circuit, voltage to current converter with grounded load, current to voltage converter and basics of voltage to frequency and frequency to voltage converters. ■ | **10** |
| **Revised Bloom's Taxonomy Level** $L_1$ – Remembering, $L_2$ – Understanding, $L_3$ – Applying, $L_4$ – Analysing. | |
| **Module-4** | |
| **Signal processing circuits:** Precision half wave & full wave rectifiers limiting circuits, clamping circuits, peak detectors, sample & hold circuits.<br>**A/D & D/A Converters:** Basics, R–2R D/A Converter, Integrated circuit 8-bit D/A, successive approximation ADC, linear ramp ADC, dual slope ADC, digital ramp ADC. ■ | |
| **Revised Bloom's Taxonomy Level** $L_1$ – Remembering, $L_2$ – Understanding, $L_3$ – Applying, $L_4$ – Analysing. | |

**15EE45 OPERATIONAL AMPLIFIERS AND LINEAR ICs (continued)**
**CHOICE BASED CREDIT SYSTEM (CBCS)**

| **Module-5** | **Teaching Hours** |
|---|---|
| **Phase Locked Loop (PLL):** Basic PLL, components, performance factors, applications of PLL IC 565.<br>**Timer:** Internal architecture of 555 timer, Mono stable, Astable multivibrators and applications. ■ | **10** |
| **Revised Bloom's Taxonomy Level** $L_1$ – Remembering, $L_2$ – Understanding, $L_3$ – Applying, $L_4$ – Analysing. | |

**Course Outcomes:**
At the end of the course the student will be able to:
- Explain the basics of linear ICs.
- Design circuits using linear ICs.
- Demonstrate the application of Linear ICs.
- Use ICs in the electronic projects.

**Graduate Attributes (As per NBA)**
Engineering Knowledge
Design / development of solutions
Conduct investigations of complex Problems

**Question paper pattern:**
- The question paper will have ten questions.
- Each full question is for 16 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module. ■

**Text/Reference Books:**

| | | | | |
|---|---|---|---|---|
| 1 | Op-Amps and Linear Integrated Circuits | Ramakant A Gayakwad | Pearson | 4th Edition 2015 |
| 2 | Operational Amplifiers and Linear ICs | David A. Bell | Oxford University Press | 3rd Edition 2011 |
| 3 | Linear Integrated Circuits; Analysis, Design and Applications | B. Somanthan Nair | Wiley India | 2013 |
| 4 | Linear Integrated Circuits | S. Salivahanan, et al | Mc Graw Hill | 2nd Edition,2014 |
| 5 | Operational Amplifiers and Linear Integrated Circuits | K. Lal Kishore | Pearson | 1st Edition, 2012 |
| 6 | Linear Integrated Circuits | Muhammad H Rashid | Cengage Learning | 1st Edition,2014 |
| 7 | Op-Amps and Linear Integrated Circuits, Concept and Application | James M Fiore | Cengage | 2009 |

**B.E ELECTRICAL AND ELECTRONICS ENGINEERING (EEE)**
**CHOICE BASED CREDIT SYSTEM (CBCS)**
**SEMESTER - IV**

**INSTRUMENTATION ENGINEERING (ELECTIVE)**

| | | | |
|---|---|---|---|
| Subject Code | 15EE461 | IA Marks | 20 |
| Number of Lecture Hours/Week | 03 | Exam Hours | 03 |
| Total Number of Lecture Hours | 40 | Exam Marks | 80 |

**Credits - 03**

**Course Objectives:**

- To study different types of sensors and transducers used for measurements.
- To understand about Data Acquisition System.
- To familiarise about measurement of pressure, temperature, speed and torque.
- To understand industrial communication techniques.

