# B.N.M. Institute of Technology

**An Autonomous Institution under VTU**

## Department of Electrical and Electronics Engineering

# III Semester Syllabus

# Department of Mathematics

## Syllabus

| Semester: III | | | |
|---|---|---|---|
| **Course: Fourier Series, Transforms, Numerical and Statistical Techniques** | | | |
| **Course Code: 21MAC131 (Common to ECE, EEE & ME)** | | | |
| **L:T:P:J** | **2:2:0:0** | **CIA** | **: 50** |
| **Credits:** | **03** | **SEA** | **: 50** |
| **Hours:** | **40** | **SEA Duration** | **: 03 Hours** |

**Course Learning Objectives:** The students will be able to

| | |
|---|---|
| 1 | Have an insight into Fourier series, Fourier transforms, Difference equations and Z-transforms. |
| 2 | Develop knowledge of solving ODE's arising in engineering applications, using numerical methods. |
| 3 | Develop knowledge of Statistical methods and curve fitting arising in engineering. |

| **Module-1: Fourier Series** | **RBT** | **Hours** |
|---|---|---|
| Periodic functions, Introduction to Fourier Series, Dirichlet's condition. Fourier series of periodic functions with period $2\pi$ and arbitrary period. Half range Fourier sine and cosine series. Practical harmonic analysis over the interval *(0, 2l).*<br>**Self-study:** Applications of Fourier series in Engineering. | **Apply** | **8** |
| **Module-2: Fourier Transforms & Z-Transforms** | **RBT** | **Hours** |
| **Fourier Transforms:** Fourier transform and properties-problems, Fourier sineand cosine transforms. Inverse Fourier transforms.<br>**Z-Transforms:** Introduction to Z-transform, Z-transform of standard functions and properties (without proof). Initial value and final value theorems, problems.<br>**Self-study**: Applications of Fourier & Z-Transform in Engineering. | **Apply** | **8** |
| **Module-3: Numerical Solutions of Ordinary Differential Equations** | **RBT** | **Hours** |
| Numerical solution of ordinary differential equations of first order- Taylor series method, Euler's method, Modified Euler's method, Runge-Kutta method of fourth order, Milne's predictor and corrector methods (without proof)<br>Numerical solution of second order ordinary differential equation using Runge-Kutta method of fourth order.<br>**Self-study**: Solution of first order ordinary differential equation using Adam-Bashforth predictor and corrector methods. | **Apply** | **8** |
| **Module-4: Statistical Methods** | **RBT** | **Hours** |
| Introduction to Measures of Central tendency and Dispersion. Moments, Skewness, kurtosis and problems. Karl Pearson's coefficient of correlation and lines of regression. Rank correlation and problems<br>**Self-study:** Problems on mean, median and mode. | **Apply** | **8** |
| **Module-5: Curve Fitting & Linear Programming** | **RBT** | **Hours** |
| **Curve Fitting:** Curve fitting by the method of least squares- fitting the curves of the form- $y = ax + b$, $y = ax^b$ *and* $y = ax^2 + bx + c$.<br>**Linear Programming problems (LPP):** General Linear programming problem, canonical and standard forms of LPP, Basic solution, Basic feasible solution, Optimal solution, Simplex method-problems.<br>**Self-study:** Linear programming problems using graphical method. | **Apply** | **8** |

**Course Outcomes:** After completing the course, the students will be able to

CO 1: Demonstrate Fourier series to study the behavior of periodic functions and their applications in system communications, digital signal processing and field theory.

CO 2: Make use of Fourier transform and Z-transform to illustrate discrete / continuous function arising in wave and heat propagation, signals and systems.

CO 3: Solve first and second order ordinary differential equations arising in engineering problems using single step and multistep numerical methods.

CO 4: Make use of rank correlation, correlation and regression analysis to fit a suitable mathematical model for the statistical data.

CO 5: Fit a curve and solve linear programming problems by simplex method

**Reference Books:**


1. E. Kreyszig: Advanced Engineering Mathematics, John Wiley & Sons, 10"Ed.(Reprint), 2016.
2. B.S. Grewal: Higher Engineering Mathematics, Khanna Publishers, 44th Ed., 2017.
3. H. K. Dass, ― Advanced Engineering Mathematics‖ S. Chand publication.
4. C.Ray Wylie, Louis C.Barrett : ―Advanced Engineering Mathematics", 6" Edition, 2. McGraw-Hill Book Co., New York, 1995.
5. James Stewart : ―Calculus ―Early Transcendentals‖, Cengage Learning India Private Ltd., 2017.
6. B.V.Ramana: "Higher Engineering Mathematics" 11" Edition, Tata McGraw-Hill, 2010.
7. Srimanta Pal & Subobh C Bhunia: ―Engineering Mathematics‖, Oxford University Press, 3"Reprint, 2016.
8. Gupta C.B., Singh S.R. and Mukesh Kumar: ―Engineering Mathematics for Semester I & II‖, Mc-Graw Hill Education (India) Pvt.Ltd., 2015.


**Web links and Video Lectures:**

1. https://archive.nptel.ac.in/courses/111/106/111106111/
2. https://www.youtube.com/watch?v=SO7wRj9vXM8
3. https://nptel.ac.in/courses/111107107
4. https://www.youtube.com/watch?v=ir1U8sIog78
5. https://nptel.ac.in/courses/111105090
6. http://academicearth.org/
7. https://archive.nptel.ac.in/courses/111/104/111104027/

# Department of Electrical and Electronics Engineering

| Semester : III | |
|---|---|
| **Course Name: Generation, Transmission and Distribution** | |
| **Course Code: 21EEE132 L:T:P:J:2:2:0:0** | **CIA: 50** |
| **Credits: 3** | **SEA: 50** |
| **Hours: 40 hrs** | **SEA Duration: 03 Hours** |

**Course Objectives:**

- To understand the concepts of various methods of generation of power
- To understand the merits and demerits of hydroelectric power plant, thermal power plant and nuclear power plant.
- To design the insulators for a given voltage level
- To calculate the parameters of the transmission line for different configurations and assess the performanceof the line
- To study underground cable, its specifications and AC distribution system

**Pre-requisites: Basic Electrical Engineering**

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

- Explain the structure of power system, generation, generation economics and the importance of High Voltage transmission system
- Calculate the economics of the transmission line and string efficiency
- Calculate the parameters of the transmission line and assess the performance of the line.
- Calculate the performance and efficiency of short, medium and long transmission lines.
- Explain the corona phenomena, underground cables and its limitations.
- Explain primary & secondary distribution system and reliability aids of distribution system.
- Explain the impact of high power transmission and distribution systems on society.

