**Dr. Ambedkar Institute of Technology, Bengaluru-560 056**

SCHEME OF TEACHING AND EXAMINATION for **Batch: 2019,** Academic Year: **2020-21**

B.E Name of the programme**: Electrical & Electronics Engineering**

**Outcome Based Education (OBE) and Choice Based Credit System (CBCS)**

**III SEMESTER**

| Sl. No | Course and Course Code | | Course Title | Teaching Department | Teaching Hours /Week | | | Examination | | | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Theory Lecture | Tutorial | Practical/ Drawing | Duration in | CIE Marks | SEE Marks | Total Marks | |
| | | | | | L | T | P | | | | | |
| 1 | BC | 18MA31 | Transforms& Applications | MAT | 2 | 2 | -- | 03 | 50 | 50 | 100 | 3 |
| 2 | PC | 18EE31 | Analog Electronic Circuits | EE | 4 | -- | -- | 03 | 50 | 50 | 100 | 4 |
| 3 | PC | 18EE32 | Logic Design | EE | 3 | 0 | -- | 03 | 50 | 50 | 100 | 3 |
| 4 | PC | 18EE33 | Network Analysis | EE | 3 | 2 | -- | 03 | 50 | 50 | 100 | 4 |
| 5 | PC | 18EE34 | Transformer and Induction Machines | EE | 4 | 0 | -- | 03 | 50 | 50 | 100 | 4 |
| 6 | PC | 18EE35 | Generation, Transmission & Distribution | EE | 3 | 0 | -- | 03 | 50 | 50 | 100 | 3 |
| 7 | PC | 18EEL36 | Electronic Circuits Lab | EE | -- | | 2 | 03 | 50 | 50 | 100 | 1 |
| 8 | PC | 18EEL37 | Logic Design Lab | EE | -- | | 2 | 03 | 50 | 50 | 100 | 1 |
| 9 | HS | 18HS31/32 | Constitution of India Professional Ethics and Human Rights/ / Env. Studies | Hu/ Civ | 1 | -- | -- | 02 | 50 | 50 | 100 | 1 |
| 10 | MC | 18HS33 | Soft skills (MC) | Humanities | 04 | | -- | 03 | 50 | - | 50 | 0 |
| | | | | **TOTAL** | **24** | **04** | **04** | **29** | **500** | **450** | **950** | **24** |
| | | | | | | | | | | | | |
| **Course prescribed to lateral entry Diploma holders admitted to III semester of Engineering programs** | | | | | | | | | | | | |
| 11 | MC | 18MAD31 | Advance Mathematics - I | Mathematics | 02 | 02 | -- | 03 | 50 | 00 | 50 | 00 |

**Subject Title : Analog Electronic Circuits**

Sub.Code: 18EE31 No. of Credits:04=04:0:0 ( L - T – P) No. of Lecture Hours/Week: 04
Exam Duration:03 Hrs CIE+Asmt+GA+SEE=40+5+5+50=100 Total No.of Contact Hours:52

Course Learning Objectives:

1 To study the basic concepts of diode circuits such as clippers, clampers and rectifiers
2 To analyze and design of different transistor circuit biasing along with bias stabilization.
3 To study the modelling of transistor and frequency response.
4 To study and to analyze general, feedback and power amplifiers.
5 To study the basics concept of oscillators and FET amplifiers along with characteristics.

| Unit No | Syllabus Contents | No.of Hours | Blooms Taxnomy level. |
|---|---|---|---|
| 1 | **Diode Circuits*:*** Diode resistance, diode equivalent circuits, transition and diffusion capacitances, clippers and clampers, rectifiers.<br>TEXT 1 and TEXT 2. Reference Book 1 to 5 | 10 | L1,L2,L3. |
| 2 | **Transistor Biasing***:* Operating point, analysis and design of fixed bias circuits, emitter stabilized biased circuits, voltage divider bias, and collector voltage feedback bias. Transistor switching circuits. Bias stabilization: stability factor of different biasing circuits.<br>TEXT 1 and TEXT 2. Reference Book 1 to 5 | 10 | L1,L2,L3. |
| 3 | **Transistor Modelling and Frequency Response:** Transistor as two port network, low frequency hybrid model., relation between h– parameter model of CE, CC and CB modes, Millers theorem and its dual. General frequency considerations, low frequency response, miller effect capacitance, high frequency response.<br>TEXT 1 and TEXT 2. Reference Book 1 to 5 | 10 | L1 to L4 |
| 4 | **a) Multistage Amplifiers:** Cascade and cascade connections, Darlington circuits, analysis and design.<br>**b) Feedback Amplifiers:** Feedback concept, different type of feedback circuits- block diagram approach, analysis of feedback circuits.<br>**c) Power Amplifiers**: Amplifier types, analysis and design of Class A & Class B amplifiers, Harmonic distortion<br>TEXT 1 and TEXT 2. Reference Book 1 to 5 | 11 | L1 to L4 |
| 5 | **a) Oscillators:** Principle of operation, analysis of phase shift oscillator, Wien bridge oscillator, RF and crystal oscillator. (BJT versions)<br>**b) Field Effect Transistors:** Construction, working and characteristics of JFET and MOSFET. Biasing of JFET. Analysis | 11 | L1 to L4 |

| | | | |
|---|---|---|---|
| | and design of JFET (only common source configuration with fixed bias)<br>TEXT 1 and TEXT 2. Reference Book 1 to 5 | | |

**Note 1**: Unit 1 to 5 will have internal choice

**Note2:**
a) Two assignments are evaluated for 5 marks: Assignment -1 from Units 1 and 2. Assignment -2 from Units 3, 4 and 5
b) Group Activity for 5 Marks has to be evaluated through PPT Presentation/ Subject Quiz/ Project/Seminar.

**Note:3** Out of 5 Units, Unit 1 is a Webinar unit conducted through Google Classroom/Zoom/Cisco WebEx etc. and will be delivered by subject faculty.

Course Outcomes:

CO1 Recall the basic diode circuits and describe various wave shaping circuits.

CO2 Explain the working of transistor biasing circuits and locate quiescent point.

CO3 Analyze the models of transistor & FET amplifier circuits.

CO4 Design and develop various transistor amplifier circuits.

CO5 Construct and solve the transistor oscillator circuits.

**Course Outcomes Mapping with Programme Outcomes**.

| Sl.No | Course Outcome | Level of Blooms Taxonomy | No. of hours of teaching | Programme Outcome | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 1. | CO1 | **2** | **10** | **3** | **3** | **1** | **3** | | | **2** | **2** | | **1** | | **1** |
| 2. | CO2 | **2** | **10** | **3** | **3** | **1** | **3** | | | **2** | **2** | | **1** | | **1** |
| 3. | CO3 | **2** | **12** | **3** | **3** | **1** | **3** | | | **2** | **2** | | **1** | | **1** |
| 4. | CO4 | **4** | **12** | **3** | **3** | **1** | **3** | | | **2** | **2** | | **1** | | **1** |
| 5. | CO5 | **5** | **8** | **3** | **3** | **1** | **3** | | | **2** | **2** | | **1** | | **1** |
| **Average CO** | | | | **3** | **3** | **1** | **3** | | | **2** | **2** | | **1** | | **1** |

**Course Outcomes Mapping with Programme Specific Outcomes**

| Course Outcome | PSO1 | PSO2 | PSO3 |
|---|---|---|---|
| **CO1** | 3 | | 1 |
| **CO2** | 3 | | 1 |
| **CO3** | 3 | 2 | 1 |
| **CO4** | 3 | 2 | 1 |
| **CO5** | 3 | 2 | 1 |
| **Average CO** | **3** | **2** | **1** |

**Text Books**.


1 Robert L. Boylestad and Louis Nashelsky, "Electronic Devices and Circuit Theory", 11th Edition, Pearson Education, 2015.

2 Millman and Halkias, "Electronic Devices and Circuits", 4th Edition, Mc Graw Hill, 2015.

3 David A Bell, "Electronic Devices and Circuits", 5th Edition, Oxford University Press, 2008.


**Reference Text Books**.


1 Muhammad Rashid, "Microelectronics Circuits Analysis and Design", 2nd edition, Cengage Learning, 2014

2 B.L. Theraja, A.K. Theraja, "A Text Book of Electrical Technology, Electronic Devices and Circuits", edition, S. Chand Reprint, 2013

3 Anil K. Maini Vasha Agarval, "Electronic Devices and Circuits",1st edition, Wiley publisher, 2009.

4 S.Salivahanan N.Suresh, "Electronic Devices and Circuits",3rd edition, Mc Graw Hill publisher, 2013

5 Thomas L Floyd, "Fundamentals of Analog Circuits", 2nd edition, Pearson publisher, 2012.


**Web Links**.

1 https://www.electronics-tutorials.ws/

2 https://www.tutorialspoint.com/electronic_circuits/electronic_circuits_introduction.htm

3 https://www.electronicshub.org/tutorials/

4 https://www.allaboutcircuits.com/video-tutorials/

**Subject Title : Logic Design**

Sub.Code: 18EE32 No. of Credits:03=03:0:0 ( L - T – P) No. of Lecture Hours/Week : 03

Exam Duration:03 Hrs CIE+Asmt+GA+SEE=40+5+5+50=100 Total No.of Contact Hours:39

Course Learning Objectives:

1 To provide a comprehensive introduction to fundamentals of digital logic design. Karnaugh Map Techniques, Quine McCluskey and MEV Techniques.

2 To provide an understanding on Karnaugh Map Techniques.

3 To provide an understanding on Quine McCluskey and MEV Techniques.

4 To design and analyze combinational circuits.

5 To design and analyze sequential circuits.

| Unit No | Syllabus Contents | No.of Hours | Blooms Taxnomy level. |
|---|---|---|---|
| **1** | Principles of Combinational Logic-I (Karnaugh maps) - 3, 4 and 5 variables, incompletely specified functions (Don't Care terms), Simplifying Max term equations.<br>TEXT 1 and TEXT 2. | 07 | L1,L2,L3. |
| **2** | Principles of Combinational Logic-II: Limitations of K-Maps, Quine-McCluskey Tabulation Algorithm, Quine-McCluskey using don't care terms, Map entered variables (one and two map variables).<br>TEXT 1 and TEXT 2. | 08 | L1,L2,L3. |
| **3** | Analysis and design of combinational logic – II: Digital multiplexers-using multiplexers as Boolean function generators. Binary adders and subtractors, binary comparators. (1 bit, 2 bits and 4 bits)<br>TEXT 1 and TEXT 2. | 08 | L1,L2,L3. |
| **4** | Sequential Circuits – I: Basic bistable element, Latches - SR latch, master-slave flip-flops (pulse-triggered flip-flops): The master-slave SR flip-flops, master-slave JK flip-flops, edge triggered flip-flops: The positive edge-triggered D flip-flops, negative-edge triggered D flip-flop<br>TEXT 1 and TEXT 2. | 08 | L1,L2,L3. |
| **5** | Sequential Circuits –II: Characteristic equations, registers, counters - binary ripple counters, synchronous binary counters, counters based on shift registers (ring and Johnson), design of a synchronous counters, design of a synchronous mod-6 counter using clocked JK, D, T & SR flip-flops. Sequential Circuit Design - Mealy and Moore models.<br>TEXT 1 and TEXT 2. | 08 | L1,L2,L5 |

**Note 1**: Unit 1 to 5 will have internal choice

**Note2:** a)Two assignments are evaluated for 5 marks: Assignment -1 from Units 1 and 2. Assignment -2 from Units 3, 4

b) Activity for 5 Marks has to be evaluated through PPT presentation/Subject quiz/ Project/ Seminar.