| **Module-1** | **Teaching Hours** |
|---|---|
| **Sensors and Transducers:** Introduction, definition of transducer, Classification, basic requirements, sensitivity and specifications. Transducers actuating mechanisms. Resistance transducers – Linear and angular motion transducers, Thermistors and resistance thermometers. Variable Inductance transducers – Electromagnetic, Electrodynamic, Eddy current, variable reluctance and Linear variable differential transformer types. Capacitive transducers based on change in area and change in distance between the plates, Piezoelectric transducers – Piezoelectric materials, desirable properties, working of piezoelectric device, advantages and disadvantages, Accelerometer. Hall effect transducers – Measurement of current, Magnetic flux and Fluid level. Thermoelectric transducers. Photoelectric transducers – photoemmssive, photovoltaic and photoconductive. Photoelectric tachometer. ■ | **08** |
| **Revised Bloom's Taxonomy Level**: $L_1$ – Remembering, $L_2$ – Understanding, $L_3$ – Applying. | |
| **Module-2** | |
| **Sensors and Transducers (continued):** Strain gauges- Introduction, Wire wound, Foil type, Semiconductor and Capacitor strain gauges. Theory of strain gauges, materials used, Adhesing techniques, strain gauge circuits – Ballast circuit, Wheatstone bridge circuit – Null mode, Deflection mode – Quarter bridge, Half bridge and full bridge versions. Temperature compensation – Adjacent arm balancing, strain gauge calibration self-temperature and Special external control circuitry. Stress – strain relationship, and gauge rosettes.<br>Load cells – Hydraulic, Pneumatic and Strain gauge load cells.<br>Proximity sensors – Eddy current, Capacitance and Inductive types. Pneumatic Sensors, Light sensors, Digital optical encoder, Smart pressure transmitters, Selection of sensors. ■ | **08** |
| **Revised Bloom's Taxonomy Level**: $L_1$ – Remembering, $L_2$ – Understanding, $L_3$ – Applying. | |
| **Module-3** | |
| **Signal Conditioning:** Measurement System components, Necessity of signal conditioning, Process used in signal conditioning, Mechanical amplification and electrical signal conditioning. Functions of signal conditioning equipment, Amplifiers – Mechanical, Fluid, Optical and, Electrical and electronic amplifiers.<br>**Data Acquisition Systems (DAS):** Introduction, Objectives and configuration. Analog and Automated, Single channel and Multi-channel DAS. Applications of DAS. | **08** |

**15EE461 INSTRUMENTATION ENGINEERING (ELECTIVE) (continued)**
**CHOICE BASED CREDIT SYSTEM (CBCS)**

**Module-3 (continued)**

**Data Transmission and Telemetry:** Data/ signal transmission – Mechanical, Hydraulic, Pneumatic, Magnetic. Electric type Transmitters and converters. Telemetry – Introduction, types of telemetry systems – Voltage, Current and Position, Frequency and Pulse telemetry systems. ■

| **Revised Bloom's Taxonomy Level** | $L_1$ – Remembering, $L_2$ – Understanding, $L_3$ – Applying. |
|---|---|

**Module-4**

**Measurement of Non- electrical Quantities:** **08**
**Measurement of Pressure** – Definition of pressure, units for pressure and measuring instruments, pressure transducers – Resistance, Pressure voltage, Inductive, Carbon pile, Piezoelectric, Photoelectric and Electromagnetic type. Measurement of high and low pressures. Calibration of pressure measuring equipment.
**Measurement of Temperature** – Introduction, measuring instruments, Electrical Resistance Thermometer, Radiation pyrometers, Optical pyrometers.
**Measurement of Displacement:** Measurement of linear and angular displacements.
**Measurement of Velocity/speed:** Linear velocity measurement, Angular velocity measurement – DC tachometer and AC tachometer
**Measurement of torque:** Introduction, Electrical torsion meter and strain – gauge torsion meter. ■

| **Revised Bloom's Taxonomy Level** | $L_1$ – Remembering, $L_2$ – Understanding, $L_3$ – Applying. |
|---|---|

**Module-5**

**Industrial Communication Techniques:** Introduction, Open System Interconnection network model, Physical layer options – Network topologies, interface standards, RS 232 – Character frame, connector and signal lines, maximum cable lengths, limitations of RS 232, wireless RS 232, Bluetooth wireless technology. RS 422, RS 423, RS 485, IEEE 488 (GPIB) – Talkers, listeners, and controllers, connector and signal lines, data bus, handshake lines, handshaking, control bus, data bus transfer timing, device addresses, physical connection, Electrical characteristics. IEEE 488.2 – control sequences and protocols. HS 488 - handshake, data transfer flow control, system configuration effects and messages. ■ **08**

| **Revised Bloom's Taxonomy Level** | $L_1$ – Remembering, $L_2$ – Understanding, $L_3$ – Applying. |
|---|---|

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

- Use the knowledge of different sensors and transducers for various measurements.
- Apply the concept of DAS for industrial applications.