| Module-1: Power Generation | RBT | Hrs |
|---|---|---|
| **Hydroelectric Power Plants:** Hydrological cycle, Merits and demerits of hydroelectric power plants (Flip Class), Selection of site, General arrangement of hydel plant, Elements of the plant, Classification of the plants based on water flow regulation, Water head and type of load the plant has to supply, Operation and Characteristics of Water turbines – Pelton wheel, Francis, Kaplan and propeller turbines (Video Lectures), Selection of water turbines<br>**Thermal Power Plant:** Introduction, Efficiency of steam plants, Merits & demerits of plants and Selection of site (Flip Class), Working of steam plant, Power plant equipment and layout, Steam turbines, Fuels and fuel handling, Fuel combustion andcombustion equipment<br>**Nuclear Power Plant:** Introduction, Economics of nuclear plants, Merits and demerits, Nuclear chain reaction, Types of Power Reactor: CANDU reactor, PWR, Fast Breeder Reactor, Disposal of nuclear waste<br>**Self-Study Component**<br>Classification of coals used in steam power plant, Classification of Nuclear reactor. | **Understand** | **8** |
| **Module–2: Economics of Generation and Electrical Supply System** | **RBT** | **Hrs** |
| **Economics of Generation:** Introduction, Effect of variable load on power system, classification of costs, Cost analysis, Load factor, diversity factor, Load curve (Brief description only) Numerical Problems.<br>**Electrical Supply System:** Layout, Advantages of HV transmission, Conventional | **Apply** | **8** |

| | | |
|---|---|---|
| conductors; Aluminium Conductor steel reinforced (ACSR), Gap type thermal resistant aluminium alloy conductor steel reinforced (GTACSR), HTLS conductor, Bundle conductor and its advantages. Importance of sag, Sag calculation – supports at same and different levels, effect of wind and ice.<br>**Overhead line Insulators:** A brief introduction to types of insulators, material used- porcelain, toughened glass and polymer (composite). Potential distribution over a string of suspension insulators. String efficiency, Methods of increasing string efficiency (Description only).<br>**Self-Study Component**<br>Classification of poles and Corona effect on the transmission line | | |
| **Module–3: Transmission Line Parameters** | **RBT** | **Hrs** |
| Introduction to line parameters- resistance, inductance and capacitance. Calculation of inductance of single phase and three phase lines with equilateral spacing, unsymmetrical spacing, double circuit and transposed lines. Inductance of composite<br>– conductors, geometric mean radius (GMR) and geometric mean distance (GMD). Calculation of capacitance of single phase and three phase lines with equilateral spacing, unsymmetrical spacing, double circuit and transposed lines, ~~effect of earth~~ geometric mean radius (GMR) and geometric mean distance (GMD). Advantages of single circuit and double circuit lines.<br>**Self-Study Component**<br>Effect of earth on the capacitance of the transmission line | **Apply** | **8** |
| **Module–4: Performance of Transmission Lines** | **RBT** | **Hrs** |
| Classification of lines – short, medium and long. Current and voltage relations, line regulation and Ferranti effect in short length lines, medium length lines considering Nominal T and nominal $\pi$ circuits, and long lines considering hyperbolic form equations. Equivalent circuit of a long line. ABCD constants in all cases<br>**Self-Study Component**<br>Skin effect, Proximity Effect and Ferranti effect on the transmission line | **Apply** | **8** |
| **Module–5: Underground Cable and Distribution System** | **RBT** | **Hrs** |
| Underground Cable: Introduction, constructional features, insulation resistance,thermal rating, charging current, grading of cables – capacitance and inter-sheath.Dielectric loss. Comparison between AC and DC cables. Limitations of cables.Specification of power cables and code of practice as per IS 1255 (1983) **Distribution:** Primary AC distribution systems – Radial feeders, parallel feeders, loop feeders and interconnected network system. Secondary AC distribution systems<br>– Three phase 4 wire system and single phase 2 wire distribution, AC distributors with concentrated and uniform loads. Effect of disconnection of neutral in a 3 phase four wire system.<br>**Self-Study Component**<br>Limitations of the distribution system and reliability aids | **Apply** | **8** |

**Reference Books**

| Sl. No. | Title | Author | Publication | Edition |
|---|---|---|---|---|
| 1 | A Course in Power Systems | J.B. Gupta | Katson | 2008 |
| 2 | A Course in Electrical Power | Soni Gupta & Bhatnagar | Dhanpat Rai & Sons. | 1st Edition, 2013 |
| 3 | Electric power generation Transmission and Distribution | S. N. Singh | PHI | 2nd Edition, 2009. |
| 4 | Principles of Power System | V K Mehta, Rohit Mehta | S Chand & Company Ltd | 3rd Edition, 2005. |
| 5 | Electrical power systems | Ashfaq Hussain | CBS publication | 5th Edition, 2007. |

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# Department of Electrical and Electronics Engineering

| **Semester: III** | | |
|---|---|---|
| **Course Name: Network Analysis (PCC)** | | |
| **Course Code: 21EEE133 L:T:P:J:2:2:0:0** | **CIA: 50** | |
| **Credits: 3** | **SEA: 50** | |
| **Hours: 40 hrs** | **SEA Duration: 03 Hours** | |

**Course Objectives:**

- To explain about the elements used to construct electrical circuit.
- To explain the use of network reduction and network solution methods for the analysis a given circuit
- To explain the concept of network theorems for complex circuits.
- To explain the concept of time domain approach to analyze the behaviour of electric circuit.
- To explain the simplified Laplace transform approach to analyze behaviour of electric circuit.

**Pre-requisites:** KVL, KCL, series parallel reduction of R,L and C elements, linear algebra, solution of differential equations, Laplace transforms and inverse Laplace transforms.

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

**CO1:** To analyze the given circuit using network reduction & network solution methods

**CO2:** To solve the given electric circuit by applying the concept of network theorems.

**CO3:** Analyze the behaviour of electrical network under initial, steady state condition and variation ofparameters.

**CO4:** Analyze the behaviour of electric circuit using Laplace transformation approach.

**CO5:** To model the given two port networks in terms of standard parameters (Z, Y and T).

| **Module-1: Fundamentals of Network theory** | **RBT** | **Hrs** |
|---|---|---|
| **Network Elements:** Ideal voltage and practical sources, dependent sources, classification of elements. **Network Reduction methods:** Concept of Source transformation & Source shifting.<br>Star delta transformation. Illustrative Examples<br>**Network Solution methods:** Node and Mesh analysis for ac and dc circuits with independent and dependent sources. Super Node and Super Mesh analysis for ac and dc circuits with independent and dependent sources.<br>**Self-Study:** Examples of Source transformation & Source shifting. | **Apply** | **8** |
| **Module–2: Network Theorems** | **RBT** | **Hrs** |
| **Network Theorems**: Superposition, reciprocity Theorems, Thevenin's, Millman's and Maximum Power Transfer theorem, Analysis of networks for ac and dc sources. (Excluding dependent sources)<br>**Self-Study:** Norton's Theorem | **Apply** | **8** |
| **Module–3: Initial Conditions & Resonance** | **RBT** | **Hrs** |
| Behavior of circuit elements under switching action (t=0 and t=∞),Evaluation of initial conditions.<br>**Resonance:** Analysis of simple series RLC circuits under resonance. Problems on Resonant frequency, Bandwidth and Quality factor at resonance.<br>**Self-Study:** Parallel resonance | **Apply** | **8** |
| **Module–4: Laplace transform** | **RBT** | **Hrs** |
| Introduction to Laplace Transformation, Initial and final value theorems, problems. Laplace transform applied to RL, RC and RLC circuits with ac and dc excitation. | **Apply** | **8** |

| Module–5: Three Phase Circuits | RBT | Hrs |
|---|---|---|
| **Three Phase Circuits:** Unbalanced three phase System, Analysis of three phase systems, calculations of real and reactive powers by applying mesh analysis.<br>**Two port networks:** Z, Y and T parameters (Definitions, relation, problems with and without dependent sources)<br>**Self-Study:** h parameter analysis | **Apply** | **8** |

**Reference Books:**


1. Engineering Circuit Analysis, William H Hayt et al, McGraw Hill, 8th Edition, 2014.
2. Fundamentals of Electric Circuits Charles K Alexander, Matthew N O Sadiku, McGraw Hill 5thEdition, 2013.
3. Network Analysis, M.E. Vanvalkenburg, Pearson 3rd Edition, 2014.
4. Circuit theory (Analysis and synthesis), A. Chakrabharathi, Dhanpat rai @co.(pvt.)Ltd, 6thedition, 2010.
5. Electric Circuits, Joseph A Edminister & Mahmood Nahavi, 5th Edition, Schaum's outlines,McGraw Hill.