**Note:3** Out of 5 Units, Unit 5 is a Webinar unit conducted through Google Classroom/Zoom/Cisco Webex etc and will be delivered by subject faculty.

**Course Outcomes:**

CO1 To exemplify the concept of combinational systems using standard gates and minimization methods (Karnaugh Maps up to 5 variables)

CO2 To identify the limitations of K- map and use computerized simplification Techniques (Quine McCluskey tabulation and MEV methods).

CO3 To analyze and design combinational systems composed of standard combinational modules, such as multiplexers, decoders, encoders, adders, subtractors and binary comparators.

CO4 To demonstrate knowledge of simple synchronous sequential systems (flip-flops and latches).

CO5 To analyze and design sequential systems composed of standard sequential modules, such as counters, registers, Mealy and Moore Models.

**Course Outcomes Mapping with Programme Outcomes.**

| Sl.No | Course Outcome | Level of Blooms Taxonomy | No. of hours of teaching | Programme Outcome | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 1. | CO1 | **2** | **08** | **3** | **3** | **1** | **2** | | | | | | **2** | | **2** |
| 2. | CO2 | **2** | **11** | **3** | **3** | **1** | **2** | | | | | | **2** | | **2** |
| 3. | CO3 | **2** | **12** | **3** | **3** | **1** | **2** | | | | | | **2** | | **2** |
| 4. | CO4 | **4** | **10** | **3** | **3** | **1** | **2** | | | | | | **2** | | **2** |
| 5. | CO5 | **5** | **11** | **3** | **3** | **1** | **2** | | | | | | **2** | | **2** |
| **Average CO** | | | | **3** | **3** | **1** | **2** | | | | | | **2** | | **2** |

**Course Outcomes Mapping with Programme Specific Outcomes**

| Course Outcome | PSO1 | PSO2 | PSO3 |
|---|---|---|---|
| **CO1** | 1 | 2 | 1 |
| **CO2** | 1 | 2 | 1 |
| **CO3** | 1 | 2 | |
| **CO4** | 1 | 2 | 1 |
| **CO5** | 1 | 3 | |
| **Average CO** | **1** | **2** | **1** |

**Text Books.**


1 John M Yarbrough, “Digital Logic Applications and Design”, Third Reprint, Thomson, 2002

2 R D Sudhaker Samuel, “Logic Design”, Revised edition, Sanguine Technical Publishers, 2006


**Reference Text Books.**

1 Charles H Roth, "Fundamentals of logic design", Second edition, Thomson Learning, 2004
2 Mono and Kim, "Logic and computer design Fundamentals", Second edition, Pearson, 2001

**Web Links**.

1 https://nptel.ac.in/courses/117/105/117105080/

**Subject Title : Network Analysis**

Sub.Code: 18EE33 No. of Credits:04=03:1:0 ( L - T – P) No. of Lecture Hours/Week : 05
Exam Duration:03 Hrs CIE+Asmt+GA+SEE=40+5+5+50=100 Total No.of Contact Hours:65

Course Learning Objectives: This course will enable students to:

1 Describe, Apply and Analyze basic network concepts emphasizing Series and Parallel Combination of Passive Components, Source Transformation and Shifting, Star-Delta Transformation Techniques.
2. Describe, Apply and Analyze use of mesh and nodal techniques for Formulating the Transfer Function of Networks.
3 Apply and Analyze various network theorems in solving the problems related to Electrical Circuits
4 To determine the solution of electrical network using Laplace transformations, Steady state behavior of circuit elements and frequency response in resonant circuits.
5 Describe and Analyze two port networks and methods of analyzing the Electrical Networks..

| Unit No | Syllabus Contents | No.of Hours | Blooms Taxnomy level. |
|---|---|---|---|
| 1 | Basic Concepts: Practical sources, source transformations, network reduction using star – delta transformation, loop and node analysis with linearly dependent and independent sources for DC and AC networks. Concepts of super node and super mesh.<br>Text 1, Text 2 and Reference Text 1 | 15 | L1,L2,L3. |
| 2 | Network Theorems: Superposition theorem, Reciprocity theorem, Thevinin's theorem, Norton's theorem and Maximum Power transfer theorem.<br>Text 1 and Text 2 | 14 | L1,L2,L3. |
| 3 | Laplace Transformation & Applications:<br>Solution of networks, step, ramp and impulse responses, waveform Synthesis.<br>Text 2 and Text 3 | 12 | L1,L2,L3. |
| 4 | a) Resonant Circuits: Series and parallel resonance, frequency-response of series and parallel circuits, Q factor, bandwidth.<br>b) Transient behaviour and initial conditions: Behaviour of circuit elements under switching condition and their representation, Evaluation of initial and final conditions in RL, RC and RLC circuits for DC excitations.<br>Text 2 | 11 | L1,L2,L3. |
| 5 | a) Network Topology: Graph of a network, Concept of tree and co-tree, incidence matrix, tie-set and cut-set schedules, Formulation of equilibrium equations in matrix form, solution of resistive networks and principle of duality.<br>Two port network parameters: Definition and Calculation of z, y, h and ABCD transmission parameters. Modeling with these parameters | 13 | L1,L2,L3. |

| | | | |
|---|---|---|---|
| | Text 2 and Text 3 and Reference 1 | | |

**Note 1**: Unit 1 to 5 will have internal choice

**Note2:** a) Two assignments are evaluated for 5 marks: Assignment -1 from Units 1 and 2. Assignment -2 from Units 3, 4

b) Activity for 5 Marks has to be evaluated through PPT presentation/Subject quiz/ Project/ Seminar.

**Note:3** Out of 5 Units, Unit 4 is a Webinar unit conducted through Google Classroom/Zoom/Cisco Webex etc and will be delivered by subject faculty.

**Course Outcomes: Acquire knowledge for solving problems related to**

CO1 Series and Parallel combination of Passive Components, source transformation techniques, Star – Delta Transformation techniques and source shifting techniques

CO2 Network Theorems and Electrical Laws to reduce circuit complexities and to arrive at feasible solutions.

CO3 Analyze the circuit using time and frequency domain.

CO4 Analyze and design resonant circuits.

CO5 Various Two Port Network parameters and their relationship for finding network solutions..

**Course Outcomes Mapping with Programme Outcomes.**

| Sl.No | Course Outcome | Level of Blooms Taxonomy | No. of hours of teaching | Programme Outcome | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 1. | CO1 | 2 | 10 | | 3 | 1 | 2 | | | | 2 | | 2 | | 2 |
| 2. | CO2 | 2 | 10 | 3 | 3 | 1 | 2 | | | | 2 | | 2 | | 2 |
| 3. | CO3 | 2 | 12 | 3 | 3 | 1 | 2 | | | | 2 | | 2 | | 2 |
| 4. | CO4 | 4 | 12 | 3 | 3 | 1 | 2 | | | | 2 | | 2 | | 2 |
| 5. | CO5 | 5 | 08 | 3 | 3 | 1 | 2 | | | | 2 | | 2 | | 2 |
| **Average Course Outcomes** | | | | **3** | **3** | **1** | **2** | | | | **2** | | **2** | | **2** |

**Course Outcomes Mapping with Programme Specific Outcomes**

| Course Outcome | PSO1 | PSO2 | PSO3 |
|---|---|---|---|
| **CO1** | **3** | **2** | **1** |
| **CO2** | **3** | **2** | **1** |
| **CO3** | **3** | **2** | **1** |
| **CO4** | **3** | **2** | **1** |
| **CO5** | **3** | **2** | **1** |
| **Average PSO** | **3** | **2** | **1** |

**Text Books**.


1 Hayt, Kemmerly and Durbin, "**Engineering Circuit Analysis**", 10th Edition, TMH Publication, 2015

2 Roy Choudhury, "**Networks and systems**", 2nd Edition, New Age International Publications, 2016

3 M. E. Van Valkenburg, "**. Network Analysis**",3rd Eedition, PHI publisher, 2009


**Reference Text Books**.


1 A K Chakraborty, S P Ghosh, "Network Analysis and Synthesis", 1st Edition, TMH publisher, 2009

2 Robert L and Boylestad "Introductory Circuit Analysis", 4TH edition, Pearson publisher, 2010

3 M Nahvi and J A Edminister, "Electric Circuits", 2nd Edition, Schaum's Series , 2002


**Web Links**.

1 https://www.khanacademy.org/science/electrical-engineering/ee-circuit-analysis-topic, "

2 https://www.circuitlab.com/

3 https://www.youtube.com/watch?v=sqxzQkAdJm0

**Subject Title : Transformers and Induction Machines**

Sub.Code: 18EE34 No. of Credits:04=04:0:0 ( L - T – P) No. of Lecture Hours/Week : 04
Exam Duration:03 Hrs CIE+Asmt+GA+SEE=40+5+5+50=100 Total No.of Contact Hours:52

Course Learning Objectives:

1 To understand the concepts of transformers, induction machines and their analysis.
2 To evaluate the performance of transformers and induction machines.
3 To analyze the concepts to operate transformers in different configurations and operate in parallel.
4 To understand starters, methods of speed control of induction motor and induction generator.
5 To analyze induction motor with high torque rotors construction.