Apply the knowledge of industrial communication techniques.

**Graduate Attributes (As per NBA)**
Engineering Knowledge

**15EE461 INSTRUMENTATION ENGINEERING (ELECTIVE) (continued)**
**CHOICE BASED CREDIT SYSTEM (CBCS)**

**Question paper pattern:**

- The question paper will have ten questions.
- Each full question is for 16 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.

**Text/Reference Books:**


| | | | | |
|---|---|---|---|---|
| 1 | Electronic Measurements and Instrumentation | R.K Rajput | S.Chand | 2nd Edition 2012 |
| 2 | Electronic Instruments and Instrumentation Technology | M.M.S. Anand | PHI | First Edition 2004 |
| 3 | Electrical and electronic Measurements and Instrumentation | A.K. Sawhney | Dhanpat Rai and Co | 10th Edition |
| 4 | Modern Electronic Instrumentation and Measuring Techniques | Cooper D and A.D. Heifrick | Pearson | First Edition |
| 5 | Electronic Instrumentation and Measurements | David A Bell | Oxford University | 3rd Edition 2013 |
| 6 | Introduction to Measurements and Instrumentation | Arun K Ghosh | PHI | 4th Edition 2012 |
| 7 | Electrical and electronics Measurements and Instrumentation | Prythwiraj Purkait et al | McGraw Hill | First Edition 2013 |

**B.E ELECTRICAL AND ELECTRONICS ENGINEERING (EEE)**
**CHOICE BASED CREDIT SYSTEM (CBCS)**
**SEMESTER - IV**

**FUNDAMENTALS OF HDL (ELECTIVE)**

| | | | |
|---|---|---|---|
| Subject Code | 15EE462 | IA Marks | 20 |
| Number of Lecture Hours/Week | 03 | Exam Hours | 03 |
| Total Number of Lecture Hours | 40 | Exam Marks | 80 |

**Credits - 03**

**Course Objectives:**

- To explain the need HDL and different technical terms of HDL
- To discuss various models of Verilog programming
- To apply various models of Verilog programming to develop programs for Digital Circuits design
- To explain procedures, tasks and functions and develop program for the same using subroutines
- To explain the basics of synthesis and mapping process.

| **Module-1** | **Teaching Hours** |
|---|---|
| Review of Intention of Hardware Description Language (HDL) and its history, Structure of the HDL module, Operators, Data types, Styles of descriptions, Simulation and Synthesis, comparison of VHDL and Verilog, Data – flow descriptions, Structure of the Data – flow descriptions, Data Type – Vectors, Common programming errors. (No question shall be set from the review portions).<br>**Behavioural Descriptions:** Introduction, Behavioural Description highlights, Structure, VHDL variable – assignment statement, Sequential statements, common programming errors. ■ | **08** |
| **Revised Bloom's Taxonomy Level** $L_1$ – Remembering, $L_2$ – Understanding, $L_3$ – Applying. | |
| **Module-2** | |
| **Structured Descriptions:** Highlights of structured descriptions, Organization of the structured description, Binding, State machines, Generate (HDL), Generic (VHDL) and parameter (Verilog).■ | **08** |
| **Revised Bloom's Taxonomy Level** $L_1$ – Remembering, $L_2$ – Understanding, $L_3$ – Applying. | |
| **Module-3** | |
| **Procedures, Tasks, and Functions:** Highlights of **Procedures**, Tasks, and Functions, Procedures and Tasks, Functions.<br>**Advanced HDL Descriptions:** File processing, Examples, VHDL record type. ■ | **08** |
| **Revised Bloom's Taxonomy Level** $L_1$ – Remembering, $L_2$ – Understanding, $L_3$ – Applying. | |
| **Module-4** | |
| **Mixed Type Descriptions:** Necessity, VHDL user – defined types, VHDL packages, Mixed type description examples.<br>**Mixed Language Descriptions:** Highlights of Mixed Language Descriptions, Invoke one language from the other, Mixed Language Description examples, Limitations. ■ | **08** |
| **Revised Bloom's Taxonomy Level** $L_1$ – Remembering, $L_2$ – Understanding, $L_3$ – Applying. | |
| **Module-5** | |
| **Synthesis Basics:** Highlights of Synthesis, Synthesis information from Entity (VHDL), Verilog Synthesis information from module inputs/outputs, Mapping process and Always in the hardware domain, Mapping the signal –assignment statement to gate level, Mapping the variable assignment statement to gate level synthesis, Mapping logical operators, Mapping the if statement, Mapping the case statement, Mapping the Loop statement, Mapping procedure or task, Mapping the function statement. ■ | **08** |