| **Semester: III** | |
|---|---|
| **Transformers and Induction Motors (PCI)** | |
| **Course Code: 21EEE134 L: T:P: J:** 3:0:2:0 | **CIE Marks:** 50 |
| **Credits: 4** | **SEE Marks:** 50 |
| **Hours: 40 + 10 Lab** | **SEE Duration:** 03 Hours |

**Course Learning Objectives:**

- To understand the working of practical transformer and auto-transformer
- To understand the performance of single-phase & three phase transformer
- To understand the characteristics & starting methods of three phase IMs
- To understand the performance of three phase IMs
- To understand the working of Special electric motors

**Pre-Requisites:** Basic Electrical Engineering

**Course Outcomes:** After the completion of the course the students will be able to:

- Explain the working of practical transformer, auto-transformer, and Special electric motors
- Determine performance parameters of single-phase transformer and three phase IM
- Explain the types of three phase transformer connections
- Explain the characteristics & starting methods of three phase IMs
- Analyze the performance characteristics of three phase IMs

| **Module-1: Performance Analysis & Testing of Single-Phase Transformers** | **RBT** | **Hours** |
|---|---|---|
| **Teaching component**: **Performance analysis of Single-phase Transformers:** Concept of exact and approximate equivalent circuit, Phasor diagram of a practical transformer, voltage regulation, all day efficiency. Parallel operation - need, conditions to be satisfied for parallel operation. Load sharing in case of similar and dissimilar transformers**,** Illustrative examples<br>**Testing:** Open circuit and short circuit tests, polarity test, back-to-back test, andseparation of hysteresis and eddy current losses, Parallel operation of single- phase transformers, Illustrative examples<br>**Self-learning component:** Description of power & distribution transformers, instrument transformers. | **L2, L3** | **8** |
| **Module-2: Three phase transformers and Auto Transformers** | **RBT** | **Hours** |
| **Teaching component**: **Three-phase Transformers:** Introduction, Constructional features of three-phase transformers. Choice between single unit three-phase transformer and a bank of three single-phase transformers,Transformer connections for three phase operation - star/star, delta/delta, star/delta, and vee/vee, choice of connections. Tertiary winding, phase shift between primary and secondary and vector groups. Scott connection for three-phase to two-phase conversion, Illustrative examples.<br>Autotransformers: - Single phase auto transformer, saving of conductor material, Equivalent circuit, comparison of auto transformer and two winding transformer, three phase auto transformers, Advantages, and disadvantages. Illustrative examples<br>Self-learning component: Labelling of three-phase transformer terminals, Applications of autotransformers | **L2, L3** | **8** |

| Module-3: Three phase Induction Motor | RBT | Hours |
|---|---|---|
| **Teaching component: Three phase Induction Motor:** Equivalent circuit, Losses and efficiency, power flow diagram, Rotor torque, Torque – Slip & Torque – Speed Characteristics, Rotor current and power factor, Starting and Maximum torques, Phasor diagram of induction motor on no load and loaded conditions. Cogging and crawling, Induction motor working as induction generator; Illustrative examples<br>**Self-learning component:** Applications of high torque IM, Importance of induction generators in windmills**.** | **L2, L3** | **8 hours** |
| **Module-4: Testing, Starters and Speed Control of IM** | **RBT** | **Hours** |
| **Teaching component: Tests on three phase Induction Motor**: Brake test, No-load and blocked rotor tests, Circle diagram and performance evaluation of the motor. Illustrative examples<br>**Starters for 3-phase IMs:** Need for starter. Direct on line (DOL), Star-Deltaand autotransformer starting, Rotor resistance starting. Soft(electronic) starters **Speed control:** Voltage, frequency, V/f control (qualitative) and rotorresistance control, Illustrative examples<br>**Self-learning component:** Comparison of starters and speed control methods | **L2, L3** | **8 hours** |
| **Module-5: Special electric motors** | **RBT** | **Hours** |
| **Teaching component**:<br>**Special electric motors:** Construction, working & ***characteristics*** of Reluctance motors, Hysteresis motors, repulsion motors, Linear induction motors, and applications.<br>Two Phase AC Servomotors: Construction, torque-speed characteristics, and applications.<br>Switched Reluctance Motors: Construction, Principle of operation, torque-speed characteristics, advantages, and disadvantages, applications<br>**Self-learning component:** comparison of Reluctance motors, Hysteresis motors, repulsion motors, Linear induction motors | **L2** | **8 hours** |
| **Laboratory Experiments:**<br>1. Open Circuit and Short circuit tests on single phase transformer and predetermination of (i) Efficiency and regulation (ii) Calculation ofparameters of equivalent circuit.<br>2. Sumpner's test on transformers and determination of individual transformer efficiency<br>3. Parallel operation of two dissimilar single-phase transformers and determination of load sharing and analytical verification using the short circuit test data.<br>4. Scott connection with balanced and unbalanced loads<br>5. Separation of hysteresis and eddy current losses in single phase transformer.<br>6. Polarity test and connection of 3 single-phase transformers in star – delta and determination of efficiency and regulation under balanced resistive load.<br>7. Comparison of performance of 3-phase transformers in delta – delta andV – V (open delta) connected under load.<br>8. Load test on three phase induction motor.<br>9. No load and Blocked rotor tests on three phase induction motor to draw the circle diagram and hence to determine (i). the performance parameters at different load conditions and (ii) obtain the equivalent circuit.<br>10. Performance characteristics of Induction Generator<br>11. Demonstration experiment: Study of the effect of change in input voltage on iron loss in a single-phase transformer. | | |

**Reference Books**


1. Electrical Machinery, J.B.Gupta, S K Kataria & Sons
2. Electric Machines, D P Kothari, I J Nagrath, TMH
3. Electrical Machines, Ashfaq Hussain, Dhanpat Rai & Co. Publications
4. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education
5. Special Electrical Machines, K Venkataratham, University Press
6. Special Electrical Machines, E G Janardhan, PHI

# Department of Electrical and Electronics Engineering

| **Semester: III** | |
|---|---|
| **Analog and Digital Electronic Circuits (PCI)** | |
| **Course Code: 21EEE135 L:T:P:J:** 3:0:2:0 | **CIE Marks:** 50 |
| **Credits: 4** | **SEE Marks:** 50 |
| **Hours: 40 Hours + 10 Hours Lab** | **SEE Duration: 0**3 Hours |

**Course Learning Objectives: The students will be able to**

- Understand non-linear application of op-amp and realize function generator using op-amp.
- Design and analyse Butterworth filter circuit
- Use D/A and A/D convertors, Linear ICs 555, Voltage regulators for Analog circuitapplications
- Implement Boolean switching functions after using K-map to simplify equations
- Use combinational circuits multiplexers, encoders, code convertors, decoders
- Use flip flops to realize registers, and counters