| Unit No | Syllabus Contents | No.of Hours | Blooms Taxnomy level. |
|---|---|---|---|
| 1 | Basic Concepts: Review of principle of operation, constructional details of shell type and core type single-phase and three-phase transformers, EMF equation, losses and commercial efficiency, condition for maximum efficiency (No question shall be set from the review portion). Concept of ideal transformer, operation of practical power transformer under no load and on load -with phasor diagrams. Equivalent circuit, Open circuit and Short circuit tests, calculation of parameters of equivalent circuit and predetermination of efficiency-commercial and all-day<br>TEXT 1 and TEXT 2. Reference Book | 10 | L2,L3,L4 |
| 2 | Transformer continuation: Voltage **r**egulation and its significance. Objects of testing of transformers, polarity test, Sumpner's test.<br>Three-phase Transformers: Introduction, choice between single unit three-phase transformer and bank of single-phase transformers. Transformer connection for three phase operation – star/star, delta/delta, star/delta, delta /star and V/V**.** Phase conversion - Scott connection for three-phase to two-phase conversion. Current inrush in transformers.<br>TEXT 1 and TEXT 2. Reference Book | 11 | L2,L3,L4 |

| Unit No | Syllabus Contents | No.of Hours | Blooms Taxnomy level. |
|---|---|---|---|
| 3 | Parallel operation (Single-phase & Three-phase): Need, conditions to be satisfied for parallel operation. Load sharing in case of similar and dissimilar transformers.<br>Instrument Transformers: Current transformer and Potential transformer.<br>(c)Three phase Induction Machines: Review of concept of rotating magnetic field. Principle of operation, construction of squirrel-cage, slip-ring induction motor (No question shall be set from the review portion).<br>TEXT 1 and TEXT 2. Reference Book 1 | 11 | L2,L3,L4 |
| 4 | (a) Characteristic Induction Motor continuation: Slip, torque, torque-slip characteristic. Maximum torque. **p**hasor diagram of induction motor on no-load and on load. Equivalent circuit, losses, efficiency. No-load and blocked rotor tests. Circle diagram and performance evaluation of the motor. Cogging and crawling.<br>(b) Starters & Speed Control of Three-phase Induction Motors: Need for starter. Direct on line (DOL) starters, Star-Delta and autotransformer starting. Rotor resistance starting. Soft (electronic) starters. Speed control - voltage, frequency, and rotor resistance.<br>TEXT 1 and TEXT 2. Reference Book 1 | 10 | L2,L3,L4 |
| 5 | High torque rotors - Double Cage and deep bar rotor, Equivalent circuit and performance evaluation of double cage induction motor. Induction generator – externally excited and self-excited. Importance of induction generators.<br>(b)Single-phase Induction Motor: Double revolving field theory and principle of operation. Types of single-phase induction motors: split-phase, capacitor start, shaded pole motors. Applications.<br>TEXT 1 and TEXT 2. Reference Book 1 | 10 | L2,L3,L4 |

**Note 1**: Unit 1 to 5 will have internal choice

**Note2:** a)Two assignments are evaluated for 5 marks: Assignment -1 from Units 1 and 2. Assignment -2 from Units 3, 4

b) Activity for 5 Marks has to be evaluated through PPT presentation/Subject quiz/ Project/ Seminar.

**Note:3** Out of 5 Units, Unit 5 is a Webinar unit conducted through Google Classroom/Zoom/Cisco Webex etc and will be delivered by subject faculty.

**Course Outcomes**:

CO1 Explain the construction, operation of transformer and induction machines (1-phase and 3-phase).

CO2 Understand the different connections for the three phase operations, advantages and applications.

CO3 Evaluate the performance of transformers and induction machines.

CO4 Analyze induction motors with different rotors and as induction generator.

CO5 Understand the different starters and speed control techniques of three-phase induction motors.

**Course Outcomes Mapping with Programme Outcomes.**

| Sl.No | Course Outcome | Level of Blooms Taxonomy | No. of hours of teaching | Programme Outcome | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 1. | CO1 | 2 | 10 | | 3 | 1 | 2 | | | | 2 | | 2 | | 2 |
| 2. | CO2 | 2 | 10 | 3 | 3 | 1 | 2 | | | | 2 | | 2 | | 2 |
| 3. | CO3 | 2 | 12 | 3 | 3 | 1 | 2 | | | | 2 | | 2 | | 2 |
| 4. | CO4 | 4 | 12 | 3 | 3 | 1 | 2 | | | | 2 | | 2 | | 2 |
| 5. | CO5 | 5 | 08 | 3 | 3 | 1 | 2 | | | | 2 | | 2 | | 2 |
| **Average Course Outcomes** | | | | **3** | **3** | **1** | **2** | | | | **2** | | **2** | | **2** |

**Course Outcomes Mapping with Programme Specific Outcomes**

| Course Outcome | PSO1 | PSO2 | PSO3 |
|---|---|---|---|
| **CO1** | 3 | | 1 |
| **CO2** | 3 | | 1 |
| **CO3** | 3 | | 1 |
| **CO4** | 3 | 2 | 1 |
| **CO5** | 3 | | 1 |
| **Average CO** | **3** | **2** | **1** |

**Text Books.**


1 I. J. Nagrath and D. P. Kothari,, “Electric Machines,”, 4th Edition, Tata Mc Graw Hill, 2010

2 B L Theraja, “Electrical technology-AC & DC Machines”, 2 Vol, S Chand Publishers, 2012


**Reference Text Books.**


1 M. G. Say, “Performance and Design of A.C. Machines”, 3rd Edition, C.B.S Publishers, 2002

2 Kosow, “Electrical Machines and Transformers”, 2nd edition, Pearson, 2007

3 Alexander Langsdorf, “Theory of Alternating Current Machines”, 2nd edition, T.M.H, 2001

4 M.V Bhakshi, “Transformer and Induction Machine”, 3rd Edition, Technical Publisher, 2009

5 Robert M. Del Vecchi, "Transformer Design Principles", 3rd Edition, CRC PRESS, 2017

**Web Links**.

1 https://www.electrical4u.com/electric-machines/

2 www.transformertechnologies.com

3 https://en.wikipedia.org/wiki/Hyperlink

**Subject Title : Generation, Transmission and Distribution**

Sub.Code: 18EE35 No. of Credits: 3; L:T:P- 3:0:0 No. of Lecture Hours/Week: 03
Exam Duration:03 Hrs CIE+Asmt+GA+SEE=40+5+5+50=100 Total No.of Contact Hours:39

Course Learning Objectives:

1 To introduce the concepts and various sources for power generation
2 To describe the overhead and underground transmission systems.
3 To understand the concepts of insulators, corona and distribution systems
4 To evaluate the line parameters of transmission systems
5 To analyze the performance of power transmission lines

| Unit No | Syllabus Contents | No.of Hours | Blooms Taxnomy level. |
|---|---|---|---|
| 1 | **a) Generation:** Sources of electrical power: General arrangement & working of nuclear, thermal and hydro power plant (block diagram approach only) , nuclear power plant - site selection, pros and cons, thermal power plant – site selection, pros and cons, hydro power plant, site selection, pros and cons.<br>**b) Introduction to typical transmission and distribution systems:** General layout of power system, Standard voltages for transmission, advantages and limitation of AC transmission system.<br>TEXT 1 and TEXT 2. Reference Book 1 & 2 | 07 | L1,L2 & L3 |
| 2 | **Overhead Transmission Lines**: Types of supporting structures and line conducting materials used. Sag calculation- supports at same level and at different levels. Effect of wind and ice, Sag at erection, Stringing chart and sag templates. Line vibration dampers. TEXT 1 and TEXT 2. Reference Book 1 & 2 | 08 | L1,L2,L4 |
| 3 | **a) Line parameters:** Calculation of inductance of single phase line, three phase line with equilateral spacing, unsymmetrical spacing, double circuit and transposed lines. Capacitance of single phase line, three phase line with equilateral spacing, unsymmetrical spacing, double circuit and transposed lines.<br>**b) Performance of Power Transmission Lines:** Short transmission lines, medium transmission lines- nominal T, End condenser and π models, long transmission lines, ABCD constants of transmission lines, Ferranti effect, line regulation.<br>TEXT 1 and TEXT 2. Reference Book 2 & 3 | 08 | L1,L2,L3,L4 |
| 4 | **a) Insulators**: Introduction, classification, potential distribution over a string of suspension insulators. String | 08 | L2,L3,L4 |

| Unit No | Syllabus Contents | No.of Hours | Blooms Taxnomy level. |
|---|---|---|---|
| | efficiency & methods of improving string efficiency - grading rings and arcing horns.<br>**b) Corona:** Phenomena, disruptive and visual critical voltages, corona power loss, illustrative examples. Advantages and disadvantages of corona. TEXT 1 and TEXT 2. Reference Book 1 & 3 | | |
| 5 | **a) Underground Cables:** Types, material used, insulation resistance, charging current, grading of cables - capacitance grading & inter sheath grading, testing of cables.<br>**b) Distribution systems:** Requirements of power distribution, radial & ring main systems, AC and DC distribution - Calculation for concentrated loads and uniform loading, illustrative examples.<br>TEXT 1 and TEXT 2. Reference Book 2 & 3 | 8 | L2,L3,L4 |

**Note 1**: Unit 1 to 5 will have internal choice

**Note2:** Two assignments are evaluated for 5 marks: Assignment -1 from Units 1 and 2. Assignment -2 from Units 3, 4 and 5 and Group Activity for 5 Marks

**Note:3** Out of 5 Units, Unit 5 is a Webinar unit conducted through Google Classroom/Zoom/Cisco Webex etc and will be delivered by subject faculty.

Course Outcomes:

CO1 Explain the different methods of Power generation concepts using renewable and non – renewable sources and typical transmission scheme and voltage levels

CO2 Describe the mechanical design calculations, different types of line insulators and the concept of Corona, formation, its influence on the operation of overhead transmission lines.

CO3 Apply the acquired knowledge of transmission and distribution systems, analyze the DC & AC distributors with different types of loads and analyse the working of underground Cables.

CO4 Apply the acquired knowledge to evaluate line parameters of 1-Φ and 3- Φ transmission and distribution systems.

CO5 Analyze the performance of power transmission lines by evaluating the line regulation and efficiency.

**Course Outcomes Mapping with Programme Outcomes.**

| Sl.No | Course Outcome | Level of Blooms Taxonomy | No. of hours of teaching | Programme Outcome | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 1. | CO1 | **1,2,3** | **10** | **3** | **3** | **1** | **2** | | | | **2** | | **2** | | **2** |
| 2. | CO2 | **1,2,4** | **10** | **3** | **3** | **1** | **2** | | | | **2** | | **2** | | **2** |
| 3. | CO3 | **1,2,3,4** | **12** | **3** | **3** | **1** | **2** | | | | **2** | | **2** | | **2** |
| 4. | CO4 | **2,3,4** | **12** | **3** | **3** | **1** | **2** | | | | **2** | | **2** | | **2** |
| 5. | CO5 | **2,3,4** | **8** | **3** | **3** | **1** | **2** | | | | **2** | | **2** | | **2** |
| **Average COs** | | | | **3** | **3** | **1** | **2** | | | | **2** | | **2** | | **2** |

**Course Outcomes Mapping with Programme Specific Outcomes.**

| Course Outcome | PSO1 | PSO2 | PSO3 |
|---|---|---|---|
| **CO1** | 3 | 1 | 1 |
| **CO2** | 3 | 1 | 1 |
| **CO3** | 3 | 1 | 1 |
| **CO4** | 3 | 1 | 1 |
| **CO5** | 3 | 1 | 1 |
| **Average CO** | **3** | **1** | **1** |

**Text Books.**


1 S. M. Singh, "Electric Power Generation, Transmission and Distribution", Second Edition, PHI Publisher, 2009

2 Soni Gupta & Bhatnagar, Dhanpat Rai & Sons, "A Course in Electrical Power", Third Edition, Dhanpat Rai & Sons Publisher, 2010