**15EE462 FUNDAMENTALS OF HDL (ELECTIVE) (continued)**
**CHOICE BASED CREDIT SYSTEM (CBCS)**

**Module-5 (continued)**

| **Revised Bloom's Taxonomy Level** | $L_1$ – Remembering, $L_2$ – Understanding, $L_3$ – Applying. |
|---|---|

**Course Outcomes:**

At the end of the course the student will be able to:

- Understand the need for HDL and different technical terms
- Discuss various models of Verilog programming
- Apply the knowledge of various models of Verilog programming to develop programs for Digital Circuits design
- Subdivide a given task and develop program for the same using subroutines

Outline the concept of synthesis

**Graduate Attributes (As per NBA)**

Engineering Knowledge

**Question paper pattern:**

- The question paper will have ten questions.
- Each full question is for 16 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module. ■

**Text/Reference Books:**

| | | | | |
|---|---|---|---|---|
| 1 | HDL Programming Fundamentals: VHDL and Verilog | Nazeih Botros | Cengage Learning | 2011 |
| 2 | Circuit Design and Simulation with VHDL | Volnei A Pedroni | PHI | 2nd Edition,2014 |
| 3 | Digital Logic Design and VHDL | A. A Phadke S.M. Deokar | Wiley | First Edition,2009 |
| 4 | Fundamentals of HDL | Cyril.P.R | Pearson | First Edition,2014 |
| 5 | Digital System Design using VHDL | Charles H. Roth, jr. | Cengage Learning | 2010 |
| 6 | VHDL; Programming by Example with CD | Douglas Perry | McGraw Hill | 4th Edition,2002 |
| 7 | A Verilog HDL Primer | J.Bhaskar | BS Publications | |

**B.E ELECTRICAL AND ELECTRONICS ENGINEERING (EEE)**
**CHOICE BASED CREDIT SYSTEM (CBCS)**
**SEMESTER - IV**

**RENEWABLE ENERGY (ELECTIVE)**

| | | | |
|---|---|---|---|
| Subject Code | 15EE463 | IA Marks | 20 |
| Number of Lecture Hours/Week | 03 | Exam Hours | 03 |
| Total Number of Lecture Hours | 40 | Exam Marks | 80 |

**Credits - 03**

**Course Objectives:**

- To explain the environmental impact and health hazards of conventional energy sources.
- To introduce different non - conventional energy sources.
- To explain solar energy, solar cell fundamentals and power generation by solar energy
- To explain power generation through wind energy, different types of wind generators.
- To explain power generation using biogas energy, geothermal energy and ocean energy.

| **Module-1** | **Teaching Hours** |
|---|---|
| **Environmental Impacts of conventional Energy Sources:** Introduction, Environmental Management Topics, Environmental Factors, The Health Risk Evaluation Process, and The Hazard Risk Assessment Process. (Chapter 22, Energy Resources Availability, Management, and Environmental Impacts, Kenneth J. Skipka and Louis Theodore).<br>**Non – Conventional Energy Sources:** Introduction to Non – Conventional Energy Sources; solar, wind, Biomass, Biogas, Ocean thermal, Tidal, Geothermal, Hydrogen, Fuel cell, Magneto Hydro Dynamic, Thermionic and Thermo – electric.<br>**Solar Energy:** Introduction, Solar constant, Effective hours of sun(EHS), Solar radiation at the earth's surface, Solar radiation geometry, Solar radiation measurements; pyrheliometer and pyranometer, Solar radiation data, Estimation of average solar radiation, Solar radiation on tilted surfaces. ■ | **08** |
| **Revised Bloom's Taxonomy Level**: $L_1$ – Remembering, $L_2$ – Understanding, $L_3$ – Applying. | |
| **Module-2** | |
| **Solar Electric System:** Solar thermal electric power generation, solar pond and concentrating solar collector (parabolic trough, parabolic dish, central tower collector). Advantages and disadvantages. Solar photovoltaic; solar cell fundamentals, Characteristics, Classification, Construction of module, Panel and array. Solar PV systems, Standalone and grid connected. Applications; Street lighting, Domestic lighting and solar water pumping systems. ■ | **08** |
| **Revised Bloom's Taxonomy Level**: $L_1$ – Remembering, $L_2$ – Understanding, $L_3$ – Applying. | |
| **Module-3** | |
| **Wind Energy:** Introduction, Basic principle of wind energy conversion – Nature of wind, power in the wind, maximum power, forces on the blades and thrust on turbines. Lift and drag. Wind data and energy estimation, site selection consideration. Basic components of Wind Energy Conversion Systems (WECS). Classification of WECS, Advantages and disadvantages of WECS. Constructional features of horizontal axis and vertical axis wind turbines. Generating systems – Introduction, schemes for electric generation, Generator control, transmission control and load control. Introduction to Solar Chimney Power Stations. Advantages and disadvantages of WECS. ■ | **08** |
| **Revised Bloom's Taxonomy Level**: $L_1$ – Remembering, $L_2$ – Understanding, $L_3$ – Applying. | |