**Pre-Requisites:** Course on Basic Electronics

**Course outcomes:** At the end of the course the student will be able to
CO1: Implement filters, waveform generators and non-linear applications of Op-Amp for a givenrequirement
CO2: Use Timer IC, Regulators, D/A and A/D converters for a given applicationCO3: Simplify given Boolean expression using k-map
CO4: Build combinational circuits for code conversion, multiplexer, decoder, addersCO5: Build sequential circuits using flip flops for registers and counter operations

| **Module-1: Introduction to Digital Circuits and Combinational circuits** | **RBT** | **Hours** |
|---|---|---|
| **Teaching component**: Review of Digital basics and logic gates, Switching equations, Canonical form of SOP and POS, Simplification and realization of Digital switching equations using K-map [3 and 4 variables], Design Code convertors [ BCD to Excess-3, BCD to 7-segment, BCD to Graycode<br>**Self-learning component:** Tabular method of simplification | **Apply** | **8** |
| **Module-2: Combinational circuits and Introduction to sequential circuits** | **RBT** | **Hours** |
| **Teaching component**: **Multiplexers (Mux) :** Implementation of 4:1, 8:1 Mux, Realization of Boolean expression using Mux<br>**Decoders:** Implementation of 2:4, 3:8 decoders, Realizing higher order decoder using lower order decoders, realization of Boolean expression using Decoders<br>**Adders:** Binary adder, Adder cum subtractor using binary adder and carry look ahead adders<br>**Flip Flops:** Basic bistable element, Gated SR Latch, Edge triggered D-flip flop, JK-flip flops and T-flip flops Characteristic equation of flip flops<br>**Self-learning component:** Encoders and De-multiplexers | **Apply** | **8 hours** |
| **Module-3: Sequential circuits** | **RBT** | **Hours** |
| **Teaching component**: Excitation table for all flip flops,<br>**Registers:** Types of registers, Shift registers, 4-bit PIPO, PISO, SISO,SIPO registers, Universal shift registers,<br>**Counters:** Binary ripple counters, Synchronous Binary counters, Countersbased on Registers, Design of Synchronous counters<br>**Self-learning component:** Use of shift registers for Serial adders and Serial | **Apply** | **8 hours** |

| | | |
|---|---|---|
| transfer | | |
| **Module-4: Operational Amplifier Applications** | **RBT** | **Hours** |
| **Teaching component**: Review of op-amp parameters<br>**Op-Amp Non-Linear Applications:** ZCD, Comparator, Schmitt Trigger[Analysis and Design]<br>**Waveform generation:** Generation of Square wave using Astable circuit[Analysis and Design], Phase shift oscillator, Triangular wave generation **Filters:** Advantage of active filter, First order Butterworth Low pass, Highpass, Band Pass filters [ Analysis and Design]<br>**Self-learning component:** All pass and Band reject filters. | **Apply** | **8 hours** |
| **Module-5: Linear IC applications** | **RBT** | **Hours** |
| **Teaching component**:<br>**D/A and A/D convertors:** Introduction to D/A and A/D convertors, R- 2R D/A convertor, Successive approximation A/D convertors<br>**555 Timer IC:** Internal Block diagram of 555, working of 555 as astable and monostable circuit. Applications of monostable and astable circuits[ Analysis and Design]<br>**Voltage regulators:** Fixed voltage regulators, adjustable voltage regulators<br>**Self-Learning component:** IC version of Regulators | **Apply** | **8 hours** |

| **Lab Experiments (10 Lab sessions)** | |
|---|---|
| **Sl. No.** | **Experiments** |
| 1 | Design and realization of 1st order Butterworth High pass and low pass filter |
| 2 | Design and realization of Schmitt trigger circuit of a given UTP and LTP |
| 3 | Design and realization of Square wave generation using 555 Timer IC |
| 4 | Realization of R-2R ladder D/A convertor |
| 5 | Realization of op-amp based function generator for Square and Triangular wave generation. |
| 6 | Simplification and realization of a given Boolean expression using logic gates |
| 7 | Realization of 4-bit adder/subtractor using Adder IC |
| 8 | Design and realization of 3-bit random sequence generator using JK Flip flops |
| 9 | Realization of 3-bit mod-N counter using counter IC |
| 10 | Realization of Johnson and Ring counter |
| **Graduate Attributes (As per NBA)**<br>Engineering Knowledge (PO1), Problem Analysis (PO2), Design/development of solutions (PO3),Individual and Teamwork (PO9), Lifelong Learning (PO12) | |

**Reference Books**


1. Op-Amps and Linear Integrated Circuits, by Ramakant A.Gayakwad, 4th edition, PHI, 2012.
2. Digital Design, by M.Morris Mano, Michael D.Ciletti, 5th edition, Pearson Education Inc.
3. Digital Principles and Design, Donald D. Givone, TMH Edition 2002
4. Charles H Roth JR, Larry L Kimney, "Fundamentals of Logic Design", Cengage Learning, 5thedn.
5. S. Shalivahanan et.al., "Linear Integrated Circuits", McH, 2nd edn, 2014

| Semester : III | |
|---|---|
| **Course Name: Python Programming for Electrical Engineers (PBL)** | |
| **Course Code: 21EEE136 L:T:P:J:** 0:0:2:2 | **CIE Marks:** 50 |
| **Credits: 2** | **SEE Marks:** 50 |
| **Hours: 30** | **SEE Duration: 0**3 Hours |

**Course objectives:**

After studying this course, students should be able to:

- To know the basics of algorithmic problem solving using python.
- To develop Python programs with conditionals, loops, and functions.
- To use Python data structures –- lists, tuples, dictionaries.
- To do input/output operations with files in Python.
- To write Python programs for problem solving and analysis in the field of Electrical Engineering.
- Determine the Electrical/ Electronic network, and machines parameters using Python
- To develop programs using Python for embedded applications

**Pre-requisites:**

a) Fundamental knowledge about computer systems, Basic knowledge of C Programming, Basic Electrical Engineering,Electrical Circuit Analysis,Analog and Digital Circuits

**Lab Course outcomes**

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

**CO1:** To create applications using Python Programming
**CO2:** Develop programs with different data types utilizing loops, decision-making statements, and functions.
**CO3:** Evaluate characteristics of the machines and transformer parameters using Python.
**CO4:** Perform linear circuit analysis using Python Module.
**CO5:** Develop a python code to design and realize logic circuits.
**CO6**: Perform Simulation of electric/analog circuits using python Module,
**CO7:** Develop a micro python program to interface sensors with a Python supported microcontroller board

| Sl. No. | Experiments |
|---|---|
| 1 | **Installation Guide, Operators, Datatypes, and Basic I/P and O/P operations.**<br>1. Write a program to demonstrate different number datatypes in python.<br>2. Write a program to perform different arithmetic operations on numbers in python.<br>3. Write a python program to convert temperature to and from Celsius to Fahrenheit.<br>4. Write a python program to compute the distance between two points taking input from the user. |
| 2 | **Decision Making and Loop Statements, arrays, strings**<br>1. Write a program to create, concatenate and print a string and access substring from a given string.<br>2. Write a python program to print prime numbers less than 50<br>3. Write a program to implement Merge sort, Selection sort, Insertion sort<br>4. Write a python program to construct the following pattern using nested for loop1<br>12<br>123<br>1234<br>12345<br>1234<br>123<br>12<br>1 |

| | |
|---|---|
| 3 | **Lists, Tuples, Sets, and Dictionaries.**<br>1. Write a python program to create a list and perform the following methods 1) insert() 2) remove() 3) append() 4) len() 5) pop() 6) clear()<br>2. Write a program to Create a tuple and perform the following methods 1) Add items 2) len() 3)check for item in tuple 4)Access items<br>3. Write a program to create a dictionary and apply the following methods 1) Print the dictionaryitems 2) access items 3) use get() 4)change values 5) use len() |
| 4 | **Functions, Modules.**<br>1. Write a function to compute gcd, lcm of two numbers. Each function shouldn't exceed one line.<br>2. Write a function to find the factorial of a number using recursion<br>3. Write a python program to define a module to find Fibonacci Numbers and import the module to another program. |
| 5 | **Files and Error Handling**<br>1. Write a program that inputs a text file. The program should print all of the unique words in the filein alphabetical order<br>2. Write a program to print each line of a file in reverse order. Write a program to compute the number of characters, words and lines in a file<br>3. Write a program in Python to handle user defined exception for given problem |
| 6 | **Introduction to PySpice(Python, Installation Guide**<br>Write a program to perform DC Analysis using Pyspice(Python) |
| 7 | Write a program to perform AC Analysis using Pyspice (Python) |
| 8 | Develop a python code to design and realize Combinational/Sequential logic circuits. |
| 9 | Simulate and Analyze 741 Op-Amp Amplifier Circuits Using Pyspice (Python) |
| 10 | Write a program to plot the Characteristics of the Induction Motor. |
| 11 | Write a python code to calculate of the equivalent circuit parameters and plot the efficiency of a Transformer at different loads. |
| 12 | **Introduction to MicroPython, Installation Guide**<br>Write a program in Python to send digital data on GPIO pins of Raspberry pi to blink LEDconnected with Raspberry pi or any other Python supported board. |
| 13 | Connect the Digital/Analog I/O module with Raspberry pi and write a program in python to interface the various Analog Sensors. |
| 14 | Write a python script to control the speed of Servomotor. |