**Reference Text Books.**


1 W.D. Stevenson, "Elements of Power System Analysis", Fourth Edition, TMH publisher, 2017

2 Dr. S. L. Uppal, "Electrical Power Systems", Fifteenth Edition, Khanna Publications publisher, 1987

3 C. L. Wadhwa, "Electrical Power Systems", Sixth Edition, New Age International Publisher, 2010


**Web Links.**

1 https://nptel.ac.in/courses/108/102/108102047/

2 https://www.smartzworld.com/notes/transmission-and-distribution-pdf-vtu-td/

**Subject Title : Electronic Circuits Lab**

| | | |
|---|---|---|
| Sub.Code: 18EEL36 | No. of Credits:1=0:0:1 ( L - T – P) | No. of Lecture Hours/Week : 02 |
| Exam Duration:3 Hrs | CIE +SEE=50+50=100 | Total No.of Contact Hours:26 |

Course Learning Objectives:

1 To introduce the electronic components and devises to identify, read their ratings, tolerance operations etc.,
2 Design resonant circuits to resonate at required frequencies.
3 Design resonant circuits to resonate at required frequencies..
4 Design and test various amplifier circuits..
5 Construct and verify various circuits to oscillate at specified frequency

| Expt No | Expertiment Contents | No.of Hours | Blooms Taxnomy level. |
|---|---|---|---|
| | **Introduction**: Use of bread board, CRO, power supplies, signal generators, DRBs, DIBs, DCBs; color codes, resistors, inductors, capacitors, rheostats, multimeters; transistors, diodes; device data sheets. | 2 | L1-L4 |
| **1** | **Clipping Circuits**: Design and testing of diode shunt, series and peak detection clippers | 2 | L1-L4 |
| **2** | **Clamping Circuits**: Design and testing of diode clamping circuits. | 2 | L1-L4 |
| **3** | **Rectifier Circuits**: Testing of half wave, full wave and bridge diode rectifiers with and without capacitor filter, determination of ripple factor, regulation and efficiency. | 2 | L1-L5 |
| **4** | **Resonant Circuits:** Characteristics of series and parallel resonant circuits. | 2 | L1-L5 |
| **5** | **Transistor Static Characteristics:** CE, CB and CC modes and determination of h parameters. | 2 | L1-L5 |
| **6** | **RC Coupled Amplifier:** Design of single stage BJT amplifier and determination of the gain-frequency response, input and output impedances. | 2 | L1-L5 |
| **7.** | **Darlington Emitter Follower:** Design of BJT Darlington emitter follower circuit and determination of the gain, input and output impedances. | 2 | L1-L5 |
| **8.** | **RC Phase Shift Oscillator**: Design and testing for the performance of BJT-RC Phase shift oscillator for a frequency, $f_0 \leq 10$ kHz | 2 | L1-L4 |

| Expt No | Expertiment Contents | No.of Hours | Blooms Taxnomy level. |
|---|---|---|---|
| **9** | **Tuned Oscillators:** Design and testing of the performance of BJT-RC Hartley and Colpitt's oscillator for frequency, $f_0 \geq 100$ kHz | 2 | L1-L5 |
| **10** | **Crystal Oscillator:** Design and testing of BJT -crystal oscillator for $f_0 > 1$ MHz | 2 | L1-L5 |
| | **Experiments beyond the Syllabus** | | |
| **1** | **Cascade Amplifier:** Design of RC coupled two stage amplifier and determination of the gain-frequency response, input and output impedances. | 2 | L1-L5 |
| **2** | **Push Pull Amplifier:** Design and testing of class B push pull power amplifier. | 2 | L1-L5 |

Note 1: Laboratory report should be submitted to the subject faculty every week and evaluation will be done on the same week only.

**Course Outcome**.

CO1 Explain the working of diode wave shaping circuits and to draw transfer characteristics.

CO2 Evaluate the characteristics of BJTs

CO3 Test the resonant circuits resonating at required frequency.

CO4 Design of amplifier circuit, draw frequency response and determine input and output impedances

CO5 Construct and test transistor circuits to oscillate at desired frequencies.

**Course outcomes Mapping with programme outcomes**

| Sl.No | Course Outcome | Level of Blooms Taxonomy | No. of hours of teaching | Programme Outcome | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 1. | CO1 | **2** | **2** | **3** | **3** | | | **1** | **1** | | | | | **2** | **2** |
| 2. | CO2 | **2** | **2** | **3** | **3** | 1 | | **1** | | | **1** | | | **2** | **2** |
| 3. | CO3 | **2** | **3** | **3** | **3** | 1 | | **1** | | **1** | | | | **2** | **2** |
| 4. | CO4 | **4** | **3** | **3** | **3** | 1 | | **1** | | | | | | **2** | **2** |
| 5. | CO5 | **5** | **3** | **3** | **3** | 1 | | **1** | **1** | | | | | **2** | **2** |
| **Average CO** | | | | 3 | 3 | 1 | | 1 | 1 | 1 | 1 | 1 | | 2 | 2 |

**Course outcomes Mapping with Programme Specific Outcomes**

| Course Outcome | PSO1 | PSO2 | PSO3 |
|---|---|---|---|
| **CO1** | 3 | 2 | 1 |
| **CO2** | 3 | 2 | 1 |
| **CO3** | | 2 | 1 |
| **CO4** | 3 | | 1 |
| **CO5** | 3 | 2 | |

| | | | |
|---|---|---|---|
| **Average CO** | 3 | 2 | 1 |

**References Text Books**.


1 Robert L. Boylestad and Louis Nashelsky, 'Electronic Devices and Circuit Theory', PHI/Pearson Education. 9TH Edition,2010

2 Departmental Laboratory Manual


**Web Links**.

1 http://vlabs.iitb.ac.in/vlabs-dev/labs/analog-electronics/experiments/wein-bridge-oscillator-iitr/

2 http://vlabs.iitb.ac.in/vlabs-dev/labs/analog-electronics/experimentlist.html

**Subject Title : Logic Design Lab**

| | | |
|---|---|---|
| Sub.Code: 18EEL36 | No. of Credits:1=0:0:1 ( L - T – P) | No. of Lecture Hours/Week : 02 |
| Exam Duration:3 Hrs | CIE +SEE=50+50=100 | Total No.of Contact Hours:26 |

Course Learning Objectives:

1 Introduction to digital electronics lab- nomenclature of digital ICs, specifications, study of the data sheet, concept of Vcc and ground, verification of the truth tables of logic gates using ICs.

2 Implementation of the given Boolean function using logic gates in both SOP and POS forms.

3 Verification of state tables of SR, JK, T and D flip-flops using ICs.

4 Implementation and verification of Decoder and Encoder using logic gates.

5 Design and verify the 4-bit synchronous counter.

| Expt No | Experiment Contents | No.of Hours | Blooms Taxnomy level. |
|---|---|---|---|
| **1** | Realization of half / full Adder and half/full Subtractors using Logic gates | 2 | L1, L2 |
| **2** | .i ) Realization of parallel adder/Subtractors using 7483 chip<br>(ii) BCD to Excess-3 code conversion and vice versa. | 2 | L1,L2,L3 |
| **3** | Realization of Binary to Gray code converter and vice versa. | 2 | L1, L2, L3,L4 |
| **4** | Design and Testing of 555 Timer | 2 | L1, L2, L3, L4 |
| **5** | Realization of One / Two bit comparator & study of 7485 magnitude comparator. | 2 | L1, L2, L3, L4 |
| **6** | MUX / DEMUX use of 74153, 74139 for arithmetic circuits and code conversion | 2 | L1, L2, L3, L4 |
| **7.** | Design and realization of 4 bit magnitude comparator using IC 7485. | 2 | L1, L2, L3, L4 |
| **8.** | Use of a) Decoder chip to drive LED/LCD Display and b) Priority encoder | 2 | L1, L2, L3, L4 |
| **9** | Truth table verification of flip-flops: 1) J-K Master Slave 2) T-Type 3) D-Type | 2 | L1, L2, L3, L4 |
| **10** | Shift left, Shift right, SIPO,SISO, PISO, PIPO operations using IC 7495S | 2 | L1, L2, L3, L5 |
| | **Experiments beyond the Syllabus** | | |
| **1** | Realization of 3 bit counters as a sequential circuit using | 2 | L1,l2 |
| **2** | Design and Testing o Ring and Johnson counters using IC7495, IC7490, IC74193 | 2 | L1,l2 |

Note 1: Laboratory report should be submitted to the subject faculty every week and evaluation will be done on the same week only.

Course Outcomes:

CO1 Apply the concept of various ICs, Logic gates and other components used in Digital logic circuit design.

CO2 Solve K-Maps and realize Boolean expressions.

CO3 Design and implement various code converters.

CO4 Design and implement combinational circuits for various digital applications.

CO5 Design and implement sequential circuits.

**Course outcomes Mapping with programme outcomes**

| Sl.No | Course Outcome | Level of Blooms Taxonomy | No. of hours of teaching | Programme Outcome | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 1. | CO1: | **2** | **5** | **3** | **3** | **3** | | **3** | | | | **3** | **3** | | **3** |
| 2. | CO2: | **3** | **5** | **3** | **3** | **2** | | **3** | | | | **2** | **3** | | **3** |
| 3. | CO3: | **5** | **5** | **2** | **2** | **2** | | **2** | | | | **2** | **2** | | **2** |
| 4. | CO4: | **5** | **5** | **3** | **2** | **3** | | **2** | | | | **3** | **2** | | **2** |
| 5. | CO5: | **5** | **4** | **3** | **3** | **3** | | **2** | | | | **3** | **3** | | **3** |
| **Average CO** | | | | **3** | **3** | **3** | | **2** | | | | **3** | **3** | | **3** |

**Course outcomes Mapping with Programme Specific Outcomes**

| Course Outcome | PSO1 | PSO2 | PSO3 |
|---|---|---|---|
| **CO1** | | 2 | |
| **CO2** | 2 | 2 | 2 |
| **CO3** | | 2 | |
| **CO4** | | 2 | |
| **CO5** | | 2 | |
| **Average CO** | **2** | **2** | **2** |

**References Text Books**.


1 K A Krishnamurthy, "Digital Lab Primer", Reprint Edition, Pearson Education Asia Publications , 2003

2 Departmental Lab Manual


**Web links.**

1. **State Diagram:** https://cse15-iiith.vlabs.ac.in/exp10/Introduction.html?domain=Computer%20Science&lab=DLD%20Lab
2. **ALU with function:** https://cse15-iiith.vlabs.ac.in/exp4/Introduction.html?domain=Computer%20Science&lab=DLD%20Lab

**Dr. Ambedkar Institute of Technology, Bengaluru-560 056**

SCHEME OF TEACHING AND EXAMINATION for **Batch: 2019,** Academic Year: **2020-21**

