# Kolhapur Institute of Technology's

# College of Engineering (Autonomous), Kolhapur

## Structure-

## Second Year B.Tech

## Electrical Engineering

(Under Graduate Program)

**From Academic Year**
**2022- 23**

## Draft Structure and Curriculum for S.Y. B.Tech in Electrical Engineering

### Teaching and Evaluation Scheme

### YEAR / SEMESTER - S.Y.B-Tech, Sem-III

| Course Code | Course | Curriculum Component | Teaching Scheme | | | | Evaluation Scheme | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P | Credits | Component | Max Marks | Min Marks | |
| UELC0301 | Electrical Machines | PC | 04 | - | - | 04 | ISE-I | 10 | 20 | 40 |
| | | | | | | | MSE | 30 | | |
| | | | | | | | ISE-II | 10 | | |
| | | | | | | | ESE | 50 | 20 | |
| UELC0302 | Analog & Digital Electronics | PC | 04 | - | - | 04 | ISE-I | 10 | 20 | 40 |
| | | | | | | | MSE | 30 | | |
| | | | | | | | ISE-II | 10 | | |
| | | | | | | | ESE | 50 | 20 | |
| UELC0303 | Electrical Circuit Analysis | ES | 03 | 01** | - | 04 | ISE-I | 10 | 20 | 40 |
| | | | | | | | MSE | 30 | | |
| | | | | | | | ISE-II | 10 | | |
| | | | | | | | ESE | 50 | 20 | |
| UELC0304 | Electrical Power Generation Systems | PC | 03 | - | - | 03 | ISE-I | 10 | 20 | 40 |
| | | | | | | | MSE | 30 | | |
| | | | | | | | ISE-II | 10 | | |
| | | | | | | | ESE | 50 | 20 | |
| UELC0305 | Engineering Mathematics-III | BS | 03 | 01** | - | 04 | ISE-I | 10 | 20 | 40 |
| | | | | | | | MSE | 30 | | |
| | | | | | | | ISE-II | 10 | | |
| | | | | | | | ESE | 50 | 20 | |
| UELA0361 | Constitution Of India.<br>Audit Course-I | HS | 02 | - | - | - | ESE | 100 | 40 | 40 |
| UELC0331 | DC Machines Lab | PC | - | - | 02** | 01 | ISE | 25 | 10 | |
| | | | | | | | ESE (POE) | 50 | 20 | |
| UELC0332 | Analog& Digital Electronics Lab | PC | - | - | 02** | 01 | ISE | 25 | 10 | |
| | | | | | | | ESE (POE) | 50 | 20 | |
| UELC0333 | Electrical Circuit Analysis Lab | PC | - | - | 02** | 01 | ISE | 50 | 20 | |
| | | | | | | | ESE (OE) | 50 | 20 | |
| **Total** | | | **18** | **02** | **06** | **22** | **-** | **750** | **300** | |
| **TOTAL CONTACT HOURS = 26, TOTAL CREDITS = 22** | | | | | | | | | | |

| Title of the Course : Electrical Machines<br><br>Course Code:UELC0301 | L | T | P | Credit |
|---|---|---|---|---|
| | 03 | 01 | - | 04 |

**Course Prerequisite:** Basic Electrical Engineering.

**Course Description:** This course contains detailed information about construction, working, testing and controlling of AC machines.

**Course Objectives:**

1. This course intends to provide details of operation and performance of asynchronous and synchronous machines.
2. It intends to develop application skills to operate asynchronous and synchronous machines.
3. It intends to develop a skill to determine asynchronous and synchronous machines.

**Course Outcomes:**

| COs | After the completion of the course the students will be able to | Blooms level | Descriptor |
|---|---|---|---|
| CO1 | **Explain** the construction and operation of DC & AC Machines. | II | Understanding |
| CO2 | **Analyze** the performance of DC & AC Machines. | II | Understanding |
| CO3 | **Evaluate** characteristics parameters of AC & DC machines using different tests. | IV | Analyzing |

**PO MAPPING**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO11 | PO 12 | PSO1 | PSO 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | | | | | 3 | | | | | | 3 | 1 | |
| CO2 | 3 | 1 | 2 | 2 | 3 | 3 | | | | | | 2 | 1 | 3 |
| CO3 | 3 | 2 | 1 | 3 | 2 | 3 | | | | | | 2 | | |

**Assessments:**

**Teachers' Assessment:**

It consists of two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

| Assessment | Marks |
|---|---|
| ISE 1 | 10 |
| MSE | 30 |
| ISE 2 | 10 |
| ESE | 50 |

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with 60-70% weight-age for course content. (Normally last three modules) covered after MSE.

**Course Contents:**

| | |
|---|---|
| **Unit 1: ---DC Generators**<br>Construction of D.C. machines, Types, Magnetic circuit of DC Machines, EMF equation, Voltage building in self excited generators, Armature Winding: Simple lap winding and wave winding, Commutation, Armature Reaction: Demagnetizing and cross magnetizing effect, principle of compensation, compensating winding and its use in machines, Applications of DC generators. (Numerical Treatment) | **8 Hrs** |
| **Unit 2: --- D.C. Motors**<br>Concept of back e.m.f., types, torque equation, speed equation, characteristics of D.C. motors, applications, 4 point of starter, method of speed control, electrical braking, Losses and efficiency, Testing & specifications of D.C. machines: Swinburn's test, Hopkinson's test, Field test on D.C. series motor. (Numerical Treatment) | **8 Hrs.** |
| **Unit 3: --- Single and PolyPhase Transformer**<br>**Single phase Transformer:** Working with phasor diagram on no-load & load, equivalent circuit parameters & circuit referred to both sides, efficiency, losses, voltage regulation, experimental determination of equivalent circuit parameters using OC and SC test, ratio and polarity test.<br>**Poly Phase Transformer**: Construction, single phase transformer bank versus polyphase transformer, transformer windings, grouping YD1, YD11, DY1, DY11, DZ1, DZ11,phase shift, parallel operation, Testing of transformers as per IS 2026, heat run test, Sumpner's test, Equivalent delta test, parallel operation of transformer. (Numerical Treatment) | **8 Hrs.** |

| | |
|---|---|
| **Unit 4: --- Three Phase Induction Motor**<br>Construction, Types- cage type (single cage, double cage), slip ring type, operation, creation of rotating field, Torque equation, speed equation, speed torque curve, starting torque, stalling torque, full load torque, equivalent circuit, power flow diagram, efficiency, starting and types of starters. Speed control: Change of supply frequency, pole changing, V/F control. Application and Testing: No load test, Blocked rotor test, and circle diagram. | **8 Hrs.** |
| **Unit 5: --- Synchronous Generator**<br>Construction, Principle of operation, EMF equation, armature reaction, armature resistance and reactance, synchronous reactance, field excitation system, damper winding, Voltage regulation by synchronous Impedance method, zero power factor method, MMF method, efficiency and losses, method of synchronizing, hunting, damping, Short Circuit Ratio & its significance. | **8 Hrs.** |
| **Unit 6: --- Synchronous Motor**<br>Construction, Saliency: direct & quadrature operation axis, speed, torque, Method of starting, phasor diagram, torque angle equation, V –curves and inverted V-curves, hunting and damping, synchronous condenser. | **8 Hrs.** |

**Textbooks:**

1. I. J. Nagrath and D. P. Kothari. "Electric Machines", McGraw Hill Education,2010.
2. A. E. Clayton, "DC Machines", Mc Graw Hill publication, 3rd Edition.
3. M. G. Say. "Performance Design of AC Machines", CBS Publishers, 3rd Edition.
4. B. L. Theraja, A. K. Theraja, S. Chand "A textbook of Electrical Technology, Vol I and Vol II"
5. O. E. Taylor, "Performance Design of AC commutator motors", Wheeler Publisher, 15th Reprint.

**References:**

1. S. K. Bhattacharya, "Electrical Machines", Tata Mc Graw Hill, New Delhi
2. J. B. Gupta, "Electrical Machines", S K Kataria and Sons, New Delhi.
3. Fitzerald and Kingsley, "Electric Machine", Tata McGraw Hill.

**Unit wise Measurable students Learning Outcomes:**

1. The students will be to evaluate the performance rating of DC Machines.
2. The students will be to understand the braking and testing methods of DC motors.
3. The students will be to determine the parameters of the single-phase induction motor.
4. The students will be able to understand working and be able to test the transformer.
5. The students will be to determine the performance of the synchronous generator.
6. The students will be to determine the performance of the single-phase induction motor and synchronous motor.

| Title of the Course : Analog & Digital Electronics<br>Course Code:UELC0302 | L | T | P | Credit |
|---|---|---|---|---|
| | 04 | - | - | 04 |

**Course Pre-Requisite:** Basic Electronics Engineering, Numbering system, Logic Gates and flip flops, Diode and BJT.

**Course Description:** This course presents concise knowledge of amplifiers and oscillators constructed with discrete components such as BJTs and FETs.

**Course Objectives: To make the students aware of**

1. To implement the regulators using BJT and IC's..
2. To understand the operation of oscillators using OPAMP.
3. To use K map for Boolean algebra reduction and design digital circuit.
4. To construct sequential and combinational circuits using flip flops and K map.

**Course Outcomes:**

| COs | After the completion of the course the students will be able to | Blooms level | Descriptor |
|---|---|---|---|
| CO1 | **Learn** operation of rectifiers and regulators using diodes, BJTs and IC's. | II | Understanding |
| CO2 | **Compare** the working of amplifiers . | IV | Analyzing |
| CO3 | **Design** and implement Combinational and Sequential logic circuits | III | Applying |
| CO4 | **Analyze** synchronous & asynchronous sequential circuits | IV | Analyzing |

**PO MAPPING**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 1 | 2 | | | | | | | | | 2 | | 1 |
| CO2 | 3 | 2 | 2 | | | | | | | | | 2 | | 1 |
| CO3 | 3 | 1 | 3 | | | | | | | | | 2 | | 1 |
| CO4 | 1 | 2 | 2 | | | | | | | | | 2 | | 1 |

**Assessments:**

**Teachers' assessment-**

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

| Assessment | Marks |
|---|---|
| ISE 1 | 10 |
| MSE | 30 |
| ISE 2 | 10 |
| ESE | 50 |

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content.(Normally first three modules)
ESE: Assessment is based on 100% course content with 60-70% weight-age for course content. (Normally last three modules covered after MSE.)

| | |
|---|---|
| **Course Contents:**<br>**Unit 1:---Voltage Regulators**<br>Need of voltage regulator, stabilization factors, shunt regulator (using Zener diode & BJT), and series voltage regulator (using BJT) series voltage regulator with pre- regulator & overload protection circuit.<br>**IC regulators :** Study the design of regulators using IC's :78XX,79XX,723,LM317,<br>Switching regulator: Introduction, study of LM3524. | **7 Hrs.** |
| **Unit 2:---Small signal & Large Signal Amplifiers**<br>**Small signal amplifiers** - Biasing circuits of BJT and FET transistors, analysis and design of BJT and FET amplifiers, chopper stabilized amplifiers, case studies – application of current amplifiers in SCR firing circuits and power supplies.<br>**Large signal amplifiers** –Analysis and design of class A and class B power amplifiers, class C and class D amplifiers, thermal considerations, tuned amplifiers. | **8Hrs.** |
| **Unit 3:- Feedback Amplifier and Oscillators**<br>General theory of feedback, Importance for negative feedback, types of negative feedback in transistor circuits: voltage series, current series, voltage shunt, current shunt feedback amplifiers, Barkhausen's criteria, frequency and amplitude stability, classification, and basic concepts of OPAMPs and IC 555.RC oscillators: RC phase shift & Wien bridge oscillator using OPAMP and IC 555, Clapp oscillator – oscillator amplitude stabilization. | **8 Hrs.** |
| **Unit 4:- Fundamentals of Digital Family**<br>Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, number systems-binary, signed binary, octal hexadecimal number, binary arithmetic, one's and two's complements arithmetic, codes, error detecting and correcting codes, characteristics of digital ICs, digital logic families, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri-state logic.. | **7Hrs.** |
| **Unit 5:- Combinational & Sequential Circuits**<br>Combinational logic representation of logic functions – SOP and POS forms, K-map representations – minimization using K-maps- simplification and implementation of combinational logic – multiplexers and demultiplexers – code converters, adders, subtractors. Sequential logic- SR, JK, D and T flip-flops – level triggering and edge triggering – counters – Pulse forming circuits - asynchronous and synchronous type – Modulo counters – Shift registers – Ring counters. | **10Hrs.** |

| | |
|---|---|
| **Unit 6:-Synchronous & Asynchronous Sequential Logic Circuits**<br>Synchronous Sequential Logic circuits - state table and excitation tables - state diagrams - Moore and Mealy models - design of counters - analysis of synchronous sequential logic circuits - state reduction and state assignment. Asynchronous sequential logic circuits- Transition table, flow table – race conditions – circuits with latches, analysis of asynchronous sequential logic circuits – introduction to design – implication table – hazards - programmable logic array and devices. | **8 Hrs.** |
| | |

**Texts and references:**


1. Allen Mottershed, "Electronic Devices & Circuits", Prentice- Hall India.
2. J. Millman & C.Halkias, "Electronic Devices & Circuits", II$^{nd}$ Edition,Tata McGraw Hill Publication.
3. N.C. Goyal & R.K. Khetan, " A Monograph on Electronics Design Principles'',V$^{th}$ Edition, Khanna Publishers.
4. R. P. Jain, "Modern Digital Electronics", McGraw Hill Education, 2009.
5. M. M. Mano, "Digital logic and Computer design", Pearson Education India, 2016.
6. A. Kumar, "Fundamentals of Digital Circuits", Prentice Hall India, 2016.