**Graduate Attributes (As per NBA)**

Engineering Knowledge (PO1), Problem analysis (PO2), Design/development of solutions (PO3), Modern tool usage (PO5), The Engineer and Society (PO6), Individual and Teamwork (PO9), Lifelong Learning (PO12)

**Reference Books**


| | | | | |
|---|---|---|---|---|
| **1.** | Think Python: How to ThinkLike a Computer Scientist | Allen B. Downey | Green Tea Press | 2ndEdition, 2015 |
| **2.** | MicroPython for the Internet of Things (A Beginner's guide to programming with Python on microcontrollers) | Charles Bell | A Press | 2017 |
| **3** | MicroPython for ESP8266 Development Workshop | Agus Kurniawan | ------- | 1st Edition, 2016 |
| **4** | https://pyspice.fabrice-salvaire.fr/releases/v1.3/examples/index.html | --- | --- | ----- |
| **5** | Introduction to programming using Python, | Y. Daniel Liang | Pearson Publications | 1st Edition,2017. |
| **6** | Python for Science and Engineering | Hans-Petter Halvorsen | https://www.halvorsen.blog/documents/programming/python/ | August,2020 |

# B.N.M. Institute of Technology

## An Autonomous Institution under VTU

## Department of Electrical and Electronics Engineering

| Semester: III/IV | | |
|---|---|---|
| **COURSE: ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ** (ಕನ್ನಡ ಬಲ್ಲ ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ) | | |
| **Course Code: 21EEE137** | **L:T:P:J: 1:0:0:0** | **CIE Marks:** 50 |
| **Credits: 1** | **1** | **SEE Marks: 5 0** |
| **Hours: 15** | **15 hrs** | **SEE Duration:** |

**Course Learning Objectives: The students will be able to**

| | |
|---|---|
| 1 | ಪದವಿ ವಿದ್ಯಾರ್ಥಿಗಳಾಗಿರುವುದರಿಂದ ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡದ ಜೊತೆಗೆ ಕ್ರಿಯಾತ್ಮಕ ಕನ್ನಡವನ್ನು, ಕನ್ನಡ ಸಾಹಿತ್ಯ, ಸಂಸ್ಕೃತಿ ಮತ್ತು ನಾಡು ನುಡಿಯ ಪರಿಚಯ ಮಾಡಿಕೊಡುವುದು. |
| 2 | ಆಧುನಿಕ ಪೂರ್ವ ನಡುಗನ್ನಡ ಸಾಹಿತ್ಯದ ಪ್ರಮುಖ ಸಾಹಿತ್ಯ ಪ್ರಕಾರಗಳಾದ ವಚನ ಸಾಹಿತ್ಯ ಮತ್ತು ಕೀರ್ತನ ಸಾಹಿತ್ಯ ಇವೆರಡರ ಮಹತ್ವವನ್ನು ಪರಿಚಯ ಮಾಡಿಕೊಡುವುದು. |
| 3 | ಆಧುನಿಕ ಕಾವ್ಯಭಾಗದಲ್ಲಿ ಅನೇಕ ಪ್ರಮುಖ ಕವಿಗಳು ಇದ್ದರಾದರೂ ಇಲ್ಲಿ ಸಾಂಕೇತಿವಾಗಿ ಈ ನಾಲ್ಕು ಕವಿಗಳ ಸಮಕಾಲೀನ ಪ್ರಜ್ಞೆಯಿಂದ ಕೂಡಿದ ಕವನಗಳನ್ನು ಪರಿಚಯ ಮಾಡಿಕೊಡುವುದು. |
| 4 | ಕನ್ನಡದ ತಾಂತ್ರಿಕ ವಿಜ್ಞಾನ ಕ್ಷೇತ್ರದ ಅಸ್ತಿಭಾರ ಹಾಕಿದ ಸರ್ ಎಂ ವಿಶ್ವೇಶ್ವರಯ್ಯನವರ ಬಗ್ಗೆ ಜನಮಾನಸದಲ್ಲಿರುವ ನೆನಪಿನ ಪ್ರಸಂಗಗಳನ್ನು ಇಟ್ಟುಕೊಂಡು ಕರ್ನಾಟಕಕ್ಕೆ ಅವರು ಮಾಡಿದ ಸೇವೆಯನ್ನು ಪರಿಚಯ ಮಾಡಿಕೊಡುವುದು. |
| 5 | ಕನ್ನಡ ಭಾಷಾಭ್ಯಾಸ,ಸಾಮಾನ್ಯ ಕನ್ನಡ ಹಾಗೂ ಆಡಳಿತ ಕನ್ನಡದ ಪದಗಳ ಪರಿಚಯ ಮಾಡಿಕೊಡುವುದು |

| | | |
|---|---|---|
| **Module 1** – ಕನ್ನಡ ನಾಡು ನುಡಿ ಮತ್ತು ಸಂಸ್ಕೃತಿಗೆ ಸಂಬಂಧಿಸಿದ ಲೇಖನಗಳು | **RBT** | **Hrs** |
| ಕರ್ನಾಟಕ ಸಂಸ್ಕೃತಿ - ಹಂಪನಾಗರಾಜಯ್ಯ<br>ಕರ್ನಾಟಕದ ಏಕೀಕರಣ, ಒಂದು ಅಪೂರ್ವ ಚರಿತ್ರೆ - ಪ್ರೊ ಜಿ ವೆಂಕಟಸುಬ್ಬಯ್ಯ<br>ಆಡಳಿತ ಭಾಷೆಯಾಗಿ ಕನ್ನಡ – ಡಾ\|\|ಎಲ್ ತಿಮ್ಮೇಶ ಮತ್ತು ಪ್ರೊ.ವಿ ಕೇಶವಮೂರ್ತಿ | **1,2,3** | **3** |
| **Module 2** – ಕಾವ್ಯಭಾಗ (ಆಧುನಿಕ ಪೂರ್ವ) | **RBT** | **Hrs** |
| ವಚನಗಳು: ಜೇಡರ ದಾಸಿಮಯ್ಯ, ಅಲ್ಲಮಪ್ರಭು, ಬಸವಣ್ಣ, ಅಕ್ಕಮಹಾದೇವಿ, ಆಯ್ದಕ್ಕಿ ಲಕ್ಕಮ್ಮ, ಆಯ್ದಕ್ಕಿ ಮಾರಯ್ಯ<br>ಕೀರ್ತನೆಗಳು : ಪುರಂದರದಾಸ, ಕನಕದಾಸ | **1,2,3** | 3 |
| **Module 3** – ಕಾವ್ಯಭಾಗ (ಆಧುನಿಕ) | **RBT** | **Hrs** |
| ಮಂಕುತಿಮ್ಮನ ಕಗ್ಗ : ಡಿ.ವಿ.ಜಿ.<br>ಕುರುಡು ಕಾಂಚಣಾ : ದ.ರಾ. ಬೇಂದ್ರೆ<br>ಹೊಸ ಬಾಳಿನ ಗೀತೆ : ಕುವೆಂಪು<br>ಚೋಮನ ಮಕ್ಕಳ ಹಾಡು : ಸಿದ್ದಲಿಂಗಯ್ಯ | **1,2,3** | **3** |
| **Module 4** – ತಾಂತ್ರಿಕ ವ್ಯಕ್ತಿ ಪರಿಚಯ | **RBT** | **Hrs** |
| ಕಥೆ ಮತ್ತು ಪ್ರವಾಸ ಕಥನ - ಸರ್ ಎಂ ವಿಶ್ವೇಶ್ವರಯ್ಯ - ವ್ಯಕ್ತಿ ಮತ್ತು ಐತಿಹ್ಯ - ಎ ಎನ್ ಮೂರ್ತಿರಾವ್ | **1,2,3** | **3** |
| **Module 5** – ತತ್ವಜ್ಞಾನ ಮತ್ತು ತಂತ್ರಜ್ಞಾನ | **RBT** | **Hrs** |
| ಭಗವದ್ಗೀತೆಯ ಸಾರ, ಭಗವದ್ಗೀತೆಯಲ್ಲಿ ಬರುವ ಗುರು ಶಿಷ್ಯ ಸಂಬಂಧ.<br>ತಾಂತ್ರಿಕ ಪದಕೋಶ - ತಾಂತ್ರಿಕ ಹಾಗೂ ಪಾರಿಭಾಷಿಕ ಕನ್ನಡ ಪದಗಳು | **1,2,3** | **3** |