B.E Name of the programme**: Electrical & Electronics Engineering**

**Outcome Based Education (OBE) and Choice Based Credit System (CBCS)**

**IV SEMESTER**

| Sl. No | Course and Course code | | Course Title | Teaching Department | Teaching Hours /Week | | | Examination | | | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Theory Lecture | Tutorial | Practical | Duration in hours | CIE Marks | SEE Marks | Total Marks | |
| | | | | | L | T | P | | | | | |
| 1 | BC | 18MA41 | Probability, Numerical and Optimization Techniques | MA | 2 | 2 | -- | 03 | 50 | 0 | 100 | 3 |
| 2 | PC | 18EE41 | Electrical & Electronic Measurements and Instruments | EE | 3 | 0 | -- | 03 | 50 | 50 | 100 | 3 |
| 3 | PC | 18EE 42 | Control Systems | EE | 4 | -- | -- | 03 | 50 | 50 | 100 | 4 |
| 4 | PC | 18EE 43 | DC Machines and Synchronous Machines | EE | 4 | 0 | -- | 03 | 50 | 50 | 100 | 4 |
| 5 | PC | 18EE 44 | Power Electronics | EE | 4 | 0 | -- | 03 | 50 | 50 | 100 | 4 |
| 6 | PC | 18EE 45 | Linear Integrated Circuits & Applications | EE | 2 | 2 | -- | 03 | 50 | 50 | 100 | 3 |
| 7 | PC | 18EE L46 | Transformer and Induction Machines Lab | EE | 0 | | 2 | 03 | 50 | 50 | 100 | 1 |
| 8 | PC | 18EE L47 | Power Electronics Lab | EE | 0 | | 2 | 03 | 50 | 50 | 100 | 1 |
| 9 | HS | 18HS41/42 | Constitution of India Professional Ethics and Human Rights/ Env. Studies | HS/CV | 1 | -- | -- | 02 | 50 | 50 | 100 | 1 |
| 10 | MC | 18HS43 | Soft skills (NCMC) | HS | 04 | | -- | 03 | 50 | - | 50 | 0 |
| **TOTAL** | | | | | **24** | **04** | **04** | **29** | **500** | **450** | **950** | **24** |
| **Course prescribed to lateral entry Diploma holders admitted to III semester of Engineering programs** | | | | | | | | | | | | |
| 11 | MC | 18MAD41 | Advance Mathematics - II | MA | 02 | 02 | -- | 03 | 50 | 00 | 50 | 0 |

**Subject Title : Electrical and Electronic Measurements and Instruments**

| | | |
|---|---|---|
| Sub.Code: 18EE41 | No. of Credits:03=03:0:0 ( L - T – P) | No. of Lecture Hours/Week : 03 |
| Exam Duration:03 Hrs | CIE+Asmt+GA+SEE=40+5+5+50=100 | Total No.of Contact Hours:39 |

Course Learning Objectives:

1. Understand the errors encountered in measuring instruments.
2. Derive the balance conditions in AC and DC bridges for the measurement L, C, R and dissipation factor etc.
3. To analyse the working of analogue and digital measuring instruments, and determine the necessary conditions for working of instrument transformers.
4. To analyse the working principles of signal generators used in the laboratories
5. To distinguish and describe various transducers and display devices used in instrumentation.

| Unit No | Syllabus Contents | No.of Hours | Blooms Taxnomy level. |
|---|---|---|---|
| 1 | **Measurement of Power, Energy, Power factor and Frequency:** Dynamometer wattmeter construction and working principle UPF and LPF wattmeters. Measurements of real and reactive power in 3 phase circuits. Induction type energy meter construction and operation. Construction and operation of single-phase and three phase dynamometer type power factor meter. Weston frequency meter and phase sequence indicator. TEXT 1 and TEXT 2. Reference Book 1 to 3 | 08 | L1-L4 |
| 2 | **a) Measurement Errors:** Definition of error, Gross errors and systematic errors, Absolute and relative errors, Accuracy, Precision, Resolution and Significant figures. **b) Digital Instruments:** Introduction, digital voltmeters (DVM) of ramp type, successive approximation principles, resolution and sensitivity, general specifications, Digital Multimeters. ADC and DAC. Digital frequency meters. TEXT 1 and TEXT 2. Reference Book1 to 3 | 08 | L1-L3. |
| 3 | **Bridges:** Wheatstone's bridge, Kelvin Bridge; AC bridges - Capacitance Comparison Bridge, Maxwell's bridge, Wein's bridge, Schering bridge, D'sautys bridge, Wagner's earth connection, examples. TEXT 1 and TEXT 2. Reference Book 1 to 3 | 07 | L1-L4 |
| 4 | **a) Measuring Instruments (AC and DC):** Introduction, ammeter, voltmeter, Multi-range voltmeter, extending voltmeter range. AC voltmeter using Rectifiers – Half wave and full wave, Peak responding and True RMS voltmeters, ammeters, multimeters. | 08 | L1-L4 |

| Unit No | Syllabus Contents | No.of Hours | Blooms Taxnomy level. |
|---|---|---|---|
| | **b) Instrument Transformers:** Construction and theory of instrument transformers, ratio and phase angle errors of C.T. and P.T. including derivation and Numerical problems.<br>TEXT 1 and TEXT 2. Reference Book 1 to 3 | | |
| 5 | **a) Signal Generators and Analyzers:** Introduction, Fixed and variable AF oscillator, standard signal generator, laboratory type signal generator, AF sine and Square wave generator, Function generator, Square and Pulse generator, Sweep frequency generator.<br>**b) Display Devices:** Digital display system, classification of display, Display devices, LEDs, LCD, Analog and Digital storage oscilloscope.<br>TEXT 1 and TEXT 2. Reference Book 1 to 3 | 08 | L1-L3. |

**Note 1**: Unit 1 to 5 will have internal choice

**Note2:**
a) Two assignments are evaluated for 5 marks: Assignment -1 from Units 1 and 2. Assignment -2 from Units 3, 4 and 5
b) Group Activity for 5 Marks has to be evaluated through PPT Presentation/ Subject Quiz/ Project/Seminar.

**Note:3** Out of 5 Units, Unit 4 is a Webinar unit conducted through Google Classroom/Zoom/Cisco WebEx etc. and will be delivered by subject faculty.

Course Outcomes:

CO1 Explain the working of various meters used for measurement of Power, Energy & understand the adjustments, calibration & errors in energy meters.
CO2 Understand the different measurement errors and analyse different digital instruments and their working.
CO3 Measure resistance, inductance and capacitance using bridges and determine earth resistance
CO4 Assess the performance of different measuring instruments.
CO5 Analyze and interpret different signal generator circuits for the generation of various waveforms and also to understand the use of different display devices.

**Course Outcomes Mapping with Programme Outcomes.**

| Sl.No | Course Outcome | Level of Blooms Taxonomy | No. of hours of teaching | Programme Outcome | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 1. | CO1 | **4** | **8** | **3** | **3** | **1** | **2** | | | | **1** | **1** | **1** | | **1** |
| 2. | CO2 | **3** | **8** | **3** | **3** | **1** | | | | | **1** | **1** | **1** | | **1** |
| 3. | CO3 | **3** | **7** | **3** | **3** | **1** | **2** | | | | **1** | **1** | **1** | | **1** |
| 4. | CO4 | **4** | **8** | **3** | **3** | **1** | **2** | | | | **1** | **1** | **1** | | **1** |
| 5. | CO5 | **3** | **8** | **3** | **3** | **1** | | | | | **1** | **1** | **1** | | **1** |
| **Average CO** | | | | **3** | **3** | **1** | **2** | | | | **1** | **1** | **1** | | **1** |

**Course Outcomes Mapping with Programme Outcomes.**

| Course Outcome | PSO1 | PSO2 | PSO3 |
|---|---|---|---|
| **CO1** | 3 | 2 | 1 |
| **CO2** | 3 | 2 | 1 |
| **CO3** | 3 | 2 | 1 |
| **CO4** | 3 | 2 | 1 |
| **CO5** | 3 | 2 | 1 |
| **Average CO** | **3** | **2** | **1** |

**Text Books.**


1 A.K. Sawhney, "Electrical and electronic Measurements and Instrumentation", 10th Edition, Dhanpat Rai and Co, 2015

*2* R K Rajput, "Electrical and Electronic Measurements and Instruments", 3rd edition, S Chand, 2013


**Reference Text Books.**


1 J. B. Gupta, "A Course in Electronics and Electrical Measurements and Instrumentation", 13th edition, Katson Books, 2008

2 David A Bell, "Electronic Instrumentation and Measurements", 2nd Edition, PHI, 2006

3 Cooper D & A D Helfrick, "Modern electronic instrumentation and measuring techniques", edition, PHI, 1998


**Web Links.**

1 https://lecturenotes.in/subject/64/electrical-and-electronics-measurement

2 https://www.academia.edu/8140873/A_K_Sawhney_A_course_in_Electrical_and_Electronic_Measurements_and_Instrumentation

3 https://www.pdfdrive.com/an-introduction-to-electrical-instrumentation-and-measurement-systems-a-guide-to-the-use-selection-and-limitations-of-electrical-instruments-and-measurement-systems-e158029348.html

**Subject Title : CONTROL SYSTEMS**

| | | |
|---|---|---|
| Sub.Code: 18EE42 | No. of Credits:04=04:0:0 ( L - T – P) | No. of Lecture Hours/Week : 04 |
| Exam Duration:03 Hrs | CIE+Asmt+GA+SEE=40+5+5+50=100 | Total No.of Contact Hours:52 |

Course Learning Objectives: The students should be able to

1 Learn the type of System, dynamics of physical systems, classification of control system, analysis and design objective

2 Represent system by transfer function and block diagram reduction method and Mason's gain formula

3 Learn time response analysis and demonstrate their knowledge to frequency response.

4 Learn stability analysis of system using Root locus, bode plot and Nyquist plot.

5 Learn the concept of Lag/Lead Compensator

| Unit No | Syllabus Contents | No.of Hours | Blooms Taxnomy level. |
|---|---|---|---|
| **1** | **a) Introduction to control system**: Types of Control Systems – Effect of Feedback Systems, Differential equation of Physical Systems – Mechanical Systems, Electrical Systems, Analogous Systems. Block diagrams and signal flow graphs: Transfer functions, Block diagram algebra and Signal Flow graphs. Introduction to P, PI and PID controllers (Excluding Design).<br>b) **Servomotor:** transfer functions, applications.<br>TEXT 1 and Reference Book-2 | 10 | L1,L2,L3. |
| **2** | **Time Response of feedback control systems:** Standard test signals, Unit step response of first and second order systems, Time response specifications, Time response specifications of second order systems, steady state errors and error constants.<br>TEXT 1 and Reference Book-2 | 10 | L1,L2,L3. |
| **3** | a) **Stability analysis:** Concepts of stability, Necessary conditions for stability, Routh- stability criterion, Relative stability analysis.<br>b) **Root Locus Techniques:** Introduction, root locus concepts, Construction of root loci and stability studies.<br>TEXT 1 and Reference Book-2 | 12 | L1,L2,L3. |
| **4** | a) **Frequency domain analysis:** Introduction, Correlation between time and frequency response, bode plots, all pass and minimum phase systems, Assessment of relative stability using Bode Plots, Experimental determination of Transfer function.<br>b) Lag and lead compensators.<br>TEXT 1 and Reference Book-1 | 10 | L1,L2,L3. |
| **5** | **Stability in the frequency domain:** Mathematical preliminaries, Nyquist stability criterion (Inverse polar plots | 10 | L1,L2,L3. |

| Unit No | Syllabus Contents | No.of Hours | Blooms Taxnomy level. |
|---|---|---|---|
| | excluded), Assessment of relative stability using Nyquist criterion (systems with transportation lag excluded).<br>TEXT 1 and Reference Book-1 | | |

**Note 1**: Unit 1 to 5 will have internal choice

**Note2:**
c) Two assignments are evaluated for 5 marks: Assignment -1 from Units 1 and 2. Assignment -2 from Units 3, 4 and 5
d) Group Activity for 5 Marks has to be evaluated through PPT Presentation/ Subject Quiz/ Project/Seminar.