**15EE463 NON-CONVENTIONAL ENERGY SOURCES (ELECTIVE) (continued)**
**CHOICE BASED CREDIT SYSTEM (CBCS)**

**Module-4**

**Biomass and Biogas Energy:** Introduction, Photosynthesis process, Biomass fuels, Biomass conversion technologies, Urban waste to energy conversion, Biomass classification, Ethanol production. Biogas production from waste biomass. Factors affecting biogas generation. Types of biogas plants – Jantha model and Khadi and Village Industries type Biogas Plant. ■ **08**

| **Revised Bloom's Taxonomy Level** | $L_1$ – Remembering, $L_2$ – Understanding, $L_3$ – Applying. |
|---|---|

**Module-5**

**Geothermal Energy:** Origin and distribution of geothermal energy, Generation based on hydrothermal resources. Current status of geothermal energy in India and world. **08**

**Ocean Energy:** (i) Tidal energy – Principle, Components of Tidal Power Plant (TPP), Classification of TPP, Estimation of energy – single basin and double basin type TPP, Advantages and limitation of TPP.

(ii) Ocean Thermal Energy – Principle, Methods of Ocean Thermal Energy Conversion (OTEC) methods; Block diagram description of Claude cycle, Anderson cycle and Hybrid cycle. Site selection, Environmental impact, Advantages and disadvantages. ■

| **Revised Bloom's Taxonomy Level** | $L_1$ – Remembering, $L_2$ – Understanding. |
|---|---|

**Course Outcomes:**

At the end of the course the student will be able to:

- Explain the environmental impact and health hazards of conventional energy sources.
- Explain the working of solar cell and power generation using solar energy.
- Explain wind energy conversion system, and estimate the power that can be generated through wind energy after locating a suitable site for a wind mill.
- Explain power generation using biogas energy, geothermal energy and ocean energy

**Graduate Attributes (As per NBA)**

Engineering Knowledge
Environment and sustainability
Engineers and society
Lifelong Learning

**Conduct of Practical Examination:**

1. All laboratory experiments are to be included for practical examination.
2. Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the examiners.
3. Students can pick one experiment from the questions lot prepared by the examiners.
4. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

| 15EE463 NON-CONVENTIONAL ENERGY SOURCES (ELECTIVE) (continued)<br>CHOICE BASED CREDIT SYSTEM (CBCS) | | | | |
|---|---|---|---|---|
| **Text/Reference Books:** | | | | |
| 1 | Energy Resources Availability, Management, and Environmental Impacts | Kenneth J. Skipka et al | CRC Press | 1st Edition, 2014 |
| 2 | Non – Conventional Energy Resources | G.D. Rai | Khanna Publishers | 4th Edition,2010 |
| 3 | Non – Conventional Energy Resources | B.H. Khan | Mc Graw Hill | 2nd Edition,2014 |
| 4 | Non – Conventional Energy Resources | Shobh Nath Singh | Pearson | 1st Edition,2015 |
| 5 | Renewable Energy Sources and Emerging Technologies | D.P Kothari et al | PHI | 2nd Edition, 2011 |
| 6 | Non-Conventional Energy Resources | D.S. Chauhan | New Age Publication | |
| 7 | Energy for 21st Century, A Comprehensive Guide to Conventional and Alternative Sources | Roy L Nersesian | Yesdee Publishing Pvt Ltd | 2011 |