## Reference Books


1. **"ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ"** ವಿಶ್ವೇಶ್ವರಯ್ಯ ತಾಂತ್ರಿಕ ವಿಶ್ವವಿದ್ಯಾಲಯದ ಕನ್ನಡ ಮಾತೃಭಾಷೆಯ ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ ನಿಗದಿಪಡಿಸಿದ ಪಠ್ಯಪುಸ್ತಕ ಪ್ರಧಾನ ಸಂಪಾದಕರು - ಕುಲಪತಿಗಳು ವಿಶ್ವೇಶ್ವರಯ್ಯ ತಾಂತ್ರಿಕ ವಿಶ್ವವಿದ್ಯಾಲಯ ಬೆಳಗಾವಿ
   ಸಂಪಾದಕರು –
   ಡಾ\|\| ಹಿ. ಚಿ. ಬೋರಲಿಂಗಯ್ಯ, ಕುಲಪತಿಗಳು ಕನ್ನಡ ವಿಶ್ವವಿದ್ಯಾಲಯ ಹಂಪಿ
   ಡಾ\|\| ಎಲ್ ತಿಮ್ಮೇಶ , ಪ್ರಾಧ್ಯಾಪಕರು ಸರ್ಕಾರಿ ಇಂಜಿನಿಯರಿಂಗ್ ಕಾಲೇಜ್, ಹಾಸನ

# B.N.M. Institute of Technology

## An Autonomous Institution under VTU

| Semester: III/IV | | |
|---|---|---|
| **COURSE: Balake Kannada ( For non Karnataka students)** | | |
| **Course Code: 21EEE137** | **L:T:P:J: 1:0:0:0** | **CIE Marks:** 50 |
| **Credits: 1** | | **SEE Marks: 5 0** |
| **Hours: 15 hrs** | | **SEE Duration:** |

**Course Learning Objectives: The students will be able to**

| | |
|---|---|
| 1 | The course will enable the non Karnataka students to understand speak read and write Kannada language and communicate or Converse in Kannada language in their daily life with Kannada speakers |
| 2 | |

| **Module 1** – SPOKEN KANNADA | **RBT** | **Hrs** |
|---|---|---|
| i. Interaction in Hostel / College.<br>ii. Conversation in a Bus.<br>iii. Conversation between friends.<br>iv. Conversation with Teachers.<br>v. Telephonic Conversation.<br>vi. Conversation with shopkeeper.<br>vii. Conversation with Auto and Cab Driver. | **1,2,3** | **5** |
| **Module 2 –** READ AND WRITE | **RBT** | **Hrs** |
| Vowels, Initial forms & Secondary forms Yogavahas, Classified consonants, Un-classified consonants. | **1,2,3** | **4** |
| **Module 3 –** History of Karnataka | **RBT** | **Hrs** |
| Royal Dynasties of Karnataka | **1,2,3** | **2** |
| **Module 4 –** LITERATURE AND TOURIST PLACES OF KARNATAKA | **RBT** | **Hrs** |
| The Birds view of Kannada Literature Karnataka's Tourist Paradise | **1,2,3** | **2** |
| **Module 5** – Kannada Language | **RBT** | **Hrs** |
| History of Kannada Language | **1,2,3** | **2** |

**Reference Books**


1. **"ಬಳಕೆ ಕನ್ನಡ"** ವಿಶ್ವೇಶ್ವರಯ್ಯ ತಾಂತ್ರಿಕ ವಿಶ್ವವಿದ್ಯಾಲಯದ ಕನ್ನಡ ಮಾತೃಭಾಷೆ ಅಲ್‌ಲದ ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ ನಿಗದಿಪಡಿಸಿದ ಪಠ್ಯಪುಸ್ತಕ.
   ಪ್ರಧಾನ ಸಂಪಾದಕರು - ಕುಲಪತಿಗಳು ವಿಶ್ವೇಶ್ವರಯ್ಯ ತಾಂತ್ರಿಕ ವಿಶ್ವವಿದ್ಯಾಲಯ ಬೆಳಗಾವಿ
   ಸಂಪಾದಕರು –
   ಡಾ|| ಎಲ್ ತಿಮ್ಮೇಶ , ಪ್ರಾಧ್ಯಾಪಕರು ಸರ್ಕಾರಿ ಇಂಜಿನಿಯರಿಂಗ್ ಕಾಲೇಜ್, ಹಾಸನ

| Semester: III | | |
|---|---|---|
| COURSE: Soft Skill-1 | | |
| **Course Code: 21SFT138** | **L:T:P:J: 0:2:0:0** | **CIA Marks:** 100 |
| **Credits:** | **1** | **SEA Marks:- -** |
| **Hours:** | **15 hrs** | **SEE Duration: --** |

**Course Learning Objectives: The students will be able**

| | |
|---|---|
| 1 | To help students understand their strengths and weakness. |
| 2 | To develop analytical and creative ability to solve problems individually or as a team. |
| 3 | To make students industry ready through practice of corporate etiquettes. |
| 4 | To enhance public speaking and presentation skills. |

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

| | |
|---|---|
| **CO1** | Understand their strength and weaknesses. |
| **CO2** | Develop analytical and creative ability to solve problems. |
| **CO3** | Identify themselves as industry ready through the practice of corporate etiquettes. |
| **CO4** | Enhance public speaking and presentation skills. |
| **CO5** | Build team collaboration by working towards shared goals. |

| Module No. | Contents of the Module | Hours | Cos |
|---|---|---|---|
| **1** | **Module-1 Understanding and Managing Self**<br>Self-Awareness, Self-Management, Anger Management, Time management, Change management.<br>Vision and goal setting - Diff between vision and goal, smart, stretched goal concept, case studies<br>Knowledge, Skill, Attitude<br>Personality analysis using Big 5 personality test<br>Critical Thinking, Problem solving, Creativity and innovation<br>Integrity, ethics, values | 8 | **1 &2** |
| **2** | **Module -2 Corporate etiquettes and Mannerism**<br>Introduction to Etiquette and Mannerism, Personal Etiquette, Grooming etiquettes- professional styling, Body & personality styling, Video Interview Etiquettes, Personal Interview Etiquettes Effective meeting skills.<br>Workplace behaviour, Personal interview | 6 | **3** |
| **3** | **Module -3 Public Speaking and presentation skills**<br>Introduction to public speaking, making ideas, illustrating and delivering ideas, overcoming fear of public speaking and developing great delivery.<br>Advanced Business presentation skills, PowerPoint presentation, Group discussion | **6** | **4** |
| **4** | **Module -4 Team Work**<br>Interpersonal skills, group work vs team work | **4** | **5** |