**Unit wise Measurable students Learning Outcomes:**

1. The students will be able to design Regulators as per specification.
2. The students will be able to implement amplifier and test its characteristics.
3. The students will be able to implement amplifier and test its characteristics.
4. The students will be able to undertake Boolean algebra operations and list truth tables of logic gates.
5. The students will be able to understand k maps and Combinational Digital Circuits.
6. The students will be able to understand analyze Synchronous & Asynchronous Sequential Counters.

| Title of the Course :Electrical Circuit Analysis<br>Course Code: UELC0303 | L | T | P | Credit |
|---|---|---|---|---|
| | 03 | 01 | - | 04 |

**Course Pre-Requisite:** Basic Electrical Engineering , Solution of Integral-Differential Equations, Laplace Transform

**Course Description:** This Course aims to discuss the basic concepts of network analysis, which is the pre-requisite for all the Electrical Engineering courses. The course deals with different methods of network reduction and network representations useful for analysis of different complex R-L-C circuits. The course enables students to design resonant circuits, filters and attenuators. Transient Response of complex R-L-C passive circuits is discussed in detail. It is necessary to design stable systems.

**Course Objectives:**

1. To analyze different complex circuits using various network reduction techniques such as source transformation, Network theorems etc.
2. To discriminate between series and parallel resonance and design Resonant circuits.
3. To evaluate two port network parameters.
4. To implement different types of passive filters.

**Course Outcomes:**

| COs | After completion of the course The students will be to | Bloom's Level | Descriptor |
|---|---|---|---|
| CO1 | **Simplify and Analyze** the basic AC and DC circuits using Nodal analysis, mesh analysis & network theorems. | IV | Analyzing |
| CO2 | **Evaluate** steady state and transient performance of DC circuit | IV | Analyzing |
| CO3 | **Analyze** different filters and attenuators | IV | Analyzing |
| CO4 | **Derive** two port network parameters and their interrelationships | IV | Analyzing |

**PO MAPPING**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 1 | 2 | 1 | 3 | 1 | | | 3 | 1 | | 3 | 2 | 1 |
| CO2 | 3 | 2 | 1 | 2 | 3 | 1 | | | 3 | 2 | | 2 | 1 | 1 |
| CO3 | 3 | 3 | 2 | 1 | 3 | 1 | | | 3 | 2 | | 3 | 2 | 1 |
| CO4 | 3 | 2 | 1 | 1 | 2 | 1 | | | 3 | 1 | | 3 | 1 | 1 |

**Assessments:**

**Teachers' assessment-**

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

| Assessment | Marks |
|---|---|
| ISE 1 | 10 |
| MSE | 30 |
| ISE 2 | 10 |
| ESE | 50 |

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with 60-70% weight-age for course content.(Normally last three modules) covered after MSE.

**Course Contents:**

| | |
|---|---|
| **Unit 1:---Network Fundamentals**<br>Representation of voltage & current sources (Independent & Dependent), source transformation, Star- Delta transformation, reduction of networks: Mesh analysis, Node analysis. Super mesh and super node analysis. | **7 Hrs** |
| **Unit 2:---Network Theorems**<br>Solution of D.C and A.C. networks using Superposition Theorem, Millman's Theorem, Norton's Theorem, Thevenin's Theorem, Maximum Power Transfer Theorem, Reciprocity Theorem, Duality Theorem, Compensation and Tellegen's Theorem. | **7 Hrs.** |
| **Unit 3:--- AC Circuit Analysis**<br>Introduction to three phase supply, Star Delta connection , Relation between phase and line parameter, Three phase power , Balanced and Unbalanced circuit ,<br>Resonance: Types: Series & parallel resonance. Series resonance- resonant frequency, variation of impedance, admittance, current & voltage across L & C with respect to frequency, Effect of resistance on frequency response, Selectivity, B.W. and Quality factor. Parallel resonance – resonance frequency, variation of impedance & admittance with frequency, Selectivity & B.W. | **6Hrs.** |
| **Unit 4:--- Transient Response with DC excitation**<br>Analysis of RC, RL, and RLC networks with DC excitation with and without initial conditions using Laplace transforms. Steady state & transient response (Voltage & Current) | **8 Hrs.** |
| **Unit 5:--- Filters & Attenuators**<br>Filters**:** Definitions, classification & characteristics of different filters, filter fundamental such as attenuation constant, phase shift constant, propagation constant, characteristic impedance, relationship between decibel and neper.<br>Attenuators-Definition, classification- T type, Π type attenuator | **8 Hrs.** |

| **Unit 6:--- Two Port Network** | **6hrs** |
|---|---|
| Two port network: Open circuit impedance (Z) parameters, Short circuit admittance (Y) parameters, Hybrid (H) parameter, Transmission parameters (ABCD), Interrelation of different parameters, Interconnections of two port network (Series, Parallel, Cascaded, Series- Parallel) Network functions: Network functions for one port & two port networks, Driving point impedance and admittance of one port network, Driving point impedance, admittance & different transfer function of two port network (Z,Y,H & T). | |

**Textbooks:**

1. A. Sudhakar, Shyammohan S. Palli, "Circuit & Network – Analysis & Synthesis", III$^{rd}$ Edition – Tata McGraw Hill Publication (Unit II, IV, VI).
2. William H Hayt, Jack E Kimmerly and Steven M. Durbin, "Engineering Circuit Analysis", Tata McGraw Hill.

**References:**

**1.** Charles K. Alexander Matthew N. O. Sadiku, Fundamentals of Electric Circuit
2. M.E.Van Valkenburg, "Network Analysis", III$^{rd}$ Edition , Pearson Education / PHI.
3. Boylestad, "Introductory Circuit Analysis', Universal book stall, New Delhi.(Unit I,II).
4. A. Chakrabarti, "Circuit Theory (Analysis & Synthesis)", III$^{rd}$ Edition (Unit I,II) Dhanpat Rai & Co.

**Unit wise Measurable Students Learning Outcomes:**

1. The students will be able to analyze Circuit using the methods learnt in this course.
2. The students will be able to apply Network Theorems to simplify DC and AC circuits with R, L, C components.
3. The students will able to design R-L-C series and parallel resonant circuit for given specifications and evaluate them.
4. The students will be able to analyze Step or DC response and Sinusoidal or AC response of RC/RL/R-L-C series circuit.
5. The students will be able to design & analyze filters and attenuators studied in this course.
6. The students will able to determine Z,Y, H and ABCD parameters of given two port network

| Title of the Course: Electrical Power Generation Systems | L | T | P | Credit |
|---|---|---|---|---|
| Course Code: UELC0304 | 3 | - | - | 3 |

**Course Pre-Requisite:** Basic Electrical Engineering.

**Course Description:** This course deals in detail about generation of electrical power using Thermal (Coal),Hydro, Nuclear fuels, Diesel, Gas, Solar, Wind, Biogas, Geothermal, Ocean & Co-generation.

**Course Objectives:**

1. To learn the concepts of power and power system.
2. To learn the concepts of electric power generation using conventional sources.
3. To learn the concepts of electric power generation using non-conventional sources.

**Course Outcomes:**

| CO | After the completion of the course the student should be able to | Blooms level | Descriptor |
|---|---|---|---|
| CO 1 | Learn the optimized working of thermal, hydro & nuclear power plant. | II | Learning |
| CO 2 | Understand the optimized working of diesel & gas turbine power plant. | II | Understanding |
| CO 3 | Know the optimized working of solar & wind power plant. | II | Grasping |
| CO 4 | Understand the optimized working of future non-conventional power generation technologies | II | Understanding |

**CO-PO Mapping:**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 1 | | 2 | | | 3 | | | | | 2 | | 1 | |
| CO2 | 1 | | 2 | | | 1 | | | | | 2 | | 2 | |
| CO3 | 1 | | 2 | | | | | | | | 2 | | | |
| CO4 | 1 | | 2 | 1 | | | 1 | | | | | | 2 | |

**Assessment Scheme:**

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weightage respectively.

| Assessment Component | Marks |
|---|---|
| ISE 1 | 10 |
| MSE | 30 |
| ISE 2 | 10 |
| ESE | 50 |

**ISE 1** and **ISE 2** are based on Assignment/Declared test/Quiz/Seminar/Group discussions/presentation, etc.
**MSE** is based on 50% of course content (first three units).
**ESE** is based on 100% course content with 60-70% weightage for course content (last three units) covered after MSE.

| Course Contents: | | |
|---|---|---|
| **Unit No.** | **Unit Title and Contents** | **Hours** |
| **1** | **Unit 1: Thermal power generation**<br>Introduction, Uses, Trends, selection of site for thermal station, main parts & working, Boilers, Economizers, electrostatic precipator, Air preheaters, Superheaters and Reheaters, steam prime mover, condensers, spray pond, cooling towers, Fuels, Delivery of coal, Unloading, preparation, transfer, outdoor storage, indoor storage, Inplant handling, coal weighting, Pulverized fuel system, coal pulverizing, ash disposal & dust collection, ash handling system, dust collection, Types of boiler, feed water, Troubles causes due to impurities in fed water, evaporators, feed water heaters, steam turbines, turbo alternator. | **07** |
| **2** | **Unit 2: Nuclear & Hydro power generation**<br>**Nuclear power generation:** Nuclear power plants – Selection of site, schematic layout of nuclear power plants. Principle of nuclear power generation, nuclear fission and fusion processes, materials used as nuclear fuel, Nuclear reactor – Main parts of reactor and their functions, three stage nuclear program of india.<br>**Hydro power generation:** Introduction, Selection of site, Hydrology, Classification of Hydro-electric plants according to quantity of water available, Classification of Hydro-electric plants according to available head, Classification of Hydro-electric plants according to nature of load, General arrangement & operation, Plant functions of different components in storage reservoir plants, Pump storage plant, different types of micro-hydro turbines for different heads: Pelton, Francis & Kaplan. | **07** |
| **3** | **Unit 3: Diesel & Gas Turbine power generation**<br>**Diesel Power Generation**: Introduction, Uses, Selection of site for a diesel station. Diesel Electric Plant: Main components, Different types of engines used in diesel power plants & their working, Diesel plant efficiency & heat balance, choice & characteristics of diesel engine, Auxiliary equipment for diesel power plant, plant layout maintenance.<br>**Gas Turbine power generation:** Introduction, A simple gas turbine plant, Methods to improve thermal efficiency of gas turbine plants, Components of gas turbine plant, Fuels for gas turbine plants, Different arrangements of components, combination gas turbine cycles, Plant layout, SOx & NOx controller, Advantages of Gas turbine plants over Steam Plants | **07** |
| **4** | **Unit 4: Solar Power generation**<br>The sun, The earth, Sun, Earth radiation spectrum, Extraterrestrial & Terrestrial radiations, Depletion of solar radiation, Solar Time, Solar cell fundamentals, Solar cell characteristics, Solar cell classification, Solar cell, Module, Panel & Array construction, Maximizing the solar PV output & load matching, Maximum Power Point Tracker (MPPT), Solar PV systems, Solar PV Application, Solar thermal systems-Solar collectors, Solar Water Heater, Solar Cookers, Solar Furnaces. | **07** |
| **5** | **Unit 5: Wind Power Generation**<br>Introduction to wind energy, role & potential of wind energy, advantages and disadvantages of wind energy conversion system, site selection, Classification of wind turbines & generation-Horizontal axis wind mills, Vertical axis wind mills, sub-system horizontal axis wind turbine generator, sub-system vertical axis wind mills, Modes of wind power generation-standalone mode, Backup mode like wind-diesel hybrid system, grid connected wind turbine generators, Salient features of electric generators used in power plant-Squirrel | **07** |

| | | |
|---|---|---|
| | cage induction generators, Wound rotor induction generators . | |
| **6** | **Unit 6: Future Non-Conventional Power Generation Technologies**<br>**Biomas Energy Generation:** Layout of a Bio-chemical based (e.g. biogas) power plant, Layout of a thermo-chemical based (e.g. Municipal waste ) power plant, Layout of a agro chemical based (e.g. bio- diesel) power plant.<br>**Geothermal Energy Generation:** Introduction, Applications, Origin & Distributed of Geothermal Energy, Types of Geothermal Resources, Environmental Consideration, Geothermal Energy in India.<br>**Ocean Energy:** Principle of Ocean Energy, Tidal power generation, Wave energy, Wave energy conversion devices and Environmental aspects of electric energy generation.<br>**Co-Generation:** Types of co-generation on basis of sequence of energy use(Topping cycle, Bottoming cycle), Types of co-generation on basis of technology (steam turbine,gas turbine, reciprocating engine), Factor governing selection of cogeneration, advantages of co-generation. | **09** |