**B.E ELECTRICAL AND ELECTRONICS ENGINEERING(EEE)**
**CHOICE BASED CREDIT SYSTEM (CBCS)**
**SEMESTER - IV**

**OPERATIONS RESEARCH (ELECTIVE)**

| | | | |
|---|---|---|---|
| Subject Code | 15EE464 | IA Marks | 20 |
| Number of Lecture Hours/Week | 03 | Exam Hours | 03 |
| Total Number of Lecture Hours | 40 | Exam Marks | 80 |

**Credits - 03**

**Course Objectives:**

- Learn to formulate the linear programming problem models from the realistic problem description and its solution by graphic solution, simplex method.
- Formulating the transportation problem, travelling salesman's problem and assignment problem as a LPP to obtain its optimal solution.
- Describe the role and application of PERT/CPM for project scheduling, to obtain the project duration and identification critical path for review and analysis, incorporating the uncertainties and probabilistic factors.
- Learn to determine the economic life of equipment, Replacement of items optimally and apply Group replacement policy.

| **Module-1** | **Teaching Hours** |
|---|---|
| **Linear Programming**: Introduction, formulation of linear programming problem, Standard and Matrix form, Graphical solution, simplex method, Computational procedure, Big M method, Dual simplex method.<br>**Special cases:** Degeneracy, Alternative optimal solutions, unbounded solutions, Non existing optimal solutions. ■ | **08** |
| **Revised Bloom's Taxonomy Level**: $L_1$ – Remembering, $L_2$ – Understanding, $L_3$ – Applying, $L_4$ – Analysing. | |
| **Module-2** | |
| **Transportation Problems:** Mathematical Formulation, Basic feasible solution by different methods, finding optimal solutions, stepping stone method, MODI method, degeneracy.<br>**Unbalanced Transportation Problem** and Maximization in Transportation Problem. ■ | **08** |
| **Revised Bloom's Taxonomy Level**: $L_1$ – Remembering, $L_2$ – Understanding, $L_3$ – Applying, $L_4$ – Analysing. | |
| **Module-3** | |
| **Assignment Problems:** Introduction, formulation, Hungarian method of solving the assignment problem, Unbalanced assignment Problem and Maximization type assignment problem.<br>**Travelling salesman problems:** Mathematical Formulation and optimal solution**.** ■ | **08** |
| **Revised Bloom's Taxonomy Level**: $L_1$ – Remembering, $L_2$ – Understanding, $L_3$ – Applying, $L_4$ – Analysing. | |
| **Module-4** | |
| **PERT & CPM Techniques:** Introduction, Definition of basic terms, Network construction, Time analysis, determining critical path, floats and slack times, project duration, variance under probabilistic modes, PERT Procedure, prediction of date of completion and Probability of completion of project in scheduled time. ■ | **08** |
| **Revised Bloom's Taxonomy Level**: $L_1$ – Remembering, $L_2$ – Understanding, $L_3$ – Applying, $L_4$ – Analysing. | |

**15EE464 OPERATIONS RESEARCH (ELECTIVE) (continued)**
**CHOICE BASED CREDIT SYSTEM (CBCS)**

| **Module-5** | **Teaching Hours** |
|---|---|
| **Replacement Theory:** Introduction, Economic life of equipment, Replacement of items that deteriorate with time, considering both the cases : (i)value of money does not change with time (ii) value of money changes with time.<br>**Group replacement policy**. ■ | **08** |
| **Revised Bloom's Taxonomy Level** $L_1$ – Remembering, $L_2$ – Understanding, $L_3$ – Applying, $L_4$ – Analysing. | |

**Course Outcomes:**

At the end of the course the student will be able to:

- Capable of analysing the actual decision making problem, model it with linear programming and obtain the optimal solution of LPP by different methods as graphical solution, simplex method, Big M method & Dual simplex method.
- Able to analyze, formulate, transportation problem, travelling salesman's problem and assignment problem as a LPP to obtain its optimal solution.
- Able to apply the PERT & CPM Techniques for project under consideration for most.
- Economical and optimal operations.
- Capable of determining the economic life of equipment, Replacement of items optimally and applying Group replacement policy.