## Mapping of Course Outcomes with Programme Outcomes:

| CO1 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|
| CO1 | 3 | 3 | | |
| CO2 | | 3 | | 3 |
| CO3 | 3 | 3 | | 3 |
| CO4 | | 3 | 3 | |
| CO5 | | | 3 | 3 |

## MOOC Course:

**Communicate with impact -** https://www.coursera.org/learn/communicate-with-impact
**Leading Diverse Teams -** https://www.coursera.org/learn/leading-diverse-teams

## Practical component:

1. Mock GD and interview may be conducted at the end of the course to check their confidence. Students can prepare their SWOT analysis and present the same.
2. The students are to be involved in various activities and games such as Just a Minute or Pick and speak to demonstrate each topic.

| **Semester: III** | |
|---|---|
| **Course Name: Innovative Project Lab**<br>**Course Code: 21EEE139** | |
| **Teaching Hours/Week (L:T:P:J): (0:0:0:2)** | **CIA: 100** |
| **Credits: 1** | **SEA: -** |
| **Hours: 15 hrs.** | **SEA Duration: -** |

**Course Objectives:**

- To encourage independent learning and innovative attitude of the students
- To inspire team working
- To expand Intellectual capacity, Credibility and Judgement.
- To develop Interactive attitude, Communication skills, Time management & Presentation skills.

All the students registered to II year of BE shall have to take up Innovative during III semester. Semester End Assessment will be conducted and the prescribed credit will be included.

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

- Demonstrate a sound technical knowledge of their selected project topic.
- Undertake problem identification, formulation and solution.
- Design engineering solutions to complex problems utilizing a systems approach.
- Communicate with engineers and the community at large in written or oral forms.

# Department of Mathematics

**Semester: III**

**Course: BRIDGE MATHEMATICS– I**

**Course Code: 21MATDIP131**

(Mandatory Learning Course : Common to all Programs)

(A bridge course for Lateral Entry students under Diploma quota to BE programs)

| | | | |
|---|---|---|---|
| **L:T:P:J** | **3:0:0:0** | **CIA** | **: 100** |
| **Credits:** | **0** | **SEA** | **: --** |
| **Hours:** | **30** | **SEA Duration** | **: --** |

**Course Learning Objectives:** The students will be able to

| | |
|---|---|
| 1 | Provide basic concepts of Laplace transform differential and integral calculus. |
| 2 | Provide an insight in to vector differentiation and first order OD E's. |

| **Module-1: Laplace Transform** | **No. of hours** | **Blooms cognitive Levels** |
|---|---|---|
| Introduction to the Laplace transform, Laplace transforms of elementary functions (statements only). Laplace transforms of $e^{at}f(t)$ , $t^n f(t)$ and $f(t)/t$ (without proofs) and unit-step function– problems | **06** | **Apply** |
| **Module-2: Inverse Laplace Transform** | | |
| Definition and problems, Inverse Laplace transform by partial fractions. Solution of second order linear differential equations using Laplace transforms. | **06** | **Apply** |
| **Module-3: Differential Calculus & Partial differentiation** | | |
| **Differential Calculus:** Review of successive differentiation-illustrative examples. Taylor's and Maclaurin's series expansions, problems on Maclaurin's series expansion. **Partial differentiation:** Introduction to partial differentiation: Euler's theorem- problems on first order derivatives only. Total derivatives-differentiation ofcomposite functions. Jacobians of order two-Problems. | **06** | **Apply** |
| **Module-4:Integral Calculus and Vector Differentiation** | | |
| **Integral Calculus:** Introduction to Double and triple integrals and problems. **Vector Differentiation:** Review of vector algebra-illustrative examples. Scalar and vector point functions. Gradient, Divergence, Curl-simple, Solenoidal and irrotational vector fields. | **06** | **Apply** |
| **Module-5: Ordinary differential equations** | | |
| Introduction-solutions of first order and first-degree differential equations: exact and reducible to exact differential equations -Integrating factors on $\frac{1}{M}\left(\frac{\partial M}{\partial y}-\frac{\partial N}{\partial x}\right)$ and $\frac{1}{N}\left(\frac{\partial M}{\partial y}-\frac{\partial N}{\partial x}\right)$, linear and reducible to linear differential equations. | **06** | **Apply** |

**Reference Books:**

1. E. Kreyszig: Advanced Engineering Mathematics, John Wiley & Sons, 10th Ed.(Reprint), 2016.
2. B.S. Grewal: Higher Engineering Mathematics, Khanna Publishers, 44th Ed., 2017.
3. B.V.Ramana: "Higher Engineering Mathematics" llth Edition, Tata McGraw-Hill, 2010.
4. Srimanta Pal &Subobh C Bhunia: "Engineering Mathematics", Oxford University Press, 3rd Reprint, 2016

| **Course Outcomes:** After completing the course, the students will be able to | |
|---|---|
| CO 1: | Apply the knowledge of Laplace transform in solving integral equations. |
| CO 2: | Use Laplace transform and inverse Laplace transform in solving differential equations. |
| CO 3: | Use derivatives and partial derivatives to calculate rate of change of multivariate functions. |
| CO 4: | Solve Double and triple integrals and illustrate the applications of multivariate calculus to understand the solenoidal and irrotational vectors . |
| CO 5: | Identify and solve first order ordinary differential equations. |

*B.N.M. Institute of Technology*

**An Autonomous Institution under VTU**

# Department of Electrical and Electronics Engineering

# IV Semester Syllabus

# Department of Mathematics

## Syllabus

| Semester: IV | | |
|---|---|---|
| **Course: Complex Analysis, Probability and Random Process**<br>**Course Code: 21MAC141 (Common to ECE, EEE & ME)** | | |
| **L:T:P:J** | **2:2:0:0** | **CIA: 50** |
| **Credits:** | **03** | **SEA: 50** |
| **Hours:** | **40** | **SEA Duration: 03 Hours** |

**Course Learning Objectives:** The students will be able to

| | |
|---|---|
| 1 | Provide an insight into applications of complex variables and conformal mapping arising in potential theory, quantum mechanics, heat conduction and field theory. |
| 2 | Develop the knowledge of probability, joint probability distribution and Random process occurring in digital signal processing, design engineering and microwave engineering. |