**Textbooks:**

| Sr.No. | Title | Edition | Author/s | Publisher |
|---|---|---|---|---|
| 1 | Generation of Electrical Energy | 5th | B.R. Gupta | S.Chand & Co. Ltd |
| 2 | Electrical Power | 10th | S.L Uppal | Khanna Publishers |
| 3 | Electric Power Generating Systems | 3rd | Gaurav Gadage | Electrotech Publication |

**Reference Books:**

| Sr.No. | Title | Edition | Author/s | Publisher |
|---|---|---|---|---|
| 1 | Electrical Power | 9th | Soni, Gupta, Bhatnagar | Dhanpatrai & Sons |
| 2 | Wind Power Technology | 3rd | Earnest, Joshua | PHI Learning, New Delhi |
| 3 | Non-conventional energy resources | 4th | B.H.Khan | Tata McGraw-Hill Publishing Company Limited |

**Unit wise Measurable students Learning Outcomes:**

1.The students will be able to understand thermal power station (TPS) using single line diagram and the functions of the major equipment and auxiliaries of a TPS.
2.The students will be able to understand working of Nuclear & Hydro power station
3.The students will be able to understand working of Diesel power station and Gas turbine power plant.
4. The students will be able to discuss Solar Energy Conversion system.
5. The students will be able to identify various components of Wind Energy Conversion system.
6. The students will be able to understand working of future non-conventional power generation technologies.

| Title of the Course: ENGINEERING MATHEMATICS-III<br>Course Code: UELC0305 | L | T | P | Credits |
|---|---|---|---|---|
| | 3 | 1 | --- | 4 |

**Course Pre-Requisite: Basic terminologies of differential equations, concepts of probability, rules and formulae of derivative and integration.**

**Course Description: This Course contains linear differential equations, Laplace transforms probability distributions, Fourier series, Fourier Transforms, Z Transform .**

**Course Objectives:**

1. To develop abstract, logical and critical thinking and the ability to reflect critically upon their work.
2. To study various mathematical tools like differential equations, integral transforms, probability to devise engineering solutions for problems arising in engineering.
3. The student must be able to formulate a mathematical model of a real life and engineering problem,solve and interpret the solution in real world.

**Course Outcomes:**

| COs | After the completion of the course the student will be able to | Bloom's Cognitive level | Descriptor |
|---|---|---|---|
| CO1 | **Solve** linear differential equations with constants coefficients and apply them to realistic problems. | III | Applying |
| CO2 | **Find** Laplace transforms of given functions and use it to solve LDEs and make use of appropriate probability distribution for finding probabilities of events. | III | Applying |
| CO3 | **Develop** Fourier series expansion of a function over the given interval. | IV | Analyzing |
| CO4 | **Determine** Fourier transforms, Z transforms of given function using its definition and properties. | IV | Analyzing |

**CO-PO Mapping:**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | | | | | | 1 | | | | | | |
| CO2 | 3 | 2 | | | | | | 1 | | | | | | |
| CO3 | 3 | 2 | | | | | | 1 | | | | | | |
| CO4 | 3 | 2 | | | | | | 1 | | | | | | |

**Assessments :**

**Teacher Assessment:**

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

| Assessment | Marks |
|---|---|
| ISE 1 | 10 |
| MSE | 30 |
| ISE 2 | 10 |
| ESE | 50 |

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.

MSE: Assessment is based on 50% of course content (Normally first three units)

ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three units) covered after MSE.

| **Course Contents:** | |
|---|---|
| **Unit 1: Linear Differential Equations with Constant Coefficients and Its Applications**<br>1.1 Definition, general form, complete solution<br>1.2 Rules for finding complementary function<br>1.3 Short methods for finding particular integral<br>1.4 General rule for finding particular integral<br>1.5 Applications to electrical circuits | 6 **Hrs.** |
| **Unit 2: Laplace Transforms**<br>2.1 Definition, transforms of elementary functions, properties of Laplace transform<br>2.2 Transforms of derivative and integral<br>2.3 Inverse Laplace transforms<br>2.4 Inverse Laplace transforms by using partial fractions and convolution theorem.<br>2.5 Transforms of periodic functions and Heaviside unit step function.<br>2.6 Solution of linear differential equations with constant coefficients by Laplace transform method | 7 **Hrs.** |
| **Unit 3: Fourier Series**<br>3.1 Definition, Euler's formulae,<br>3.2 Dirichlet's conditions, functions having points of discontinuity.<br>3.3 Change of interval<br>3.4 Expansion of odd and even periodic functions<br>3.5 Half range series | 8 **Hrs.** |
| **Unit 4: Fourier Transform**<br>4.1 Fourier integral theorem<br>4.2 Fourier transforms<br>4.3 Fourier sine and cosine transforms<br>4.4 Finite Fourier sine and cosine transforms<br>4.5 Properties of Fourier transforms<br>4.6 Convolution theorem for Fourier transform<br>4.7 Parseval's identity for Fourier transform | 8 **Hrs.** |
| **Unit 5: Z Transform**<br>5.1 Definition, convergence of Z transforms, some standard Z Transforms<br>5.2 Properties of Z transforms.<br>5.3 Inverse Z transforms.<br>5.4 Inverse Z transforms using Power series method and partial fraction method.<br>5.5 Application to difference equations. | 7 **Hrs.** |
| **Unit 6: Probability Distributions**<br>6.1 Random variable<br>6.2 Probability mass function and probability density function<br>6.3 Binomial distribution<br>6.4 Poisson distribution<br>6.5 Normal distribution | 6 **Hrs.** |

**Recommended Books:**

1. Higher Engineering Mathematics by Dr. B. S. Grewal, Khanna Publishers, Delhi.
2. A Text Book of Applied Mathematics, Vol. I, Vol. II and vol. III by P. N. Wartikar & J. N. Wartikar, Pune VidyarthiGrihaPrakashan, Pune.

**Reference Books:**

1. Advanced Engineering Mathematics by Erwin Kreyszig, Wiley India Pvt. Ltd.
2. Advanced Engineering Mathematics by H. K. Dass, S. Chand, New Delhi.
3. A text book of Engineering Mathematics by N. P. Bali, Iyengar, Laxmi Publications (P) Ltd., New Delhi.
4. Mathematics for Engineers Vol-I & Vol-II by Rakesh Dube, Narosa Publishing House.

**Unit wise Measurable Learning Outcomes:**

**Unit 1: Linear Differential Equations with Constant Coefficients and Its Applications**

Students will be able to

a) Solve linear differential equations with constant coefficients.
b) Solve the problems on **electrical circuits.**

**Unit 2: Laplace Transforms**

Students will be able to

a) Find Laplace transform by using definition
b) Recall properties of Laplace transform and use to find transforms of given functions.
c) Use Laplace transform method to solve linear differential equations.

**Unit 3 : Fourier Series**

Students will be able to

a) Define Fourier series, Euler's formulae.
b) Develop Fourier series in an interval.
c) Expand function as the half range sine or half range cosine series

**Unit 4: Probability Distributions**

Students will be able to

a) Verify the function as probability mass and density function.
b) Use probability distributions in solving physical and engineering problems.

**Unit 5: Fourier Transforms**

Students will be able to

a) Find Fourier transforms of various functions
b) Find Fourier sine and cosine transforms of given functions

**Unit 6: Z Transforms**

Students will be able to

c) Find Z transforms of various functions
d) Find inverse Z transforms of given functions

| Title of the Course :DC Motors and Transformers LAB | L | T | P | Credit |
|---|---|---|---|---|
| Course Code:UELC0331 | - | - | 2 | 01 |

**Course Prerequisite:** Basic Electrical Engineering Lab

**Course Description:** This course contains experimentation to familiarize and operate and control electric machines studied in electric machines-I theory course.

**Course Objectives:**

1. To develop skills to demonstrate performance/ operation of DC motors & transformers using different tests.
2. To develop skills to analyze operation and performance of DC machines & transformers.

**Course Outcomes:**

| COs | After the completion of the course the students will be able to | Bloom's level | Descriptor |
|---|---|---|---|
| CO1 | **Find** electrical characteristics of DC machines and Transformers. | III | Applying |
| CO2 | **Analyze** performance of DC machines and Transformers. | IV | Analyzing |
| CO3 | **Control** a machine as per requirement. | IV | Applying |

**PO MAPPING**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 1 | | | 1 | | 2 | 3 | 3 | 3 | | 2 | 2 | 1 |
| CO2 | 3 | | | | 3 | 2 | | | 2 | | | 1 | 1 | |
| CO3 | 3 | | | | 3 | | | | 3 | 2 | | 1 | | |

**Assessments:**

**Teachers' assessment-**

In Semester Evaluation (ISE), and End Semester Examination (ESE) having 50% weightage each

| Assessment | Marks |
|---|---|
| ISE | 25 |
| ESE(POE) | 50 |

ISE is based on at least two of the assessment tools like performance of student in laboratory, experimental write-up, presentation, oral, and test (surprise/declared/quiz). ESE Assessment is based on performance in a practical examination and oral test thereafter, at the end of the semester.

| **Course Contents:** | |
|---|---|
| **Experiment No.1:** --- Swinburne's test on DC Shunt Motor. | **2Hrs** |
| **Experiment No.2:** --- Field control of DC Shunt Motor. | **2Hrs** |
| **Experiment No.3:** --- Armature Voltage Control of a DC Shunt Motor. | **2Hrs** |
| **Experiment No.4:**--- Brake load test on DC Shunt Motor. | **2Hrs** |
| **Experiment No.5:**--- Performance analysis of Brushless DC motor. | |
| **Experiment No.6:**--- Parallel operation of single phase transformers to demonstrate load sharing. | **2Hrs** |
| **Experiment No.7:**---OC and SC test on single phase transformer. | **2Hrs** |
| **Experiment No.8:**--- Scott connections for converting 3 phase to 2 phase supply. | **2Hrs** |
| **Experiment No.9:**--- Phase shift and transformation ratio of 3 phase transformer. | **2Hrs** |
| **Experiment No.10:**--- Sumpner's test on identical transformers. | **2Hrs** |
| **Experiment No.11:**---Ratio and polarity test on transformer. | **2Hrs** |

**Textbooks:**

1. A.E.Clayton, "DC Machines", Mc Graw Hill publication, 3rd Edition.
2. M. G. Say. "Performance Design of AC Machines", CBS Publishers, 3rd Edition.
3. O. E. Taylor, "Performance Design of AC commutator motors", Wheeler Publisher, 15th Reprint.

**References:**

1. Nagrath and Kothari, "Electrical Machines", Tata Mc Graw Hill, New Delhi.
2. J. B. Gupta, "Electrical Machines", SK Kataria and Sons, New Delhi.
3. Fitzerald and Kingsley, "Electric Machine", Tata McGraw Hill.

**Experiment wise Measurable students Learning Outcomes:**

**Experiment No.1-** The students will be able to find constant loss in a dc shunt motor.

**Experiment No.2-** The students will be able to control the speed of the dc motor by field control method.

**Experiment No.3-** The students will be able to control the speed of the dc motor by armature voltage control method.

**Experiment No.4-** The students will be able to verify the effect of loading on different parameters of a dc shunt motor.

**Experiment No.5-** The students will be able to analyze the performance of BLDC motor.

**Experiment No.6-** The students will be able to connect the two transformers in parallel for sharing the load.

**Experiment No.7-** The students will be able to find equivalent circuit parameters of a transformer

**Experiment No.8-** The students will be able to obtain 2 phase supply from three phase supply.

**Experiment No.9-** The students will be able to measure phase shift introduced by a 3 phase transformer.

**Experiment No.10-** The students will be able to calculate identical transformers' power loss and equivalent circuit parameters.