**Graduate Attributes (As per NBA)**
Engineering Knowledge
Lifelong Learning

**Question paper pattern:**

- The question paper will have ten questions.
- Each full question is for 16 marks.
- There will be 2 full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module. ■

| 15EE464 OPERATIONS RESEARCH (ELECTIVE) (continued)<br>CHOICE BASED CREDIT SYSTEM (CBCS) | | | | |
|---|---|---|---|---|
| **Text/Reference Books:** | | | | |
| 1 | Operations research | S.D. Sharma | Kedar Nath, et al | 2nd Edition, 2001 |
| 2 | Operations research- Concept and cases | Fredrick S Hillier and Lieverman | Mc Graw Hill | 8th edition, 2007 |
| 3 | Operations research an Introduction | Hamdy A Taha | Pearson | 9th Edition, 2014 |
| 4 | Operations research | Kanti Swaroop et.al | S. Chand | 2005 |
| 5 | Operations research | Panneerselvam | PHI | 2nd Edition, 2006 |
| 6 | Operations research | Pradeep Jha | Mc Graw Hill | 1st Edition, 2014 |
| 7 | Operations research | A.M Natarajan, et al | Pearson | 2nd Edition,2014 |
| 8 | Operations research | Er. PremKumar Gupta et al | S.Chand | 7th edition, 2014 |

**B.E ELECTRICAL AND ELECTRONICS ENGINEERING (EEE)**
**CHOICE BASED CREDIT SYSTEM (CBCS)**
**SEMESTER - IV**

**OP- AMP AND LINEAR ICS LABORATORY**

| | | | |
|---|---|---|---|
| Subject Code | 15EEL47 | IA Marks | 20 |
| Number of Practical Hours/Week | 03 | Exam Hours | 03 |
| Total Number of Practical Hours | 42 | Exam Marks | 80 |

**Credits - 02**

**Course Objectives:**

- To conduct different experiments using OP-Amps
- To conduct experiments using Linear IC's

**a).**Study of pin details, specifications, application features of IC741 (LM741) and IC555 (Timer) through corresponding datasheets (Datasheets are instruction manuals for electronic components. They explain exactly what a component does and how to use it.).
**b).**Comparison of output performance quantity of an Operational Amplifier obtained by rigging up the circuit with the ideal value of
(i) A Non – Inverting Amplifier ($V_{out} = AV_{in}$) (ii) An Inverting Amplifier ($V_{out} = -AV_{in}$) (iii) A Difference Amplifier ($V_{out} = -A(V_p - V_n)$) (iv) A Difference Amplifier with floating inputs ($V_{out} = AV_{in}$) (v) A Non – Inverting Amplifier with negative feedback (ii) An Inverting Amplifier with negative feedback (vi) A Differential Amplifier with a negative feedback (vii) A Differential Amplifier with negative feedback and equalised amplifications.
(viii) A Voltage follower (ix) A differential – in differential –out amplifier (x) An instrumentation amplifier
**c).** Plot of input and output transfer characteristics to analyse and conclude that op-amps are rarely used in open-loop.
**d).** Testing of op – amp.

To be covered in 03 Laboratory classes.

| Sl. No | Experiments |
|---|---|
| 1 | Design and verify a precision full wave rectifier. Determine the performance parameters. |
| 2 | Design and realize to analyse the frequency response of an op – amp amplifier under inverting and non - inverting configuration for a given gain. |
| 3 | Design and realize op – amp voltage follower (used as buffer) to operate a buzzer. |
| 4 | Design and verify the output waveform of an op – amp RC phase shift oscillator for a desired frequency. |
| 5 | Design and realize Schmitt trigger circuit using an op – amp for desired upper trip point (UTP) and lower trip point (LTP). |
| 6 | Verify the operation of an op – amp (a) voltage comparator circuit and (b) zero crossing detector. |
| 7 | Design and verify the operation of op – amp as an (a) adder (b) subtractor (c) integrator and (d) differentiator. |
| 8 | Design and realize an op – amp based first order Butterworth (a) low pass (b) high pass and (c) band pass filters for a given cut off frequency/frequencies to verify the frequency response characteristic. |
| 9 | Design and realize an op – amp based function generator to generate sine, square and triangular waves of desired frequency. |
| 10 | Design and verify an IC 555 timer based astable and monostable multivibrator for given frequency and duty cycle. |
| 11 | Design and verify an IC 555 timer based pulse generator for the specified pulse. |
| 12 | Designing of Fixed voltage power supply (voltage regulator) using IC regulators 78 series and 79 series. |

| | |
|---|---|
| **Revised Bloom's Taxonomy Level** | $L_3$ – Applying, $L_4$ – Analysing, $L_5$ – Evaluating, $L_6$ – Creating |