**Note:3** Out of 5 Units, Unit 3 is a Webinar unit conducted through Google Classroom/Zoom/Cisco WebEx etc. and will be delivered by subject faculty.

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

CO1 Demonstrate an understanding of the fundamentals of control systems.

CO2 Develop the mathematical model of the physical systems.

CO3 Analyze the response of the closed and open loop systems.

CO4 Analyze the stability of the closed and open loop systems using Root locus and Bode plot techniques.

CO5 Design the various kinds of compensator

**Course Outcomes Mapping with Programme Outcomes.**

| Sl.No | Course Outcome | Level of Blooms Taxonomy | No. of hours of teaching | Programme Outcome | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | a | b | c | d | e | f | g | h | i | j | k | l |
| 1. | CO1 | **2** | **10** | **3** | **3** | **1** | **2** | | | | **2** | | **2** | | **2** |
| 2. | CO2 | **2** | **10** | **3** | **3** | **1** | **2** | | | | **2** | | **2** | | **2** |
| 3. | CO3 | **2** | **12** | **3** | **3** | **1** | **2** | | | | **2** | | **2** | | **2** |
| 4. | CO4 | **4** | **12** | **3** | **3** | **1** | **2** | | | | **2** | | **2** | | **2** |
| 5. | CO5 | **5** | **8** | **3** | **3** | **1** | **2** | | | | **2** | | **2** | | **2** |
| **Average Course Outcomes** | | | | **3** | **3** | **1** | **2** | | | | **2** | | **2** | | **2** |

**Course Outcomes Mapping with Programme Specific Outcomes**

| **Course Outcome** | **PSO1** | **PSO2** | **PSO3** |
|---|---|---|---|
| CO1 | 3 | 2 | 1 |
| CO2 | 3 | 2 | 1 |
| CO3 | 3 | 2 | 1 |
| CO4 | 3 | 2 | 1 |
| CO5 | 3 | 2 | 1 |
| Average CO | 3 | 2 | 1 |

**Text Books**.


1 J. Nagarath and M.Gopal, "Control Systems", First Edition, Spectrum Publisher, 2008


**Reference Text Books**.


1 K. Ogata, ". Modern Control Engineering", 4th edition, Pearson Education Asia/PHI, 2002

2 P. S. Satyanarayana, "Concepts of Control Systems", 1st edition, Dynaram publishers, 2001

3 M. Gopal, "Control Systems – Principles and Design", 2nd edition, TMH, 1999

4 J. J. D'Azzo and C. H. Houpis, ". Feedback Control System Analysis And Synthesis", 5th edition, McGraw Hill, 2010

5 Enter name, "Book title", edition, publisher, year


**Web Links**.

1 http://ctms.engin.umich.edu/CTMS/index.php?aux=Home ;Control Tutorials for MATLAB and Simulink

2 https://www.youtube.com/user/ControlLectures/

**Subject Title : DC MACHINES AND SYNCHRONOUS MACHINES**

| | | |
|---|---|---|
| Sub.Code: 18EE43 | No. of Credits:04=4:0:0 ( L - T – P) | No. of Lecture Hours/Week : 04 |
| Exam Duration:03 Hrs | CIE+Asmt+GA+SEE=40+5+5+50=100 | Total No.of Contact Hours:52 |

Course Learning Objectives:

1. To gain knowledge on construction and working of DC machines and synchronous machines
2. To analyze characteristics of DC machines and synchronous machines
3. To evaluate various methods of testing, losses and efficiency of DC machines.
4. To analyze various methods of determining voltage regulation of a synchronous generator.
5. To analyze the operation of a synchronous machine (both as a generator and motor).

| Unit No | Syllabus Contents | No.of Hours | Blooms Taxnomy level. |
|---|---|---|---|
| **1** | **DC Generator**: Classification of DC generator, types of armature winding, emf equation, no-load characteristic, armature reaction, load characteristics. Commutation, types of commutation, commutation difficulties, interpoles, compensating winding and equalizer rings (only qualitative treatment).<br>Classification of DC motors, back emf and its significance, torque equation, characteristics of shunt, series & compound motors, speed control of shunt and series motors. Application of DC motors.<br>TEXT 1 and TEXT 2. Reference Book. 1 & 2 | 10 | L1,L2 |
| **2** | **Losses and efficiency:** Losses in dc machines, power flow diagram, efficiency, condition for maximum efficiency.<br>**Testing of dc machines**: Direct & indirect methods of testing of DC machines-brake test, swine burn's test, Hopkinson's test, retardation test, field's test, merits and demerits of tests.<br>TEXT 1 and TEXT 2. Reference Book. 1 & 2 | 10 | L2,L3 |
| **3** | **Synchronous machines:** Principle of operation, construction of salient & non-salient pole synchronous machines, generated emf, effect of distribution and chording of winding, harmonics-causes, reduction and elimination. Armature reaction, synchronous reactance, leakage reactance, phasor diagram of non-salient type alternator.<br>TEXT 1 and TEXT 2. Reference Book. 2 & 3 | 10 | L3,L4 |
| **4** | **Voltage Regulation**: Voltage regulation by EMF, MMF, ZPF & ASA method. Short circuit ratio and its importance. Two reaction theory-direct and quadrature axis reactance, phasor diagram. Slip test and regulation. | 12 | L3,L4 |

| Unit No | Syllabus Contents | No.of Hours | Blooms Taxnomy level. |
|---|---|---|---|
| | Synchronizing to infinite bus bars, parallel operation of alternators. Operating characteristics, power angle characteristics excluding armature resistance, operation for fixed input and variable excitation.<br>TEXT 1 and TEXT 2. Reference Book: 4 | | |
| **5** | **Synchronous motor:** Principle of operation, phasor diagrams, torque and torque angle, effect of change in load, effect of change in excitation, 'V' and 'inverted V curves'. Synchronous condenser, hunting and damping. Methods of starting of synchronous motors.<br>**Special DC motors**: Permanent magnet motors, brushless DC motors. Applications.<br>TEXT 1 and TEXT 2. Reference Book 4 | 10 | L4,L5 |

**Note 1**: Unit 1 to 5 will have internal choice

**Note2:**

e) Two assignments are evaluated for 5 marks: Assignment -1 from Units 1 and 2. Assignment -2 from Units 3, 4 and 5

f) Group Activity for 5 Marks has to be evaluated through PPT Presentation/ Subject Quiz/ Project/Seminar.

**Note:3** Out of 5 Units, Unit 5 is a Webinar unit conducted through Google Classroom/Zoom/Cisco WebEx etc. and will be delivered by subject faculty.

**Course Outcomes**:

CO1 Explain phenomena related to DC, synchronous machines and special machines.

CO2 Explain the operation, characteristics and performance of DC, synchronous machines and special machines.

CO3 Solve problems related to speed control, losses and efficiency of DC machines.

CO4 Analyze the behaviour of synchronous machines in parallel and on infinite bus bars.

CO5 Evaluate voltage regulation of synchronous generators by various methods.

**Course Outcomes Mapping with Programme Outcomes.**

| Sl.No | Course Outcome | Level of Blooms Taxonomy | No. of hours of teaching | Programme Outcome | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 1. | CO1 | **1** | **10** | **3** | **2** | | **1** | | | **1** | | | **1** | | **2** |
| 2. | CO2 | **2** | **10** | **3** | **2** | | **1** | | | **1** | | | **1** | | **2** |
| 3. | CO3 | **3** | **10** | **3** | **2** | | **1** | | | **1** | | | **1** | | **2** |
| 4. | CO4 | **4** | **12** | **3** | **2** | | **1** | | | **1** | | | **1** | | **2** |
| 5. | CO5 | **5** | **10** | **3** | **2** | | **1** | | | **1** | | | **1** | | **2** |
| **Average CO** | | | | **3** | **2** | | **1** | | | **1** | | | **1** | | **2** |

**Course Outcomes Mapping with Programme Specific Outcomes.**

| Course Outcome | PSO1 | PSO2 | PSO3 |
|---|---|---|---|
| CO1 | 3 | 2 | 1 |
| CO2 | 3 | 2 | 1 |
| CO3 | 3 | 2 | 1 |
| CO4 | 3 | 2 | 1 |
| CO5 | 3 | 2 | 1 |
| Average CO | 3 | 2 | 1 |

**Text Books**.


1 DP Kothari, I.J.Nagarath, "Electrical Machinery", Fourth Edition, TMH, 2010

2 P.S Bhimbra, "Electrical Machines", Seventh Edition, Khanna Publishers, year

3 AshfaqHussain, DhanpatRai, "Electrical Machines", edition, DhanpatRai Publications, year


**Reference Text Books**.


1 M. G. Say, "Performance& Design of Alternating Current machines", Third Edition , CBS publishers, 2002

2 A.E Clayton & N.N.Hancock e, "The Performance & Design of DC machines", Third edition CBS Publication, 2004

3 Mulukuntla.S.Sarma, "Electric Machines", First edition, Cengage Learning, 2009

4 Ahhijit Chakrabarti, SudiptaBebnath, "Electric Machines", Electrical Machines Kindle Edition, McGraw Hill Education (India) Private Limited, year


**Web Links**.

1 https://nptel.ac.in/courses/108/102/108102146/

2 http://nptel.vtu.ac.in/econtent/courses/EEE/10EE54/index.php

3 https://nptel.ac.in/courses/108/105/108105017/

**Subject Title : POWER ELECTRONICS**

Sub.Code: 18EE44 No. of Credits:04=04:0:0 ( L - T – P) No. of Lecture Hours/Week : 04
Exam Duration:03 Hrs CIE+Asmt+GA+SEE=40+5+5+50=100 Total No.of Contact Hours:52

Course Learning Objectives:

1 Understand various power semiconductor devices, characteristics and their applications
2 Study different methods of triggering power semiconductor devices
3 Learn different power electronics converters with modes of operation
4 Analyze the performance of different power converter circuits for electric drives
5 Apply different methods of speed control of Electric motors

| Unit No | Syllabus Contents | No.of Hours | Blooms Taxnomy level. |
|---|---|---|---|
| **1** | **Introduction to Power Semiconductor Devices:** Power semiconductor devices, applications. Thyristor types, SCR structure – static characteristics, switching characteristics of SCR, MOSFET and IGBT, ratings, two transistor model, di/dt and dv/dt protection. Firing circuits using UJT and digital ICs. Isolation of control & power circuit.<br>TEXT 1 and TEXT 2. Reference Book 1 | 10 | L1,L2,L3. |
| **2** | **Controlled Rectifiers:** Principle of phase controlled converter operation. Single-phase and three-phase converters – half, semi and full bridge converters with R & RL load.<br>TEXT 1 and TEXT 2. Reference Book | 10 | L1,L2,L3. |
| **3** | **DC Choppers:** Introduction to commutation, Chopper classification, Performance parameters, control strategies, Principle of step-down and step-up chopper with R & R-L load. DC motor (Separately, Shunt & Series) Speed control, open loop and closed loop transfer function for separately excited motor -four quadrant operation of DC drive.<br>TEXT 1 and TEXT 2. Reference Book 2 | 10 | L1,L2,L3. |
| **4** | **a) AC Voltage Controllers:** Principle of ON-OFF and phase control with R and RL load. Single-phase bidirectional controllers with resistive and inductive loads.<br>**b) Inverters:** Inverter classification**,** Principle of operation of basic half bridge inverter and full bridge inverter, Performance parameters. Three-phase bridge inverter-$120^0$ and $180^0$mode of operation.<br>TEXT 1 and TEXT 3. Reference Book1 | 12 | L2,L3,L4 |
| **5** | **Control of AC Drives:** Basic Induction Motor Equations, speed control of squirrel cage induction motor by voltage source inverter- stator voltage control, variable frequency control. Rotor resistance control and Slip power recovery scheme. | 10 | L1,L2,L3. |

| | | | |
|---|---|---|---|
| | TEXT 1 and TEXT 3.Reference Book1 | | |

**Note 1**: Unit 1 to 5 will have internal choice

**Note2:** a) Two assignments are evaluated for 5 marks: Assignment -1 from Units 1 and 2. Assignment -2 from Units 3, 4 and 5 .

b) Group Activity for 5 Marks has to be evaluated through PPT Presentation/ Subject Quiz/Project/Seminar.

**Note:3** Out of 5 Units, Unit 4is a Webinar unit conducted through Google Classroom/ Zoom/Cisco-Webex.., and will be delivered by subject faculty.

**Course Outcomes**:

CO1 Identify various power semiconductor devices and study their control characteristics.

CO2 Understand the operation of analog and digital triggering circuits

CO3 Analyze different converters for power conversion system and their applications.

CO4 Apply the knowledge of different power conversion system for the control of DC drives.

CO5. Apply the knowledge of different power conversion system for the control of AC drives

**Course Outcomes Mapping with Programme Outcomes**.

| Sl.No | Course Outcome | Level of Blooms Taxonomy | No. of hours of teaching | Programme Outcome | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 1. | CO1 | 2 | 10 | | 3 | 1 | 2 | 1 | | 2 | 2 | | 2 | | 3 |
| 2. | CO2 | 2 | 10 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | | 2 | | 3 |
| 3. | CO3 | 3 | 12 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | | 2 | | 3 |
| 4. | CO4 | 3,4 | 12 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | | 2 | | 3 |
| 5. | CO5 | 3,4 | 8 | 3 | 3 | 2 | 2 | 3 | 2 | 3 | 2 | | 2 | | 3 |
| Average CO | | | | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | | 2 | | 3 |

**Course Outcomes Mapping with Programme Specific Outcomes**.

| **Course Outcomes** | PSO1 | PSO2 | PSO3 |
|---|---|---|---|
| CO1 | 1 | 1 | |
| CO2 | 2 | 3 | |
| CO3 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 |

| | | | |
|---|---|---|---|
| Average CO | 3 | 2 | 3 |

**Text Books**.


1 M.H.Rashid "Power Electronics", First Edition, P.H.I. /Pearson, New Delhi, 2nd Edition, 2002

2 Ned Mohan, Tore M. Undeland, and William P. Robins, "Power Electronics - Converters, Applications and Design,", 3rd Edition, John Wiley and Sons, 2012

3 Gopal K.Dubey, "Fundamentals of Electrical Drives", 2nd edition, Tata.Mc.Hill, 2015


**Reference Text Books**.


1. G.K. Dubey, S.R. Doradla, A. Joshi and R.M.K. Sinha, "Thyristorised Power Controllers", 2nd edition,New Age International Publishers.,2001
2. M.D. Singh and Khanchandani K.B, "Power Electronics ",2nd edition,Narosa Publishing House, , Reprint 2015
3. J.M. Jacob Thomson, "Power Electronics, Principles and Applications",2nd edition, Vikas Publications, 2010


**Web Links**.

1. M B Patil,IITB,"Sequel Applications for Classroom Teaching", , https://www.ee.iitb.ac.in/ ~sequel/ sequel_app.html
2. L Umananda, "Ngspice- Power Conversion circuits," IISc, Bengaluru https://swayam.gov.in/ nd1_noc20_ee12
3. G.Bhuvaneswari,IIT Delhi. https://onlinecourses.nptel.ac.in /108/101/108101126/,
4. Prof. Vivek Agarwal, IIT, Bombay,Mumbai, "Fundamentals of Power Electronics" https://freevideolectures.com/ course/4266/ nptel-fundamental-power-electronics.

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**Subject Title : LINEAR ICS AND APPLICATIONS**

Sub.Code: 18EE45 No. of Credits: 03=:2:2:0 ( L - T – P) No. of Lecture Hours/Week : 04
Exam Duration:03 Hrs CIE+Asmt+GA+SEE=40+5+5+50=100 Total No.of Contact Hours:52

Course Learning Objectives:

1 To understand the concepts of the basic characteristics and amp in AC amplifier circuits
2 To acquaint the students regarding frequency response and frequency compensating of op-amp..
3 To design & analyze different linear, non-linear & mathematical application circuits using op-amp
4 To understand the concepts of switched capacitor filters ,Voltage regulator and various amplifiers
5 To understand the basics of PLL and its practical applications.

| Unit No | Syllabus Contents | No.of Hours | Blooms Taxnomy level. |
|---|---|---|---|
| 1 | **a) Introduction:** Operational amplifier description- Circuit symbol and terminals block diagram. Basic op-amp parameters - Input and output voltage range, offset voltage and current, offset nulling, CMRR, PSRR, input and output impedance**.**<br>**b) OP-Amps as AC Amplifiers:** Capacitor-Coupled voltage follower, High $Z_{in}$ Capacitor Coupled voltage follower, Capacitor-Coupled non-inverting amplifier, High $Z_{in}$ Capacitor Coupled non-inverting amplifier, Capacitor-Coupled inverting amplifier, setting upper cut off frequency, use of single polarity supply. TEXT 1 and TEXT 2. Reference Book. 1 & 2 | 11 | L1,L2,L3 |
| 2 | **a) OP-Amp Frequency Response and Compensation:** Circuit stability, Frequency and phase response, Frequency compensating methods, Band width, slew rate effects, stray capacitance effects, load capacitance effects, $Z_{in}$ mod compensation, and circuit stability precautions<br>**b) Signal Processing Circuits:** Introduction, saturating precision half wave rectifier, non-saturating half wave precision rectifier, two output precision half wave rectifier, precision full wave rectifier using half wave rectifier and summing circuit, high input impedance full wave precision rectifier, peak clipper, dead zone circuit, precision clipper, precision clamping circuit, precision rectifier peak detector, voltage follower peak detector, sample and hold circuit. TEXT 1 and TEXT 2. Reference Book. 1 & 2 | 11 | L2,L3 |
| 3 | **a) OP-Amp Nonlinear Circuits:** Op-amps in switching circuits, zero crossing detectors, Inverting & Non inverting Schmitt trigger circuits, Astable multivibrator and monostable multivibrator. | 10 | L3,L4 |

| Unit No | Syllabus Contents | No.of Hours | Blooms Taxnomy level. |
|---|---|---|---|
| | **b) Signal Generators:** Triangular wave generator, rectangular wave generator, phase shift oscillator, Wien bridge oscillator. TEXT 1 and TEXT 2. Reference Book. 1 & 2 | | |
| 4 | **Active Filters:** First order low pass active filter, second order low pass active filter, first order high pass active filter, second order high pass active filter, band pass filter, band stop filter. TEXT 1 and TEXT 2. Reference Book:2 | 10 | L3,L4 |
| 5 | **a) DC Voltage Regulators:** Basic linear voltage regulator, fixed output voltage regulators, adjustable output regulator(LM317/LM337), IC voltage regulators(IC723) **b) Specialized IC Applications:** Basics of universal active filter, basic phase lock loops, power amplifiers. TEXT 1 and TEXT 2. Reference Book 3 | 10 | L2,L4,L5 |

**Note 1**: Unit 1 to 5 will have internal choice

**Note2:** a) Two assignments are evaluated for 5 marks: Assignment -1 from Units 1 and 2. Assignment -2 from Units 3, 4 and 5 .

c) Group Activity for 5 Marks has to be evaluated through PPT Presentation/ Subject Quiz/Project/Seminar.

**Note:3** Out of 5 Units, Unit 5is a Webinar unit conducted through Google Classroom/ Zoom/Cisco-Webex and will be delivered by subject faculty.

Course Outcomes:

CO1 Describe the characteristics of ideal and practical operational amplifier.

CO2 Understand the behavior of op-amp linear and non- linear circuits.

CO3 Analyze the operation of op-amp in signal processing and oscillator circuits.

CO4 Analyze the operation of op-amp in filter circuits.

CO5 Design a circuit or system using integrated circuits (IC's).