**Experiment No.11-**The students will be able to determine polarity of winding terminals and find the voltage ratio of the transformer.

| Title of the Course :Analog & Digital Electronics LAB | L | T | P | Credit |
|---|---|---|---|---|
| Course Code: UELC0332 | - | - | 02 | 01 |

**Course Pre-Requisite:** Basic knowledge of Semiconductor physics, Basic Electrical Engineering

**Course Description: :** This course includes experimentation to study the performance of applications of various types of electronic components such as BJT, FET, oscillators, combinational and sequential circuit implementation using logic gates.

**Course Objectives:**

1. To implement the regulators using BJT and IC's.
2. To evaluate oscillators using OPAMP.
3. To implement combinational circuits using K-map.
4. To design code converters.

**Course Outcomes:**

| COs | After completion of the course the students will be to | Bloom's Level | Descriptor |
|---|---|---|---|
| CO1 | **Learn** operation of voltage regulators using diodes, BJTs and IC's. | II | Understanding |
| CO2 | **Compare** performance of regulators using different ICs. | IV | Analyzing |
| CO3 | **Demonstrate** truth tables of logic gates, flip flops. | II | Understanding |
| CO4 | **Relate** code converters using logic gates. | III | Apply |

**PO MAPPING**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 1 | 2 | | | | | | | | | 2 | | 1 |
| CO2 | 3 | 2 | 2 | | | | | | | | | 2 | | 1 |
| CO3 | 3 | 1 | 3 | | | | | | | | | 2 | | 1 |
| CO4 | 1 | 2 | 2 | | | | | | | | | 2 | | 1 |

**Assessments:**
**Teachers' assessment-**
In Semester Evaluation (ISE), and End Semester Examination (ESE) having 50% weightage each

| Assessment | Marks |
|---|---|
| ISE | 25 |
| ESE(POE) | 50 |

ISE is based on at least two of the assessment tools like performance of student in laboratory, experimental write-up, presentation, oral, and test (surprise/declared/quiz). ESE Assessment is based on performance in a practical examination and oral test thereafter, at the end of the semester.

| **Course Contents:** | |
|---|---|
| **Experiment No.1:---** Zener diode shunt voltage regulator. | **2Hrs** |
| **Experiment No.2:---** Series voltage regulator with Pre- regulator & Overload protection circuit using BJT. | **2Hrs** |
| **Experiment No.3:---** Performance of regulators using IC's:78XX, 79XX, 723, LM317 | **2Hrs** |
| **Experiment No.4:---** Wien Bridge oscillator. | **2Hrs** |
| **Experiment No.5:---** RC phase shift oscillator. | **2Hrs** |
| **Experiment No.6:---** K-map implementation using logic gates | **2Hrs** |
| **Experiment No.7:---** 3:8 decoder design for binary to octal decoding. | **2Hrs** |
| **Experiment No.8:---** Three bit full adder design using any open source software. | **2Hrs** |
| **Experiment No.9:---** Logical circuit converter design to convert binary to binary to Gray code converter. | **2Hrs** |
| **Experiment No.10:---**Multiplexer & demultiplexer design using logic gates. | **2Hrs** |
| **Experiment No.11:---** Verification of the truth table of flip flops using logic gates. | **2Hrs** |

**Textbooks:**
1. S. Salivahanan, A Vallavaraj.,N Suresh Kumar, "Electronic Devices and circuits".
2. Anil K. Maini, Varsha Agarwal, "Electronic Devices and Circuits", Wiley India.
3. A. P. Godse and U.A. Bakshi, "Electronic Devices and Circuits".
4. Electronic Devices and Circuits by Mantri & Jain.

**References:**
1. Boylestad, "Electronic Devices and Circuit Theory".
2. J. B. Gupta, "Electronic Devices and Circuits".
3. Millman, Halkias Pulse, "Digital & Switching Waveforms", TMH.
4. Schaum's Outlines, "Electronic Devices and Circuit".
5. Allen Mottershead, "Electronic Devices and Circuits", PHI.

6. Ben Streetman, Pearson, Solid State Electronic Devices.
7. Data Sheets.

**Experiment wise Measurable students Learning Outcomes:**

**Experiment No.1**-The students will be able to evaluate the performance of Zener diode shunt voltage regulator.

**Experiment No.2**-The students will be to evaluate the performance of series voltage regulator with Pre-regulator & overload protection circuit using BJT.

**Experiment No.3** -The students will be able to evaluate performance of regulators using IC's:78XX, 79XX, 723,LM317.

**Experiment No.4**-The students will be able to evaluate the performance of RC phase shift oscillator.

**Experiment No.5**-The students will be able to evaluate the performance of Wien Bridge oscillator

**Experiment No.6**-The students will be able to realize simplified logic circuit using K-map.

**Experiment No.7**- The students will be able to design 3:8 decoder.

**Experiment No.8**-The students will be able to develop binary to gray code converter.

**Experiment No.9**-The students will be able to design code converters.

**Experiment No.10** - The students will be able to implement multiplexer and demultiplexer using logic gates.

**Experiment No.11** - The students will be able to verify truth tables of different types of flip-flops.

| Title of the Course : Electrical Circuit Analysis LAB | L | T | P | Credit |
|---|---|---|---|---|
| Course Code:UELC0333 | - | - | 02 | 01 |

**Course Pre-Requisite:** Basic Electrical Engineering Lab

**Course Description:** This course contains experimentation to find/ verify properties of different electrical networks.

**Course Objectives:**

1. To make students demonstrate electrical circuit theorems through various experiments.
2. To develop skills for experimenting with first and second order electrical circuit.
3. To develop skills to measure two port electrical networks.

**Course Outcomes:**

| COs | After the completion of the course the students will be able to | Blooms level | Descriptor |
|---|---|---|---|
| CO1 | **Verify** A.C. and D.C. circuit theorems through experiments. | IV | Analyzing |
| CO2 | **Analyze** first and second order circuits through simulation. | IV | Analyzing |
| CO3 | **Analyze** first and second order circuits through experiments. | IV | Analyzing |
| CO4 | **Measure** parameters of any two port network | V | Applying |

**PO MAPPING**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO 11 | PO 12 | PSO 1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 1 | 2 | 1 | 3 | 1 | | | 3 | 1 | | 3 | 2 | 1 |
| CO2 | 3 | 2 | 1 | 2 | 3 | 1 | | | 3 | 2 | | 2 | 1 | 1 |
| CO3 | 3 | 3 | 2 | 1 | 3 | 1 | | | 3 | 2 | | 3 | 2 | 1 |
| CO4 | 3 | 2 | 1 | 1 | 2 | 1 | | | 3 | 1 | | 3 | 1 | 1 |

**Assessments:**

**Teachers' assessment-**

In Semester Evaluation (ISE), and End Semester Examination (ESE) having 50% weightage each

| Assessment | Marks |
|---|---|
| ISE | 50 |
| ESE(OE) | 50 |

ISE is based on at least two of the assessment tools like performance of student in laboratory, experimental write-up, presentation, oral, and test (surprise/declared/quiz). ESE Assessment is based on performance in a practical oral examination thereafter, at the end of the semester

| **Course Contents:**<br>Use of software like PSpice, Matlab, Electric studio app is recommended. | |
|---|---|
| **Experiment No.1:---** Analysis of D.C circuits using Mesh and Node analysis. | **2Hrs** |
| **Experiment No.2:---** Validation of Superposition theorem. | **2Hrs** |
| **Experiment No.3:---** Validation of Thevenin's and Norton's theorem. | **2Hrs** |
| **Experiment No.4:---** Verification of Maximum Power Transfer theorem. | **2Hrs** |
| **Experiment No.5:---** Analysis of transient and steady state behavior of a first order circuit (R-C circuit). | **2Hrs** |
| **Experiment No.6:---** Analysis of transient and steady state behavior of a second order circuit (R-L-C circuit). | **2Hrs** |
| **Experiment No.7:---** Measurement of Z, Y, ABCD and Hybrid parameters of two port network. | **2Hrs** |
| **Experiment No.8:---** Analysis of A.C. circuits using Mesh and Node analysis.<br>**Computer Usage / Lab Tool:** PSpice. | **2Hrs** |

**Textbooks:**

**1.** C.K. Alexandar and M.O. Sadiku "Electric Circuits Analysis", Tata McGraw Hill, 5th Edition, 2013.

**References:**

1. L.P. Huelsman, "Basic Circuit Theory", PHI Publication, 3rd Edition, 2009.
2. M.E. Van Valkenburg, "Network Analysis", PHI publication, 3rd Edition, 1983.
3. Sudhakar Shyammohan "Circuit and Networks", Tata McGraw Hill, 2nd Edition, 2002.

**Experiment wise Measurable students Learning Outcomes:**

**Experiment no.1** -The students will be able to find unknown circuit parameters using Kirchhoff's law.
**Experiment no.1**-The students will be able to analyze D.C circuits using Mesh and Node analysis.
**Experiment no.2**-The students will be able to use Superposition Theorem to analyze a circuit.
**Experiment no.3**-The students will be able to apply Thevenin's and Norton's theorem. to analyze a circuit.
**Experiment no.4**-The students will be able to use Maximum Power Transfer theorem..to analyze a circuit.
**Experiment no.5**-The students will be able to relate time constant with transient and steady state behavior of a first order circuit (R-C circuit).
**Experiment no.6**-The students will be able to relate time constant with transient and steady state behavior

of a first order circuit (R-L circuit).
**Experiment no.7-**The students will be able to co- relate Z, Y, ABCD and Hybrid parameters of two port network.
**Experiment no.8 -**The students will be able to analyze A.C circuits using Mesh and Node analysis.

## Draft Structure and Curriculum for S.Y. B.Tech in Electrical Engineering

### Teaching and Evaluation Scheme

### YEAR / SEMESTER – S.Y.B -Tech, Sem - IV

| Course Code | Course | Curriculum Component | Teaching Scheme | | | | Evaluation Scheme | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P | Credits | Component | Max Marks | Min Marks | |
| UELC0401 | Power Electronics | PC | 03 | - | - | 03 | ISE-I | 10 | 20 | 40 |
| | | | | | | | MSE | 30 | | |
| | | | | | | | ISE-II | 10 | | |
| | | | | | | | ESE | 50 | 20 | |
| UELC0402 | Feedback Control System | PC | 04 | - | - | 04 | ISE-I | 10 | 20 | 40 |
| | | | | | | | MSE | 30 | | |
| | | | | | | | ISE-II | 10 | | |
| | | | | | | | ESE | 50 | 20 | |
| UELC0403 | Electrical Power Transmission &Distribution | PC | 03 | - | - | 03 | ISE-I | 10 | 20 | 40 |
| | | | | | | | MSE | 30 | | |
| | | | | | | | ISE-II | 10 | | |
| | | | | | | | ESE | 50 | 20 | |
| UELC0404 | Electromagnetic Fields | ES | 03 | 01** | - | 04 | ISE-I | 10 | 20 | 40 |
| | | | | | | | MSE | 30 | | |
| | | | | | | | ISE-II | 10 | | |
| | | | | | | | ESE | 50 | 20 | |
| UELC0405 | Signals & Systems | PC | 03 | 01** | - | 04 | ISE-I | 10 | 20 | 40 |
| | | | | | | | MSE | 30 | | |
| | | | | | | | ISE-II | 10 | | |
| | | | | | | | ESE | 50 | 20 | |
| UELA0461 | Environmental studies<br>Audit Course-II | HS | 02 | - | - | - | ESE | 100 | 40 | 40 |
| UELC0431 | Power Electronics Lab | PC | - | - | 02** | 01 | ISE | 25 | 10 | |
| | | | | | | | ESE (POE) | 50 | 20 | |
| UELC0432 | Feedback Control System Lab | PC | - | - | 02** | 01 | ISE | 25 | 10 | |
| | | | | | | | ESE (OE) | 25 | 20 | |
| UELC0433 | AC Machines Lab | PC | - | - | 02** | 01 | ISE | 25 | 10 | |
| | | | | | | | ESE (POE) | 50 | 20 | |
| UELC0434 | Min Project-I | PRJ | - | - | 02** | 01 | ISE | 50 | 10 | |
| **Total** | | | **18** | **02** | **08** | **22** | **-** | **750** | **300** | |
| **TOTAL CONTACT HOURS =28, TOTAL CREDITS = 22** | | | | | | | | | | |

| Title of the Course: Power Electronics | L | T | P | Credit |
|---|---|---|---|---|
| Course Code: UELC0401 | 03 | -- | -- | 03 |

**Course Pre-Requisite:** Basics of Electrical and electronics circuits and devices. Analog and digital circuits and devices. Applications of Semiconductor.