**15EEL47 OP- AMP AND LINEAR ICS LABORATORY (continued)**
**CHOICE BASED CREDIT SYSTEM (CBCS)**

**Course Outcomes:**

At the end of the course the student will be able to:

- To conduct experiment to determine the characteristic parameters of OP-Amp
- To design test the OP-Amp as Amplifier, adder, subtractor, differentiator and integrator
- To design test the OP-Amp as oscillators and filters
- Design and study of Linear IC's as multivibrator power supplies.

**Graduate Attributes (As per NBA)**

Engineering Knowledge
Individual and Team work
Communication

**Conduct of Practical Examination:**

1. All laboratory experiments are to be included for practical examination.
2. Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the examiners.
3. Students can pick one experiment from the questions lot prepared by the examiners.
4. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

**B.E ELECTRICAL AND ELECTRONICS ENGINEERING (EEE)**
**CHOICE BASED CREDIT SYSTEM (CBCS)**
**SEMESTER - IV**

**ELECTRICAL MACHINES LABORATORY -2**

| | | | |
|---|---|---|---|
| Subject Code | 15EEL48 | IA Marks | 20 |
| Number of Practical Hours/Week | 03 | Exam Hours | 03 |
| Total Number of Practical Hours | 42 | Exam Marks | 80 |

**Credits - 02**

**Course Objectives:**

- To perform tests on dc machines to determine their characteristics.
- To control the speed of dc motor
- To conduct test for pre-determination of the performance characteristics of dc machines
- To conduct load test on single phase and three phase induction motor.
- To conduct test on induction motor to determine the performance characteristics
- To conduct test on synchronous motor to draw the performance curves.

| Sl. No | Experiments |
|---|---|
| 1 | Load test on dc shunt motor to draw speed – torque and horse power – efficiency characteristics |
| 2 | Load characteristics of dc series motor. |
| 3 | Speed control of dc shunt motor by armature and field control. |
| 4 | Swinburne's Test on dc motor to determine performance quantities and to plot the curves. |
| 5 | Retardation test on dc motor to find the stray losses and determination of efficiency for a given values of motor copper. |
| 6 | Load test and three phase induction motor and performance characteristics. |
| 7 | Blocked and no - load test on three phase induction motor to draw equivalent circuit and circle diagram and determination of performance from each. |
| 8 | Performance characteristic of an induction machine working as a generator. |
| 9 | Comparison of the performance of three phase induction motor when run on three phase supply and when one of the three lines is open. |
| 10 | Load test on single phase induction motor to draw output versus torque, current, power and efficiency characteristics. |
| 11 | Conduct suitable tests to draw the equivalent circuit of split phase induction motor and determine performance parameters. |
| 12 | Conduct an experiment to draw V and A curves of synchronous motor at no load, 50 % and 100 % full load, and thereon identify the minimum excitation current ( below which the synchronous motor pulls out of synchronism), draw the curves corresponding 1.0, 0.8 and 0.6 lagging and leading power factors. Also identify leading and lagging regions of each V curve and whether the reactive power is generated or absorbed in each region. |

| | |
|---|---|
| **Revised Bloom's Taxonomy Level** | $L_3$ – Applying, $L_4$ – Analysing, $L_5$ – Evaluating, $L_6$ – Creating |

**ELECTRICAL MACHINES LABORATORY -2 (continued)**
**CHOICE BASED CREDIT SYSTEM (CBCS)**

**Course Outcomes:**

At the end of the course the student will be able to:

- Test dc machines to determine their characteristics.
- Control the speed of dc motor
- Pre-determine the performance characteristics of dc machines by conducting suitable tests.
- Perform load test on single phase and three phase induction motor to assess its performance.
- Conduct test on induction motor to pre-determine the performance characteristics
- Conduct test on synchronous motor to draw the performance curves.

**Graduate Attributes (As per NBA)**

Engineering Knowledge
Individual and Team work
Communication

**Conduct of Practical Examination:**

1. All laboratory experiments are to be included for practical examination.
2. Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the examiners.
3. Students can pick one experiment from the questions lot prepared by the examiners.
4. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero. ■

**** END ****