**Course Outcomes Mapping with Programme Outcomes.**

| Sl.No | Course Outcome | Level of Blooms Taxonomy | No. of hours of teaching | Programme Outcome | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 1. | CO1 | **1** | **11** | **3** | **2** | **2** | **1** | **-** | **-** | **1** | **1** | **-** | **2** | **-** | **1** |
| 2. | CO2 | **2** | **11** | **3** | **2** | **2** | **1** | **-** | **-** | **1** | **1** | **-** | **2** | **-** | **1** |
| 3. | CO3 | **3** | **10** | **3** | **2** | **2** | **1** | **-** | **-** | **1** | **1** | **-** | **2** | **-** | **1** |
| 4. | CO4 | **4** | **10** | **3** | **2** | **2** | **1** | **-** | **-** | **1** | **1** | **-** | **2** | **-** | **1** |
| 5. | CO5 | **5** | **10** | **3** | **2** | **2** | **1** | **-** | **-** | **1** | **1** | **-** | **2** | **-** | **1** |
| Average CO | | | | **3** | **2** | **2** | **1** | | | **1** | **1** | | | | **1** |

**Course Outcomes Mapping with Programme Specific Outcomes.**

| Course Outcome | PSO1 | PSO2 | PSO3 |
|---|---|---|---|
| **CO1** | 3 | 2 | 1 |
| **CO2** | 3 | 1 | 1 |
| **CO3** | 3 | 1 | 1 |
| **CO4** | 3 | 2 | 1 |
| **CO5** | 3 | 2 | 1 |
| **Average CO** | **3** | **2** | **1** |

**Text Books.**


1 David A Bell, "Operational amplifiers and linear ICs", Third Edition, Oxford University Press, 2010

2 B.Somanathan Nair,, "Linear Integrated Circuits - Analysis, Design and Applications", First Edition, Wiley India,, 2009


**Reference Text Books.**


1 S. Salivahanan, V S KanchanaBhaaskaran, "Linear Integrated Circuits", Second Edition , McGraw Hill, 2015

2 Stanley William D, "Operational amplifiers with Linear Integrated Circuits", Fourth Edition Pearson Education, 2002

3 Ramakanth A Gayakwad, "Operational amplifiers and linear ICs", Fourth edition, PHI, 2009


**Web Links.**

1. https://nptel.ac.in/courses/108/108/108108111/
2. https://www.yumpu.com/en/document/view/60502162/e-book-op-amps-and-linear-integrated-circuit-technology-by-ramakant-a-gayakwad

**Subject Title : Transformers and Induction Machines Lab**

| | | |
|---|---|---|
| Sub.Code:18EEL46 | No. of Credits:1=0:0:1( L - T – P) | No. of Lecture Hours/Week :02 |
| Exam Duration:3 Hrs | CIE +SEE=50+50=100 | Total No.of Contact Hours:26 |

Course Learning Objectives:

1. To introduce various tests on Transformer, poly-phase Induction Machines and single-phase Induction Motor and evaluation of their performance.
2. To verify the parallel operation of two dissimilar transformers load sharing.
3. To learn various methods of speed control of Induction motor.
4. To study the connection of single phase transformers for three phase operation and phase conversion.
5. To study and calculation of equivalent circuit parameter of transformer and induction machine

| Expt No | Experiment contents | No.of Hours | Blooms Taxnomy level. |
|---|---|---|---|
| **1** | (a) Predetermination of efficiency and regulation by Open Circuit and Short circuit tests on single - phase transformer.<br>(b) Calculation of equivalent circuit parameters from the test data and determination of efficiency, Regulation from the equivalent circuit to correlate results obtained earlier. | 2 | L2,L3,L4 |
| **2** | Sumpner's test on similar transformers and determination of combined and individual transformer efficiency | 2 | L2,L3,L4 |
| **3** | Parallel operation of two dissimilar (different kVA) single-phase transformers and determination of load sharing and analytical verification given the Open Circuit and Short circuit tests details. | 2 | L2, L3, L4 |
| **4** | Connection of 3 single phase transformers star-detla, delta-star and determination of efficiency under balanced and Unbalanced resistive load | 2 | L2,L3, L4 |
| **5** | Scott connection with balanced and unbalanced resistive loads. | 2 | L2,L3, L4 |

| Expt No | Experiment contents | No.of Hours | Blooms Taxnomy level. |
|---|---|---|---|
| **6** | Load test on 3-phase Induction motor and determination of performance characteristics. | 2 | L2 L3,L4 |
| **7.** | (a) NO load and Blocked rotor tests on 3-phase induction Motor Predetermination of performance from the Circle diagram.<br>(b) Determination of parameters of the equivalent circuit of a 3-phase Induction Motor and correlate the results obtained from the circle diagram. | 2 | L2,L3,L4 |
| **8.** | Speed control of 3-phase Induction motor by varying rotor resistance. | 2 | L2,L3,L4 |
| **9** | Load test on- Induction generator. | 2 | L2,L3,L4 |
| **10** | Load test on Single- Phase Induction motor. | 2 | L2,L3,L4 |
| | **Experiments beyond the Syllabus** | | |
| **1** | Polarity Test on Transformers | 2 | L2,L3 |
| **2** | Determination of parameters of equivalent circuit of a 3-phase Induction Motor | 2 | L1,L2 |

Note 1: Laboratory report should be submitted to the subject faculty every week and evaluation will be done on the same week only.

**Course Outcomes**:

CO1 Conduct various tests on single-phase transformer, and evaluate their performance

CO2 Poly-phase induction machines and single-phase induction motor and evaluate their performance

CO3 Operate two dissimilar transformers in parallel for different load sharing.

CO4 Experiment the various methods of speed control of Induction motor.

CO5 Examine the connection of single phase transformers for three phase operation and phase conversion.

**Course outcomes Mapping with programme outcomes**

| Sl.No | Course Outcome | Level of Blooms Taxonomy | No. of hours of teaching | Programme Outcome | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 1. | CO1 | **2,3,4** | **4** | 3 | | | | 2 | | | 2 | 1 | 1 | 2 | |
| 2. | CO2 | **2,3,4** | **4** | 3 | | | | 3 | | | 1 | 2 | 1 | 1 | |
| 3. | CO3 | **2,3,4** | **4** | 3 | | | 2 | 2 | | | | 1 | 1 | 1 | |
| 4. | CO4 | **2,3,4** | **4** | 3 | | | 3 | 2 | | | | 1 | 1 | 1 | |
| 5. | CO5 | **2,3,4** | **4** | 3 | | | | 2 | | | | 1 | | 1 | |
| **Average CO** | | | | 3 | | | 3 | 2 | | | 2 | 1 | 1 | 1 | |

**Course Outcomes Mapping with Programme Specific Outcomes**

| Course Outcome | PSO1 | PSO2 | PSO3 |
|---|---|---|---|
| **CO1** | 3 | | 1 |
| **CO2** | 3 | | 1 |
| **CO3** | 3 | | 1 |
| **CO4** | 3 | | 1 |
| **CO5** | 3 | | 1 |
| **Average CO** | **3** | | **1** |

**References Text Books**.


1 I. J. Nagrath and D. P. Kothari,, “Electric Machines”, 4th Edition, Tata Mc Graw Hill, 2010

2 B L Theraja, “Electrical technology-AC & DC Machines”, S Chand Publishers

3 M.V Bhakshi, “Transformer and Induction Machine”, Technical Publisher

**Web Links**.

1 https://www.svec.education/courses/eee-course-material-lab-manuals/

2 http://rmkcet.ac.in/eee-machines-lab.php/

3 https://www.slideshare.net/KamiWijaya/2-electrical-machines-lab

4 https://www.slideshare.net/sai55chaitanya/electrical-machines-2-lab-manual/

**Subject Title : Power Electronics Lab**

Sub.Code:18EEL47 No. of Credits:1=0:0:1(L-T-P) No. of Lecture Hours/Week :02

Exam Duration:3 Hrs CIE +SEE=50+50=100 Total No.of Contact Hours:26

Course Learning Objectives:

1 Study the characteristics of Power semiconductor devices practically.
2 Understand controllable switches in different power electronic circuit applications.
3 Understand to generate gating signals using analog and digital modules.
4 Learn to control the speed of electrical motors using power converters
5 Analyse to control power in converters circuits with different loads

| Expt No | Experiment Contents | No.of Hours | Blooms Taxnomy level. |
|---|---|---|---|
| **1** | Static characteristics of SCR. | 2 | L1, L2 |
| **2** | Static characteristics of MOSFET and IGBT. | 2 | L1, L2 |
| **3** | SCR turn-on circuit using UJT relaxation oscillator. | 2 | L1, L2, L3,L4 |
| **4** | SCR Digital triggering circuit for single phase controlled rectifier. | 2 | L2, L3, L4 |
| **5** | Single-phase full-wave controlled rectifier connected to *R* and *R-L* loads- with and without freewheeling diode | 2 | L1, L2, L3 |
| **6** | A.C. voltage controller using TRIAC – DIAC/UJT combination connected to *R* load. | 2 | L1, L2, L3 |
| **7.** | To control the Speed of a stepper motor in half step, full step mode- both in forward and reverse direction. | 2 | L1, L2, L3 |
| **8.** | To control the Speed of a universal motor using TRI AC | 2 | L2, L3 |
| **9** | To control the Speed of a separately excited D.C. motor using an IGBT based chopper module. | 2 | L1, L2, L3, L4 |
| **10** | To generate PWM signal using MOSFET based single-phase full-bridge inverter and study for variation in frequency and R load. | 2 | L1, L2, L3, L4 |
| | Experiments beyond the Syllabus | | |
| **1** | Study the performance of SCR forced commutating circuits. —<br>(i) By reducing the forward current below the holding current (current commutation)<br>(ii) By applying a large reverse voltage across conducting SCR (Voltage commutation) | 3 | L1, L2, L3, L4 |

Note 1: Laboratory report should be submitted to the subject faculty every week and evaluation will be done on the same week only.

Course Outcomes:

CO1 Understand the basic operation of various power semiconductor devices experimentally.
CO2 Illustrate the basic principles of triggering circuit.

CO3 Analyse the role of power electronics in utility-related applications

CO4 Understand the operation of different power converter circuits

CO5 Justify the use of Power Electronics converters for motor control applications.

**Course outcomes Mapping with Programme Outcomes**

| Sl.No | Course Outcome | Level of Blooms Taxonomy | No. of hours of teaching | Programme Outcome | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 1. | CO1 | 2 | 6 | | 3 | 1 | 2 | | | | 2 | 2 | 2 | 2 | 2 |
| 2. | CO2 | 2 | 5 | 3 | 3 | 1 | 2 | | | | 2 | 2 | 2 | 2 | 2 |
| 3. | CO3 | 3 | 5 | 3 | 3 | 1 | 2 | | | | 2 | 2 | 2 | 2 | 2 |
| 4. | CO4 | 3 | 5 | 3 | 3 | 1 | 2 | | | | 2 | 2 | 2 | 2 | 2 |
| 5. | CO5 | 4 | 5 | 3 | 3 | 1 | 2 | | | | 2 | 2 | 2 | 2 | 2 |
| Average CO | | | | 3 | 3 | 1 | 2 | | | | 2 | 2 | 2 | 2 | 2 |

**Course outcomes Mapping with Programme Specific Outcomes**

| **Course Outcomes** | PSO1 | PSO2 | PSO3 |
|---|---|---|---|
| CO1 | 1 | 1 | |
| CO2 | 2 | 3 | |
| CO3 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 |
| Average CO | 3 | 2 | 3 |

**References Text Books**.


1 M.H.Rashid "Power Electronics", First Edition, P.H.I. /Pearson, New Delhi, 2nd Edition, 2002

2 G.K. Dubey, S.R. Doradla, A. Joshi and R.M.K. Sinha, "Thyristorised Power Controllers", 2nd edition, New Age International Publishers., 2001

3 Dr Jyoti Koujalagi -Lab Manual


**Web Links**.

1 L Umananda,IISc, Bengaluru, Ngspice- Power Conversion circuits, https://swayam.gov.in/ nd1_noc20_ee12

2 M B Patil,IITB,"Sequel Applications for Classroom Teaching", , https://www.ee.iitb.ac.in/ ~sequel/ sequel_app.html

3 G.Bhuvaneswari,IIT Delhi, www.nptel.ac.in - https://nptel.ac.in/courses/108/101/108101126/

4. Prof. Vivek Agarwal, IISc , Bengaluru, "Fundamentals of Power Electronics ", https://freevideolectures.com/ course/4266/ nptel-fundamental-power-electronics.

**Note:** 20% program or experiments through virtual lab or any other online platform.