**Course Description:** This course discusses the Power electronics circuits, consists of Power semiconducting devices and its characteristics. It deals with switching transitions in thyristor, MOSFETS and IGBTs. Three major areas of Electrical Engineering-power,electronics and control. Under controlled power conditions, load performs better.So there hasalways been a popular demand to have power modulators. Various types of power modulators are discussed, Students are expected apply these modulators tosolve various practical problems.

**Course Objectives:**

1. Understand the power semiconductor devices characteristics its applications.
2. Analyze the power converter circuits and determine the performance parameters.
3. Apply the control techniques for power converter to control performance parameters and solve the practical problems.

**Course Outcomes:**

| COs | After completion of the course the students will be to | Bloom's Level | Descriptor |
|---|---|---|---|
| CO1 | **Understand** the power semiconductor devices characteristics & its applications | II | Understanding |
| CO2 | **Evaluate** the power converter circuits and **analyze** the performance parameters. | V | Evaluate |
| CO3 | **Design** the control techniques for power converter to control performance parameters and solve the practical problems. | VI | Creating |

**PO MAPPING**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | | | 2 | | | | | 3 | | | 2 | 1 | 1 |
| CO2 | 3 | | | 3 | | | | | 3 | | | 2 | 1 | 1 |
| CO3 | 3 | | | 4 | | | | | 3 | | | 2 | 1 | 1 |

**Assessments:**

**Teacher's assessment-**

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

| Assessment | Marks |
|---|---|
| ISE 1 | 10 |
| MSE | 30 |
| ISE 2 | 10 |
| ESE | 50 |

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with 60-70% weight-age for course content.(Normally last three modules) covered after MSE.

**Course Contents:**

| | |
|---|---|
| **Unit 1: ---Introduction to Power Electronics**-Power electronic system, Applications of Power Electronics, Power semiconductor devices/switches, classification of switches, characteristics of switches, Power diode-types, Switching & Reverse Recovery Characteristics. Construction and working of Power MOSFET, IGBT and characteristics. Data sheet reading of Power diode SCR, MOSFET, IGBT | **7 Hrs.** |
| **Unit 2: ---Thyristors**-Construction and working of Thyristor, Static V-I characteristics of Thyristor, Thyristor Turn-on methods, Two-Transistor Model of SCR, Switching Characteristics of SCR, Gate Characteristics of SCR, Protection of SCR, firing/gating circuits for Thyristor, Heating and cooling circuit of SCR, Series &Parallel Operation of SCR. | **7Hrs.** |
| **Unit 3: ---Controlled Rectifiers**-Single phase half wave-controlled rectifier with R load, RL load, freewheeling diode. Single phase full wave (B-2 connection) controlled rectifier with RLE load. Single phase semi converter. Single phase symmetrical and asymmetrical semi converter. Numerical on performance of full and semi converter. Three-phase half wave-controlled rectifiers R, RL, RLFWD load. Three-phase full-controlled converter. Three phase semi converters. Effect of source inductance on performance of single phase and three phase converters. Dual converter. | **8Hrs.** |
| **Unit 4:---DC Converters-**<br>Chopper-Principle of Chopper Operation. Control Strategies, Types of Chopper Circuits, Buck, Boost and Buck-Boost Converters, Thyristor Chopper Circuits, Voltage and Current-commutated Chopper. Inverter-Single-phase Voltage Source Inverters, Voltage Control in Single-phase Inverter. Pulsewidth Modulated Inverters ,Reduction of Harmonics in the Inverter Output Voltage, Single phase Current Source Inverters. | **7 Hrs.** |
| **Unit 5:---AC Converter-**<br>AC Voltage Controllers-Introduction, Principle of phase control & Integral cycle control, Single-Phase Full-Wave Controllers with Resistive Loads and Inductive Load, Sequence Control of ac Voltage Controllers, Matrix converter, | **7 Hrs.** |
| **Unit 6:---Applications**-Switched Mode Power Supply (SMPS),Uninterruptible Power Supplies, Static Switches, Static Circuit Breakers, Solid State Relays, Resonant Converters-Zero-current Switching Resonant Converters, Zero-voltage-switching Resonant Converters, Comparison Between ZCS and ZVS Converters. | **6 Hrs.** |

**Textbooks:**

1. Power Electronicsby Dr. P. S. Bimbhra- Khanna publishers,4th edition.
2. Power Electronics circuits, devices and applications by M.H. Rashid, third edition Prentice Hall of India New Delhi, 2000
3. Power Electronics – by M. D. Singh & K. B. Kanchandhani, Tata McGraw – Hill Publishing Company, 1998.

**References:**

1. Introduction to Power Electronics", by Mohan, Undeland, Robbins, "John Willey & Sons.3rd edition.
2. Modern power electronics and drives by Bimal K. Bose, Pearson

**Unit wise Measurable students Learning Outcomes:**

After completion of the course students will be able to

3. Explain the power semiconductor devices characteristics & its applications.
4. Explain the Thyristor characteristics and circuit configurations with its applications.
5. Analyze the single phase and three phase circuit configurations by using thyristor.
6. Analyze the AC voltage controller and cycloconverters circuits.
7. Analyze the Chopper and Inverter circuits.
8. Apply the Converter circuits for practical applications.

| Title of the Course : Feedback Control Systems<br><br>Course Code: UELC0402 | L | T | P | Credit |
|---|---|---|---|---|
| | 03 | 01 | - | 04 |

**Course Prerequisites:** Knowledge about Calculus and Transforms, Signals and Systems, Programming with MATLAB, Conceptsof circuit analysis and Simulation.

**Course Description:**

This course deals with the fundamentals of classical control system and analysis of systems. This course deals with mathematical modeling of physical control systems in the form of differential equations and transfer functions. System performance indices are discussed with the help of classical techniques such as root-locus and frequency-domain methods, state space analysis.

**Course Objectives:**

1. This course intends to model a physical system that is useful from control point of view.
2. This course intends to introduce various analysis techniques determining performance features of the systems.

**Course Outcomes:**

| COs | After completion of the course the students will be to | Bloom's Level | Descriptor |
|---|---|---|---|
| CO1 | Interpret and analyze systems in time domain and frequencydomain. | IV | Analyzing |
| CO2 | Determine the response of different order systems for variousstandard signals. | V | Evaluating |
| CO3 | Formulate the mathematical models of any physical systems. | VI | Creating |
| CO4 | Develop, analyze and interpret the models in virtual environment – MATLAB. | VI | Creating |

**CO-PO MAPPING**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 2 | | | | | | | | | | 2 |
| CO2 | 2 | 3 | | 2 | | | | | | | | | | 1 |
| CO3 | 2 | 2 | 2 | | | | | | | | | | | 2 |
| CO4 | 2 | 2 | 2 | | 3 | | | | | | | | | 2 |

**Assessments:**

**Teachers' assessment-**

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively

| Assessment | Marks |
|---|---|
| ISE 1 | 10 |
| MSE | 30 |
| ISE 2 | 10 |
| ESE | 50 |

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with 60-70% weight-age for course content.(Normally last three modules) covered after MSE.

**Course Contents:**

| | |
|---|---|
| **Unit I: Introduction to Control Engineering**<br>Feedback principle, examples of open-loop and closed-loop systems, Classification of feedback control systems, Effects of feedback. | **07 Hrs** |
| **Unit II: Components of Control Systems**<br>Modeling of elements of control systems- AC/DC Servo motor, Synchro, Tacho generator,Stepper motor. | **07 Hrs** |
| **Unit III: Modeling of Systems and Their Representations**<br>Transfer function of typical control-system devices. Block diagram, introduction to Signalflow graphs, State-variable representation and state-diagram, Different Canonical forms, Controllability, Observability. | **07 Hrs** |
| **Unit IV: Time Domain Analysis**<br>Specifications in time domain, type 0, 1, 2 systems and error coefficients. Stability: Routh Hurwitz Criterion, Root locus techniques. | **07 Hrs** |
| **Unit V: Frequency Response Analysis-I**<br>Correlation between Time Response and Frequency Response, Graphical representation-Bode plot and relative stability criteria, Stability, Gain Margin and Phase Margin via Bode plots. [Numerical Treatment] | **07 Hrs** |
| **Unit VI: Frequency Response Analysis-II**<br>Polar plots and Nyquist stability criterion, Stability: Gain Margin and Phase Margin via Polar and Nyquist plot. Different types of Controllers, P, PI and PID, Lead- Lag Compensators.[Numerical Treatment] | **07 Hrs** |

**Text Books:**

1. Control System Engineering, Norman S. Nise, 4th Edition, John Wiley and Sons, 2004
2. Control Systems Engineering, I.J. Nagrath and M. Gopal, 5th Edition, Anshan Publishers, 2008.
3. Control Systems, 2nd Edition, N.C. Jagan, BS Publications
4. Advanced Control Engineering, R.S. Burns, Butterworth Heinemann, 2001.

**References:**

1. Basic Control Systems Engineering, Paul H. Lewis & Chang Yang, Pentice Hall

2. Modern Control Engineering, Eastern Economy, K. Ogata, 4th Edition, 2002.
3. Modern Control system, Dorf and Bishop, 8th Edition Adison Wesley Longman 1998.
4. Control Systems, Benjeman C. Kuo.

**Unit wise Measurable students Learning Outcomes:**

1. The students will be able to summarize effects of feedback in a system.
2. The students will be able to identify the Transfer Function of a given machine.
3. The students will be able to find a Transfer Function of a given system.
4. The students will be able to find out performance of system in Time domain analysis.
5. The students will be able to perform frequency domain analysis using Bode Plot.
6. The students will be able to analyze a system in frequency domain using Polar Plot.

| Title of the Course: Electric Power Transmission and Distribution<br><br>Course Code: UELC0403 | L | T | P | Credit |
|---|---|---|---|---|
| | 04 | -- | - | 04 |

**Course Pre-Requisite:** Basic Electrical Engineering, 3 phase ac circuits, transformers

**Course Description:** This course contains study of basic parameters and concepts in a transmission system. It includes study of configuration of various types of AC and DC distribution system. It also discusses about performance of insulator strings in transmission line and sag calculation in transmission line.

**Course Objectives:**

1.To determine transmission line parameters and quality of underground cables
2.To design the overhead transmission lines
3.To discuss various types of AC and DC distribution system

**Course Outcomes:**

| COs | After completion of the course the students will be to | Bloom's Level | Descriptor |
|---|---|---|---|
| CO1 | **State** structure and components of power transmission and distribution system | II | Understanding |
| CO2 | **Explain** various types of AC and DC distribution system | II | Understanding |
| CO3 | **Analyze** effect of various parameters on power economics | IV | Analyze |
| CO4 | **Model and design** transmission line | V | Evaluate |

**CO-PO MAPPING**

| CO | PO 1 | PO 2 | PO3 | PO4 | PO5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | | | | | 2 | | | | | | 2 | 3 | |
| CO2 | | 2 | 2 | 2 | 2 | | | | | | | 1 | 1 | |
| CO3 | 3 | 3 | | | | 1 | | | | | 2 | | | 2 |
| CO4 | | 2 | 3 | | 3 | | | | | | | 1 | | 2 |

**Assessments:**

**Teachers' assessment-**

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively

| Assessment | Marks |
|---|---|
| ISE 1 | 10 |
| MSE | 30 |
| ISE 2 | 10 |
| ESE | 50 |

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ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with 60-70% weight-age for course content.(Normally last three modules) covered after MSE.

**Course Contents:**

| | |
|---|---|
| **Unit I:--- Introduction to power system**<br>Structure of power systems, Power Grid, Introduction to Grid codes, Regional grids in India, ac and dc transmission concepts. Transmission and distribution administrative and control architecture, Components of transmission and distribution system: Main components of overhead lines, conductor, line supports, insulators, Introduction to substation, single line diagram. | **6 Hrs.** |
| **Unit II:--- Transmission line parameters and modeling**<br>Resistance, inductance and capacitance of single phase and three phase line, concept of GMR and GMD, Skin effect, Proximity Effect, Transmission line models - short, medium and long lines, Line performance-Efficiency and Voltage regulation , voltage and current waves, surge impedance loading of TL, Ferranti effect, methods of voltage control | **6Hrs.** |
| **Unit III:--- Design aspects of overhead Transmission Lines**<br>Types of insulators, potential distribution over suspension insulators, string efficiency, methods of improving string efficiency, corona, factors affecting corona, methods of reducing corona effect, sag in overhead lines and sag calculations. | **6Hrs.** |
| **Unit IV:--- Underground Cables**<br>Construction and classification of cables for single and three phase service, Insulation resistance, capacitance and dielectric stresses in cable, Most economical conductor size in cables, Grading of cables, capacitance grading and inter-sheath grading, Capacitance of three core cable and measurements of capacitances, Methods of laying underground cables. | **6 Hrs.** |
| **Unit V:--- A.C &D.C. Distribution system**<br>Introduction, connection scheme of distribution system: Radial, Ring main Interconnected system<br>DC Distribution: Types of DC distributors, types of loading, distributor fed at one end, distributor fed at both end, Calculation of load at different points, concentrated and Uniform loading, ring distributor, three wire DC system, ground detectors.<br>AC Distribution system: AC distribution calculations, Calculation of load at different points three phase unbalanced loads. Ground detector. | **6 Hrs.** |
| **Unit VI:--- Power System Economics**<br>Cost of Electrical Energy , Load curve and important terms: – maximum demand, average demand, demand factor, diversity factor, plant capacity factor, Different types of tariff such as fixed rate tariff, block rate tariff, two-part tariff, maximum demand tariff, M.D. calculation, Power factor improvement methods | **6Hrs.** |

| | |
|---|---|
| | |

**Textbooks:**

1.V. K. Mehta ,RohitMehta , Principle of Power System ,S. Chand
2.S. N. Singh: Electric Power Generation, Transmission and Distribution, Prentice-Hall, 2007

**References:**

1. J. Nagrath, D. P. Kothari, Modern Power System Analysis, 3rd Edition, Tata McGraw Hill Publishing Co. Ltd., 2003.
2. Hadid Sadat, Power System Analysis, McGraw Hill International, latest edition
3. Ashfaq Husain, Electrical Power Systems, CBS Publishers, 2009
4. W.D. Stevenson (Jr.), Elements of Power System Analysis, 4th Edition, McGraw Hill International, 1982.

**Unit wise Measurable students Learning Outcomes:**

1. The students will be able to understand structure and sectors of power system in India.
2. The students will be able to explain the effect of transmission line parameters on the power system.
3. The students will be able to explain role of different components of overhead transmission lines
4. The students will be able to explain characteristics of underground cables
5. The students will be able to calculate load distribution in dc distributors and A.C Distributors
6. The students will be able to discuss different tariffs and the concerned factors

| Title of the Course: Electromagnetic Fields | L | T | P | Credit |
|---|---|---|---|---|
| Course Code: UELC0404 | 3 | 1 | - | 4 |

**Course Pre-Requisite:** Basic Knowledge about electromagnetic fields and magnetic effect.

**Course Description:** This course discusses the concepts of magnetic and electric fields.

**Course Objectives:**

1. To provide basic concepts of scalar & vector algebra, vector calculus and coordinate system.
2. To introduce the basic concepts applicable to electrostatic fields in conductors & dielectrics.
3. To explain the forces created by magnetic field on charged particles, current elements, loops and dipoles.

**Course Outcomes:**

| CO | After the completion of the course the student should be able to | Blooms level | Descriptor |
|---|---|---|---|
| CO1 | **Understand** the concepts of electromagnetism | II | Understanding |
| CO2 | **Analyze** mathematical operations on scalar, vector, coordinate system, electrostatics and electromagnetic fields. | IV | Analyzing |
| CO3 | **Apply** vector calculus to understand the behavior of static electric fields in standard configurations | IV | Analyzing |
| CO4 | Apply vector calculus to understand the behavior of static magnetic fields in standard configurations. | IV | Analyzing |

**CO-PO Mapping:**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 1 | | | | | | | | | | | | 1 |
| CO2 | 2 | 3 | | | | | | | | | | | | 1 |
| CO3 | 1 | 2 | | | | | | | | | | | | 1 |
| CO4 | 1 | 3 | | | | | | | | | | | | 1 |

**Assessment Scheme:**

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weightage respectively.

| Assessment Component | Marks |
|---|---|
| ISE 1 | 10 |
| MSE | 30 |
| ISE 2 | 10 |
| ESE | 50 |

**ISE 1** and **ISE 2** are based on Assignment/Declared test/Quiz/Seminar/Group discussions/presentation, etc.
**MSE** is based on 50% of course content (first three units).
**ESE** is based on 100% course content with 60-70% weightage for course content (last three units) covered after MSE.

**Course Contents**

| Unit No. | Unit Title and Contents | Hours |
|---|---|---|
| 1 | **Unit 1: Vector Analysis**<br>Scalar & Vector Algebra, Vector Calculus, Del Operator, Cartesian Coordinate System, Vector Component, Vector Field, Dot Product, Cross Product, Spherical and Cylindrical Coordinate System, Conversion between Coordinate System, Divergence of Vector, Curl of a Vector, Gradient of Scalar, Divergence Theorem. | 6Hrs. |
| 2 | **Unit 2: Electrostatics** | 6Hrs. |

| | | |
|---|---|---|
| | Coulomb's law, Field intensity, Electric Field due to line, Volume and surface charges, Electric flux density, Gauss law (differential and integral form),Work done, Electric Potential and gradient, Relationship between E and V,. Energy Density, Electric Dipole and moment, Electric dipole and flux lines, Energy density in electrostatic fields. | |
| **3** | **Unit 3: Magnetostatics**<br>Current distributions, Biot savart law, Ampere's Circuital Law in integral and differential form, Stroke's Theorem, Magnetic flux & Magnetic flux density, Scalar & vector magnetic potentials, Derivation of steady magnetic field laws. | **6Hrs.** |
| **4** | **Unit 4: Conductors and Dielectrics**<br>Linear, isotropic, frequency dependent and homogenous electric material. Current density, Convection and conduction current, Relation between Current density, Electric potential & Volume charge density, Continuity equation,Conductors-relaxation time, effect of field on conductor, Ohms law, effect of field on dielectric, Boundary conditions. | **6Hrs.** |
| **5** | **Unit 5: Poisson's and Laplace's Equations**<br>Introduction, Resistance and capacitance, Derivation of Poisson's and Laplace's equations, General procedures for solving Poisson's and Laplace's equations, Uniqueness theorem, Method of images. | **6Hrs.** |
| **6** | **Unit 6: Maxwell's Equations of Static and Time varying Fields**<br>Maxwell's equations for static field for Faradays law, Amperes law, Gauss law in electric and magnetic field. Maxwell's Equation for time varying field for Faradays law, Amperes law, Gauss law in Electric & Magnetic Field, Maxwell's equations For harmonically varying Fields (phasor Form). | **6Hrs.** |

**Textbooks:**

| Sr.No. | Title | Edition | Author/s | Publisher |
|---|---|---|---|---|
| 1 | Electromagnetic Engineering | 6th | William H. Hayt, Jr John A Buck | Mc Graw Hill |
| 2 | Electromagnetics | 2nd | John D. Kraus | Tata Mc Graw Hill |

**Reference Books:**

| Sr.No. | Title | Edition | Author/s | Publisher |
|---|---|---|---|---|
| 1 | Electromagnetics | 2nd | Joseph A. Edminster | Tata Mc Graw Hill |
| 2 | Elements of Electromagnetics | 4th | M. Sadiku | OUP |
| 3 | Electromagnetic | 4th | J.D. Kraus | McGraw Hill |

**Unit wise Measurable students Learning Outcomes:**

1.The students will be to perform numerical operations on scalars & vectors.
2.The students will be to calculate forces due electrostatic field in free space & in materials.
3.The students will be to grasp various concepts of electromagnetic field and calculate the forces existed by magnetic field.

| |
|---|
| 4.The students will be to explain electric fields in Conductors and Dielectrics.<br>5.The students will be to understand Poisson's and Laplace's Equations.<br>6.The students will be to solve Maxwell's equations of static and time varying fields. |

| Title of the Course : Signal & Systems<br>Course Code: UELC0405 | L | T | P | Credit |
|---|---|---|---|---|
| | 03 | 01 | - | 04 |

**Course Pre-Requisite:** Knowledge of Differentiation, Integration, Matrices and Laplace transform**.**
Knowledge of electrical circuits performing basic mathematical operations

**Course Description:** .This course discusses basic mathematical frame work of signals and systems. It discusses various properties of signals and systems. It focusses on different methods to analyze especially Linear Time Invariant Systems - like Fourier Transform, Laplace transform and z transform. It also discusses on realization of a system with given response characteristic. This course serves as a prerequisite for other courses in this program of Electrical Engineering such as control systems, communication systems, digital signal processing.

**Course Objectives:**

1. To develop basic conceptual thinking ability in students about test signals, their properties and processes on a signal and to understand different properties of the system.
2. To impart students the knowledge of problem solving capabilities on analysis of the system and its output interpretation.
3. To build knowledge base of different transform techniques applicable for system realization.

**Course Outcomes:**

| COs | After the completion of the course the students will be able to | Blooms level | Descriptor |
|---|---|---|---|
| CO1 | **Understand** and interpret different types of test signals applied to systems in electrical applications. | II | Understanding |
| CO2 | **Explain** properties of Linear Time invariant System. | II | Understanding |
| CO3 | **Apply** different transform techniques to analyze a system | III | Applying |
| CO4 | **Realize** a system with desired characteristics | V | Evaluating |

**PO MAPPING**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 1 | | 1 | | | | 1 | | | 1 | 1 | 3 |
| CO2 | 3 | 3 | 1 | | 1 | | | | 1 | | | 1 | 1 | 3 |
| CO3 | 3 | 3 | 1 | | 1 | | | | 2 | | | 1 | 1 | 3 |
| CO4 | 3 | 3 | 3 | | 1 | | | | 2 | | | 1 | 1 | 3 |

**Assessments:**

**Teachers' assessment-**

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

| Assessment | Marks |
|---|---|
| ISE 1 | 10 |
| MSE | 30 |
| ISE 2 | 10 |
| ESE | 50 |

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content.(Normally first three modules)
ESE: Assessment is based on 100% course content with 60-70% weight-age for course content. (Normally last three modules covered after MSE.)

| **Course Contents:** | |
|---|---|
| **Unit 1: Introduction to Signals & System:** Basic definitions, Classification of signals and systems. Signal operations and properties. Basic continuous time signals, signal sampling and quantization, discretization of continuous time signals, discrete time signals. Basic system properties, Representation of digital signals. Case study of different signals from electrical field. | **6 Hrs.** |
| **Unit 2: Continuous & Discrete Time Linear Time System :** Impulse response characterization and convolution integral for CT- LTI system, signal responses to CT-LTI system, properties of convolution, LTI system response properties from impulse response. Impulse response characterization and convolution sum, Causal signal response to DT-LTI systems. Properties of convolution summation, Impulse response of DT-LTI system. DT-LTI system properties from Impulse response. System analysis from difference equation model. | **7 Hrs.** |
| **Unit 3:Fourier series & its Transform:** Representation of Fourier series, Properties of Fourier Series, Dirichlet's conditions, Trigonometric Fourier Series and Exponential Fourier Series, Complex Fourier spectrum. Deriving Fourier Transform from Fourier series, Fourier Transform of arbitrary signal, Fourier Transform of standard signals, Fourier Transform of Periodic Signals, Properties of Fourier Transform | **7 Hrs.** |
| **Unit 4: Continuous-Time Fourier Transform & Discrete-Time Fourier Transform:** Representation of a non -periodic continuous signal, continuous-time Fourier transform (FT), Properties of continuous-time Fourier transform, Applications. Frequency response of LTI systems, Solutions of differential equations along with case study.. Representations of non-periodic discrete signals: The discrete-time Fourier transform (DTFT), Properties of DTFT and applications. Frequency response of LTI system, Solutions of difference equations. | **7Hrs.** |
| **Unit 5:Laplace Transform :** Definition of Laplace Transforms, Inverse Laplace Transform, Concept of Region of Convergence (ROC) for Laplace Transforms, Properties of ROC, Properties of L.T, Relation between L.T and F.T of a signal, Laplace Transform of certain signals. Stability and Causality of CT-LTI system using LT along with case study., block diagram representation and system realization of CT-LTI system | **7Hrs.** |

| | |
|---|---|
| **Unit 6: Z Transform:** Definition of z-Transform, Convergence of z-Transform, z-Transform,of simple signals, Properties of ROC of Z transform, Properties of z-Transform, Inverse z-Transform and Solving difference equation using z-Transform, Stability and Causality of DT-LTI system using Z Transform along with case study, block diagram representation and system realization of DT-LTI system | **6 Hrs.** |
| | |

**Texts Books:**

1.Signals, Systems & Communications – B.P. Lathi, 2013, BSP.
2.Signals and Systems – A.V. Oppenheim, A.S. Willsky and S.H. Nawabi, 2 Ed.
3.Signals and Systems – Simon Haykin and Van Veen, Wiley 2 Ed.,

**Reference Books:**

1.Signals and Systems – A. Rama Krishna Rao, 2008, TMH
2. Fundamentals of Signals and Systems – Michel J. Robert, 2008, MGH International Edition.
3.Signals, Systems and Transforms – C. L. Philips, J.M.Parr and Eve A.Riskin, 3 Ed., 2004, PE.
4.Signals and Systems – K. Deergha Rao, Birkhauser, 2018.

**Unit wise Measurable students Learning Outcomes:**

1.The students will be able to understand the Concept of signals and systems.
2.The students will be able to understand the concept of LTI system.
3.The students will be able to derive Fourier Series for a given periodic signal.
4.The students will be able to find Fourier Transform of a signal and realize a system from its frequency response.
5.The students will be able to find Laplace transform of a signal and realize a system from its transfer function.
6.The students will be able to find Z-transform of a signal and realize a system from its system function.
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| **Class:** S.Y.B.Tech Electrical Engineering<br>**Title of the Course:** Audit Course – I : Environmental Studies<br>**Course Code:** UELA0461 | **L** | **T** | **P** | **Credit** |
|---|---|---|---|---|
| | 02 hours per week | --- | --- | 02 |

**Course Pre-Requisite:**

Students shall have knowledge of:

- Science
- Technology

**Course Description:**

The objective of the course is imparting fundamental knowledge and awareness of Environmental science among students and importance of conservation of environment.

**Course Learning Objectives:**

At the end of the course students will be able to

1. Study scope and importance of natural resources, ecosystems, biodiversity for creating awareness and their conservation in multiple disciplines.
2. Learn various types of pollution, their impacts and control measures for minimizing pollution and sustainable development.
3. Understand social issues related environment, environmental ethics and human rights towards environment.
4. Study various laws and regulations related to environment and its applicability in society and industries.

**Course Outcomes:**

| **CO** | **After the completion of the course the student should be able to** | **Bloom's Descriptor** |
|---|---|---|
| **CO1** | Describe natural resources, importance of ecosystem and conservation of biodiversity with respect to multiple disciplines. | Cognitive (Understanding) L2 |
| **CO2** | Explain causes, effects, solutions for various pollution problems and its minimization strategies. | Cognitive (Understanding) L2 |
| **CO3** | Discuss environmental ethics and their implementation for betterment of environment and human life. | Cognitive (Analyzing) L4 |
| **CO4** | Differentiate between requirements of laws and regulations for environmental conservation and applicability of legislations in society and industries. | Cognitive (Analyzing) L4 |

**CO-PO Mapping:**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | | | | | | | 2 | | | | | |
| CO2 | 3 | | | | | | | | | | | |
| CO3 | | | | | | | | 2 | | | | |
| CO4 | | | | | | 2 | | | | | | |

| COs | PSO1 | PSO2 |
|---|---|---|
| CO.1 | | |
| CO.2 | 1 | 1 |
| CO.3 | | 1 |
| CO.4 | | 1 |

**Assessments:**

| Assessment | Weightage (Marks) |
|---|---|
| ESE | 100 |

**ESE:** Assessment is based on 100% course content.

**Course Contents:**

| | |
|---|---|
| **Unit 1: Nature of Environmental Studies**<br>Definition, scope and importance, Multidisciplinary nature of environmental studies, Need for public awareness. | 4 Hours |
| **Unit 2: Natural Resources and Associated Problems**<br>a) Forest resources: Use and over-exploitation, deforestation, dams and their effects on forests and tribal people.<br>b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dam's benefits and problems.<br>c) Mineral resources: Usage and exploitation. Environmental effects of extracting and using mineral resources.<br>d) Food resources: World food problem, changes caused by agriculture effect of modern agriculture, fertilizer-pesticide problems.<br>e) Energy resources: Growing energy needs, renewable and nonrenewable energy resources, use of alternate energy sources.<br>Solar energy, Biomass energy, Nuclear energy.<br>f) Land resources: Solar energy, Biomass energy, Nuclear energy, Land as a resource, land degradation, man induced landslides, soil erosion and desertification.<br>Role of individuals in conservation of natural resources. | 4 Hours |
| **Unit 3: Ecosystems**<br>Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumers and decomposers. Energy flow in the ecosystem, Ecological succession.<br>Food chains, food webs and ecological pyramids.<br>Introduction, types, characteristics features, structure and function of the following ecosystem:<br>a) Forest ecosystem, b) Grassland ecosystem, c) Desert ecosystem, d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries). | 4 Hours |
| **Unit 4: Biodiversity and its conservation**<br>Introduction- Definition: genetic, species and ecosystem diversity. | 4 Hours |

| | |
|---|---|
| Bio-geographical classification of India.<br>Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values.<br>India as a mega- diversity nation, Western Ghat as a biodiversity region.<br>Hot-spot of biodiversity. Threats to biodiversity habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India. Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity. | |
| **Unit 5: Environmental Pollution**<br>Definition: Causes, effects and control measures of: Air pollution, Water pollution, soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards. Solid waste Management: Causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution. | 4 Hours |
| **Unit 6: Social Issues and the Environment**<br>Disaster management: floods, earthquake, cyclone, tsunami and landslides. Urban problems related to energy Water conservation, rain water harvesting, watershed management, Resettlement and rehabilitation of people; its problems and concerns.<br>Environmental ethics: Issue and possible solutions. Global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Wasteland reclamation.<br>Consumerism and waste products. | 4 Hours |
| **Unit 7: Environmental Protection**<br>From Unsustainable to Sustainable development.<br>Environmental Protection Act.<br>Air (Prevention and Control of Pollution) Act.<br>Water (Prevention and control of Pollution) Act.<br>Wildlife Protection Act.<br>Forest Conservation Act.<br>Population Growth and Human Health, Human Rights. | 4 Hours |
| **Textbooks:**<br>1. Environmental Studies by Dr. P.D.Raut (Shivaji University, Kolhapur) | |
| **Reference Books:**<br>1. Miller T.G. Jr., Environmental Science. Wadsworth Publications Co.(TB).<br>2. Odum, E.P.1971, Fundamentals of Ecology, W.B.Saunders Co. USA,574p<br>3. Trivedi R.K. Handbook of Environmental Laws, Rules, Guidelines,Compliances and Standards, vol. I and II, Environmental Media (R) | |
| **Unit wise Learning Outcomes:**<br>At the end of the course the students will be able to:<br>1.Describe scope and importance of environmental studies.<br>2. Describe types of natural resources, their use and conservation.<br>3. Explain structure and functions of ecosystem, their types and importance.<br>4. Discuss biodiversity, endangered species and methods of biodiversity conservation.<br>5. Explain causes, effects and solutions to pollution problems.<br>6. Discuss environmental ethics and various social issues related to environment.<br>7. Discuss laws and regulations for conservation of environment. | |

| Title of the Course :Power Electronics LAB | L | T | P | Credit |
|---|---|---|---|---|
| Course Code: UELC0431 | - | - | 2 | 01 |

**Course Pre-Requisite:**
Basics of Electrical and electronics circuits and devices, Basic Semiconductor physics, Electric circuit analysis, Operating skill of measuring devices.

**Course Description:** This course discusses with evaluation of characteristics and performance parameters analysis of Power semiconductor devices like SCR, MOSFET, IGBT. Circuit configuration of various type of power modulator and its analysis.

**Course Outcomes:**

| COs | After the completion of the course the students will be able to | Bloom's level | Descriptor |
|---|---|---|---|
| CO1 | **Understand** the Characteristics of semiconductor switches and evaluate its performance parameters. | II | Understanding |
| CO2 | **Analyze** the controlled converter circuit configurations to determine the output voltage. | IV | Analyze |
| CO3 | **Design** the control techniques to Chopper and inverter circuit to control the output voltage. | VI | Apply |

**PO MAPPING**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | | | 2 | | | | | 3 | | | 2 | 1 | 1 |
| CO2 | 3 | | | 3 | | | | | 3 | | | 2 | 1 | 1 |
| CO3 | 3 | | | 3 | | | | | 3 | | | 2 | 1 | 1 |

**Assessments:**

**Teachers' assessment-**

In Semester Evaluation (ISE), and End Semester Examination (ESE) having 50% weightage each

| Assessment | Marks |
|---|---|
| ISE | 25 |
| ESE(POE) | 50 |

ISE is based on at least two of the assessment tools like performance of student in laboratory, experimental write-up, presentation, oral, and test (surprise/declared/quiz). ESE Assessment is based on performance in a practical examination and oral test thereafter, at the end of the semester.

**Course Contents:**

The student should perform minimum 10 experiments from the following list.

| | |
|---|---|
| **Experiment No.1:** ---Static VI characteristics of SCR | **2Hrs** |
| **Experiment No.2:** --- Characteristics of MOSFET | **2Hrs** |
| **Experiment No.3:** --- Characteristics of IGBT | **2Hrs** |
| **Experiment No.4:** --- Gating/triggering circuits for SCR | **2Hrs** |
| **Experiment No.5:** --Single phase fully controlled bridge rectifier with R & RL load | **2Hrs** |
| **Experiment No.6:** ---Three phase half-controlled bridge converter with R load | **2Hrs** |
| **Experiment No.7:** ---Three phase half wave-controlled rectifier with R load | **2Hrs** |
| **Experiment No.8:** ---Single phase dual converter with R & RL load | **2Hrs** |
| **Experiment** No.**9:** ---MOSFET/IGBT based buck converter | **2Hrs** |
| **Experiment No.10:** --- MOSFET/IGBT based boost converter | **2Hrs** |
| **Experiment No.11:** ---Single phase Cycloconverter | **2Hrs** |
| **Experiment No.12:** ---Single Phase PWM Inverter | **2Hrs** |

**Textbooks:**

1. Power Electronics by M.H. Rashid, PHI Publishers, New Delhi, 3rd edition, 2007.
2. Power Electronics P.S. Bimbhra, Khanna Publishers, New Delhi, 3rd edition, 2008.
3. Power Electronics – by M. D. Singh & K. B. Kanchandhani, Tata McGraw – Hill Publishing Company, 1998.

**References:**

1. Mohan, Undeland, Robbins, "Introduction to Power Electronics", John Willey & Sons.

**Experiment wise Measurable students Learning Outcomes:**

Experiment No.1- The students will be able to obtain the characteristics of SCR
Experiment No.2- The students will be able to obtain the characteristics of MOSFET
Experiment No.3- The students will be able to obtain the characteristics of IGBT
Experiment No.4- The students will be able to compare different gating/triggering circuit of SCR
Experiment No.5- The students will be able to control Single phase fully controlled bridge rectifier with R & RL load.
Experiment No.6- The students will be able to control Three phase half-controlled bridge converter with R load
Experiment No.7- The students will be able to control Three phase half wave-controlled rectifier with R load
Experiment No.8- The students will be able to control Single phase dual converter with R & RL load
Experiment No.9- The students will be able to evaluate the operation of MOSFET based buck converter
Experiment No.10- The students will be able to evaluate the operation of MOSFET based boost converter
Experiment No.11- The students will be able to control Single phase Cycloconverter operation
Experiment No.12-The students will be able to control Single Phase PWM Inverter operation

| Title of the Course: AC Machines LAB | L | T | P | Credit |
|---|---|---|---|---|
| Course Code:UELC0432 | - | - | 02 | 01 |

**Course Prerequisite:** Basic Electrical Engineering, DC machines.

**Course Description:** This course contains experimentation to familiarize and operate and control electric machines studied in electric machines theory course.

**Course Objectives:**

1. This course intends to demonstrate performance operation of synchronous and asynchronous machines.
2. It intends to develop skills to analyze operation and performance of asynchronous and synchronous machines.

**Course Outcomes:**

| COs | After the completion of the course the students will be able to | Blooms level | Descriptor |
|---|---|---|---|
| CO1 | **Find** electrical characteristics of AC Machines in real life. | III | Applying |
| CO2 | **Analyze** the performance of AC Machines. | IV | Analyzing |
| CO3 | **Control** the AC Machines as per requirement. | IV | Analyzing |

**PO MAPPING**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | | | 1 | 2 | | | | 3 | 3 | | 2 | 2 | |
| CO2 | 3 | | | | 3 | | | | 2 | | | 1 | 2 | |
| CO3 | 3 | | | 1 | 3 | | | | 3 | 2 | | 2 | 2 | |

**Assessments:**

**Teachers' assessment-**

In Semester Evaluation (ISE), and End Semester Examination (ESE) having 50% weightage each

| Assessment | Marks |
|---|---|
| ISE | 25 |
| ESE(POE) | 50 |

ISE is based on at least two of the assessment tools like performance of students in laboratory, experimental write-up, presentation, oral, and test (surprise/declared/quiz). ESE Assessment is based on performance in a practical examination and oral test thereafter, at the end of the semester.

| **Course Contents:** | |
|---|---|
| **Experiment No.1:** --- Starters for 3 phase induction motor. | **2Hrs** |
| **Experiment No.2:** --- No load and Blocked rotor test on 3 phase induction motor and circle diagram. | **2Hrs** |
| **Experiment No.3:**--- Direct load test on 3 phase induction motor. | **2Hrs** |
| **Experiment No.4:** --- Speed control of 3 phase induction motor using VFD | **2Hrs** |
| **Experiment No.5:** --- Effect of speed on frequency & emf of alternator | **2Hrs** |
| **Experiment No.6:** --- Voltage regulation of alternator using Synchronous Impedance method. | **2Hrs** |
| **Experiment No.7:** --- Voltage regulation of alternator using MMF method. | **2Hrs** |
| **Experiment No.8:** --- Voltage regulation of alternator using direct load method. | **2Hrs** |
| **Experiment No.9:** --- Synchronization of alternators. | **2Hrs** |
| **Experiment No.10:** --- V Curves & Inverted V Curves of Synchronous Motor. | **2Hrs** |

**Textbooks:**

1. M. G. Say. "Performance Design of AC Machines", CBS Publishers, 3rd Edition.
2. O. E. Taylor, "Performance Design of AC commutator motors", Wheeler Publisher, 15th Reprint

**References:**

1. 1. J. Chapman, "Electrical Machine", 3/E, S McGraw Hill.
2. J. B. Gupta, "Electrical Machines", SK Kataria and Sons, New Delhi.
3. Fitzerald and Kingsley, "Electric Machine", Tata McGraw Hill.

**Experiment wise Measurable students Learning Outcomes:**

**Experiment no.1**- The students will compare performance of different starters for the induction motor.

**Experiment no.2-** The students will be to draw a circle diagram of the induction motor and evaluate performance parameters from it.

**Experiment no.3-** The students will be to perform a direct load test Induction motor.

**Experiment no.4-** The students will be to control the speed of 3 phase induction motor using VFD

**Experiment no.5**- The students will be able to study the effect of speed on frequency and emf of alternator

**Experiment no.6-** The students will be to determine voltage regulation of alternator using Synchronous Impedance method.

**Experiment no.7-** The students will be to determine of voltage regulation of alternator using MMF method.

**Experiment no.8-** The students will be to calculate voltage regulation of alternators using direct load method.

**Experiment no.9**-The students will be to synchronize two alternators.

**Experiment no 10**-The students will be able to draw V and inverted V curves of the synchronous motor.

| Title of the Course :Feedback Control System LAB | L | T | P | Credit |
|---|---|---|---|---|
| CourseCode:UELC0432 | - | - | 02 | 01 |

**Course Pre-Requisite:** Calculus and Transforms ,Engineering Mathematics –III, Signals and Systems, Programming with MATLAB, Electric Circuits & Simulation Lab.

**Course Description:**

This course deals with the verification of fundamentals of classical control system andtheanalysisthereupon.Thiscourseprovidestechniquestodevelopmathematicalmodelsof physical control systems or devices in the form of differential equations and transfer functions. Virtual environment like MATALB is used for the analysis.

**Course Objectives:**

1. This course intends to model a physical system that is useful from control point of view.
2. This course intends to introduce various analysis techniques determining performance features of the systems.
3. It intends to impart skills to evaluate the performance of systems using transient analysis.
4. It aims to estimate the stability of linear systems.

**Course Outcomes:**

| COs | After completion of the course the students will be to | Bloom's Level | Descriptor |
|---|---|---|---|
| CO1 | **Draw** the root locus and analyze the system with given T.F | IV | Analyzing |
| CO2 | **Plot** the bode plot, polar and Nyquist plot and analyze frequency domain | IV | Analyzing |
| CO3 | **Determine** the mathematical model of different electro mechanical systems. | V | Evaluating |
| CO4 | **Select** appropriate feedback signals, synthesis feedback gains, and analyze their results and Deduce the first and second order responses | V | Evaluating |

**CO-PO MAPPING**

| CO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO1 | PSO 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 2 | 3 | | 2 | | | | | | | | | 2 |
| CO2 | 2 | 2 | 3 | | 2 | | | | | | | | | 2 |
| CO3 | 3 | 2 | 3 | 2 | 2 | | | | | | | | | 2 |
| CO4 | 3 | 3 | | 2 | | | | | | | | | | 1 |

**Assessments:**

**Teachers' assessment-**

In Semester Evaluation (ISE), and End Semester Examination (ESE) having 50% weightage each

| Assessment | Marks |
|---|---|
| ISE | 25 |
| ESE(OE) | 25 |

ISE is based on at least two of the assessment tools like performance of student in laboratory, experimental write-up, presentation, oral, and test (surprise/declared/quiz). ESE Assessment is based on performance in a practical oral examination thereafter, at the end of the semester

**Course Contents:**

**Thestudentshouldperformminimum10experimentsfromthefollowinglist.**

**Experiment1:----** Modeling of DC Motor: (i)Armature controlled (ii)Field controlled

**Experiment2 ------** T.F. of AC Servomotor &Speed-Torque characteristics

**Experiment3 -----** Study of DC Position Control system

**Experiment4:----**Study of Synchro Transmitter-Receiver as a control device

**Experiment5 ------** lag compensation

**Experiment6 -------** lead compensator

**Experiment7 ------** Time Response of analysis of First order and second order Electric circuits.

**Experiment8 -------** Root Locus Plot using simulation software

**Experiment9:----**Bode Plot using simulation software

**Experiment10:----**Polar & Nyquist Plot using simulation software

**Experiment11------** State Space Representation-Controllability & Observability

**Text Books:**

1. Control System Engineering, Norman S. Nise, 4th Edition, John Wiley and Sons,2004
2. Control Systems Engineering, I.J. Nagrath and M. Gopal, 5th Edition, AnshanPublishers, 2008.
3. ControlSystems,2ndEdition,N.C.Jagan,BSPublications.
4. AdvancedControlEngineering,R.S.Burns,ButterworthHeinemann,2001.

**References:**

1. BasicControlSystemsEngineering,PaulH.Lewis&ChangYang,PenticeHall.
2. ModernControlEngineering,EasternEconomy,K.Ogata,4thEdition,2002.
3. Modern Control system, Dorf and Bishop, 8th Edition Adison Wesley Longman1998.
4. Control Systems, Benjeman C. Kuo, John Wiley & Sons; 9th Revised edition (21July 2009), ISBN-

| |
|---|
| 10:0470048964;ISBN-13:978-0470048962. |
| **Experiment wise Measurable students Learning Outcomes:** |
| **Experiment1:**Students will be able to model of DC Motor. |
| **Experiment2:**Students will be able to find T.F. of AC Servomotor & plot its Speed- Torque characteristics. |
| **Experiment3:**Students will be able to control position using DC Servo control system. |
| **Experiment4:**Students will be able to control position using Synchro Transmitter - Receiver. |
| **Experiment5:**Students will be able to verify the effect of lag compensation. |
| **Experiment6:**Students will be able to verify the effect of lead compensation. |
| **Experiment7:**Students will be able to analyze Time Response of First order and second order system |
| **Experiment8:**Students will be able to plot Root Locus plot from Transfer Function. |
| **Experiment9:** Students will be able to plot Bode plot from Transfer Function. |
| **Experiment10:**Students will be able to plot(Polar & Nyquist ) from Transfer Function. |
| **Experiment11:**Students will be able to study State Space Representation– Controllability & Observability. |

| Title of the Course :Mini Project-I | L | T | P | Credit |
|---|---|---|---|---|
| CourseCode:UELC0434 | - | - | 02 | 01 |

**Course Pre-Requisite:** Basic Knowledge of PCB Design, electronics components ,software like Pspice, Matlab, ETAP.

**Course Description:**

This lab prepares students to develop thinking process to solve social problems by application of science and engineering in innovative manner. The group of students not more than 3 should identify social problems, perform requirement analysis. After interactions with course coordinator and based on comprehensive literature survey/need analysis, the student shall identify the title and define the aim and objectives of micro-project. As per requirements the group should develop specifications of final outcome of the project. The students should think critically and undertake design of the project with skills available with them to meet the requirements and specifications. The group is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and submit the proposal within first week of the semester. The student is expected to exert on design, development and testing of the proposed work as per the schedule. The working model of the project will be demonstrated for internal submission. Completed micro project and documentation in the form of micro project report is to be submitted at the end of semester. The project should complete in 12 weeks including field trails if any. At the end of project the guide should advise students to protect Intellectual Property either in the form of Patent or registration of design or publish paper on work completed or participate in project competition.

**The probable areas of the project work (but not restricted to) are :** Environment protection, global warming, safe drinking water, waste management, renewable energy utilities, biomedical engineering, accident prevention, enabling weaker section of society, efficiency/cost/ time improvements, human hardship reduction, prosthesis, smart city, smart transportation.

**Course Objectives:**

1. **Identify** the problem statement.
2. **Understand** the methodology to troubleshoot the small circuit
3. **Convert** idea in to product.
4. **Work** in a group to implement the idea.
5. **Communicate** effectively to present theme of mini-project.

**Course Outcomes:**

| COs | After completion of the course the students will be to | Bloom's Level | Descriptor |
|---|---|---|---|
| **CO1** | **Apply** the knowledge of electric and electronic fundamental for problem definition. | IV | Analyzing |
| **CO2** | **Develop** methodology to troubleshoot circuit. | IV | Analyzing |
| **CO3** | **Test** the outcomes for desired results. | V | Evaluating |
| **CO4** | **Work** in groups to assemble Mini Project circuits. | V | Evaluating |
| **CO5** | **Demonstrate** presentation skills through Mini Project report. | IV | Analyzing |

**CO-PO MAPPING**

| CO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 1 | 1 | 2 | | | | | | | | 1 | 1 |
| **CO2** | 3 | 2 | 3 | 2 | 2 | | 2 | | 2 | | | | 2 | 2 |
| **CO3** | 2 | 2 | 3 | 2 | 2 | | 2 | | 2 | | | | 2 | 2 |
| **CO4** | | 1 | 3 | 2 | 2 | | | | 3 | | | | 2 | 2 |
| **CO5** | | 1 | 3 | 2 | 2 | | | 2 | 3 | | | | 2 | 2 |

**Assessments:**

**Teachers' assessment-**

InSemesterEvaluation(ISE),andEndSemesterExamination(ESE)having50%weightageeach

| Assessment | Marks |
|---|---|
| ISE | 50 |

ISE is based on performance of student in laboratory, experimental write-up,presentation, oral, and test (surprise/declared/quiz).

**Course Contents:**

- Environment protection, global warming, safe drinking water, waste management, renewable energy utilities, biomedical engineering, accident prevention, enabling weaker section of society, efficiency/cost/ time improvements, human hardship reduction, prosthesis, smart city, smart transportation, energy audit and saving.
- Students should form groups of maximum four in respective practical batch.
- Mini project should be a working model based upon their knowledge, understanding and practices.

- Evaluation of mini project will be through presentation, demonstration and report writing.

1. Study various resources and components in electrical engineering projects.
2. Study datasheet of basic circuit components of a project.
3 To 5 Study various software in building of project like: Electric Circuit, X-Circuit, Electrician app,
4 Electronic Tutorials, MATLAB, ETAP, Logisim, Circuit simulator, Free PCB, Ki CAD EDA software suit, SYC labs etc.
6. Preparation of PCB for a given project.
7. Verification and analysis of project.
8. Report Writing.

**Experiment wise Measurable students Learning Outcomes:**

1. The students will develop sensitivity towards social problems.
2. The students will be able to develop thinking process to solve social problems by application of Science and engineering in innovative manner.
3. The students will be able to think critically and undertake design of the project with skills.
4. The students will be able to design, develop and test any assigned work.

Note:

- **ESE:** End Semester Examination, **MSE:** Mid Semester Examination, **ISE:** In Semester Evaluation.
- **HS:** Humanities, Social science and Management, **BS:** Basic sciences including mathematics
- **ES:** Engineering Science, **PC:** Professional Core, **PE:** Professional Elective
- **O:** Open elective, **PRJ**: Project work, Seminar, Internship in industry etc.

## List of Audit Courses - Semester III and IV

| Year | Audit Course | Course Code | Audit Course |
|---|---|---|---|
| Second Year B.Tech-I | Audit Course-I | UELA0361 | Constitution Of India |
| Second Year B.Tech-II | Audit Course-II | UELA0461 | Environmental Studies |