| Module-1: Complex Analysis | RBT | Hrs |
|---|---|---|
| Review of function of a complex variable, limits, continuity and differentiability. Analytic functions. Cauchy-Riemann equations in Cartesian and polar forms.Consequences of Cauchy-Riemann equations (only statement), construction of analytic function using Milne-Thomson method.<br>**Self study:** Applications of Complex function in Engineering. | **Apply** | **8** |
| **Module-2: Conformal Mapping& Complex Integration** | **RBT** | **Hrs** |
| **Conformal mapping:**Introduction, discussion of transformations: $W = z^2$, $w = e^z$, $w = z + \frac{1}{z}$ $(z \neq 0)$ and bilinear transformations.<br>**Complex integration:** Introduction to complex integration, Cauchy's theorem and Cauchy's integral formula.<br>**Self study:** Problems on Complex line integration. | **Apply** | **8** |
| **Module-3: Probability Distributions & Jointprobabilitydistribution** | **RBT** | **Hrs** |
| **Probability Distributions:** Review of basic probability theory. Discrete and continuous Random variables, probability mass/density functions (definitions only). Binomial, Poisson, exponential and normal distributions(without proof).<br>**Joint probability distribution:** Joint Probability distribution for two discrete random variables, expectation, covariance and correlation.<br>**Self study:** Applications of probability distribution in Engineering. | **Apply** | **8** |
| **Module-4:Markov Chain & Sampling Theory** | **RBT** | **Hrs** |
| **Markov Chain**: Introduction to Stochastic process, Probability vectors, Stochastic matrices, Regular stochastic matrices, Markov Chains, Higher transition probabilities, Stationary distribution of Regular Markov chains and absorbing states, Markovian processes.<br>**Sampling Theory**: Introduction to sampling theory, Testing of hypothesis, level of significance, confidence limits, test of significance of mean and difference of means for large samples-z-test,test of significance of small samples-Student's t- distribution, Goodness of fit-Chi-square test.<br>**Self study:** Applications of Markov Chain in Engineering. | **Apply** | **8** |
| **Module-5: Random Process** | **RBT** | **Hrs** |
| Introduction, classification of random process, methods of description of a random | | |

| | | |
|---|---|---|
| process, stationary, auto-correlation function, Ergodicity, Spectral representation, Weiner-Kinchine theorem, Poisson process, pure birth process, birth and death processwith a constant rate, death process with a linear rate.<br>**Self study:** Applications of Random process in Engineering. | **Apply** | **8** |

**Course Outcomes:** After completing the course, the students will be able to

CO1: Use the concepts of analytic function and complex potentials to solve the problems arising in electromagnetic field theory.

CO2: Utilize conformal transformation and complex integral arising in aerofoil theory, fluid flow visualization and image processing.

CO3: Apply discrete and continuous probability and joint probability distributions in analyzing the probability models arising in engineering field.

CO4: Use Markov chain in prediction of future events and demonstrate the validity of testing the hypothesis.

CO5: Use the concepts of random process in dealing with signals in engineering problems

**Reference Books:**


1. E. Kreyszig: Advanced Engineering Mathematics, John Wiley & Sons, 10"Ed.(Reprint), 2016.
2. B.S. Grewal: Higher Engineering Mathematics, Khanna Publishers, 44th Ed., 2017.
3. S. D. Sharma : ‒Operations Research", KedarNath Ram Nath& Co. Meerut, 2014.
4. C. Ray Wylie, Louis C. Barrett : ―Advanced Engineering Mathematics", 6" Edition, 2. McGraw-Hill Book Co., New York, 1995.
5. James Stewart : Calculus —Early Transcendental, Cengage Learning India Private Ltd., 2017.
6. T Veerarajan : Probability, Statistics and Random processes, McGraw Hill Education(India) Private Limited, Third edition, Nineteenth reprint 2017.
7. B. V. Ramana: "Higher Engineering Mathematics" 11" Edition, Tata McGraw-Hill, 2010.
8. Srimanta Pal &Subobh C. Bhunia: ‒Engineering Mathematics‖, Oxford University Press, 3"Reprint, 2016.


**Web links and Video Lectures:**

1. https://nptel.ac.in/courses/111106141
2. https://www.digimat.in/nptel/courses/video/111107119/L29.html
3. https://archive.nptel.ac.in/courses/122/107/122107036/
4. https://archive.nptel.ac.in/courses/105/105/105105045/
5. https://archive.nptel.ac.in/courses/111/102/111102014/
6. https://archive.nptel.ac.in/courses/111/103/111103159/

| | |
|---|---|
| **Semester: IV** | |
| **Course Name: Linear Control Systems (PCC)** | |
| **Course Code: 21EEE142 L:T:P:J:** 2:2:0:0 | **CIA Marks:** 50 |
| **Credits: 3** | **SEA Marks:** 50 |
| **Hours: 40** | **SEA Duration:** 03 Hours |

**Course Learning Objectives:**

- To understand modelling of physical systems and obtain the transfer function
- To understand time domain response and estimate transient parameters and errors in steadystate conditions
- To use Routh-Hurwitz and Root locus techniques to determine stability of linear systems
- To use Bode and Nyquist techniques to determine stability of linear systems
- To understand use of state space analysis as a modern control theory concepts to analyse linearsystems

**Pre-Requisites: NIL**

**Course Outcomes:** After the completion of the course the students will be able to:

- Develop electrical analogous circuits for mechanical systems and transfer function forservomotors
- Develop transfer function using block diagram reduction and signal flow graph techniques
- Obtain the transient and steady state parameters for an 2nd order system subjected to stepresponse
- Determine stability of a given system using Routh Hurwitz, Root locus, Bode and Nyquistmethods.
- Apply modern control theory concepts to represent a given system in state space representation, determine controllability and observability of a given system

| **Module-1: Mathematical Modelling and Block Diagram** | **RBT** | **Hrs** |
|---|---|---|
| **Teaching component**: Introduction to Control system and Classification of control system<br>**Mathematical modelling:** Modelling of mechanical system elements, electrical systems, Analogous systems, servomotors- modelling of armature controlled and field controlled servomotors<br>**Block diagram:** Block diagram of a closed loop system, procedure for drawing block diagram and block diagram reduction to find transfer function.<br>**Self-learning component:** Synchro | **Apply** | **8** |
| **Module-2: Signal flow graphs and Time domain analysis** | **RBT** | **Hrs** |
| **Teaching component**: **Signal flow graphs:** Construction of signal flowgraphs, basic properties of signal flow graph, construction of signal flowgraph for control systems, Masons gain formula to find transfer function **Time Domain Analysis:** Standard test signals, time response of second order systems, Time domain specifications**,** steady state errors and staticerror constants.<br>**Self-learning component:** P, PI, PD and PID controllers | **Apply** | **8** |
| **Module-3: Stability analysis using Root locus and Routh Hurwitz** | **RBT** | **Hrs** |
| **Teaching component:** Routh Stability criterion: BIBO stability, Necessary conditions for stability, Routh stability criterion, difficulties in formulation of Routh table, application of Routh stability criterion to linear feedback systems.<br>Root locus technique: Introduction, root locus concepts, construction of root loci, rules for the construction of root locus<br>**Self-learning component:** Effect of addition of pole and zero | **Apply** | **8** |

| Module-4: Stability analysis in Frequency domain | RBT | Hrs |
|---|---|---|
| **Teaching component**: **Frequency Response analysis:** Co-relation between time and frequency response – 2nd order systems only.<br>**Bode plots:** Basic factors G (jw) / H (jw), General procedure for constructing bode plots, computation of gain margin and phase margin, reverse bode plots<br>**Self-learning component:** Compensators | **Apply** | **8** |
| **Module-5: State Space Representation** | **RBT** | **Hrs** |
| **Teaching component:** Advantages of state-space approach, Basic terms - state, state variable, state vector and State equation and output equation, State diagram representation, state models for linear time-invariant systems,State space representation using physical variables, state space representation for electrical networks and mechanical networks, Solutions of state equations, Homogeneous and non-homogeneous parts of state equations, significance of state transition matrix, properties of state transition matrix, computation of $e^{At}$, Eigen values and Eigen vectors | **Apply** | **L=4**<br>**T=4** |
| **Graduate Attributes (As per NBA)**<br>Engineering Knowledge (PO1), Problem Analysis (PO2), Design/development of solutions (PO3),Individual and Teamwork (PO9), Lifelong Learning (PO12) | | |

**Reference Books**


1. A Anand Kumar, **"**Control systems", PHI learning private limited, New Delhi
2. Benjamin C Kuo, Farid Golnaraghi, "Automatic Control System", Wiley, 9th edn, 2010
3. Ashfaq Husain, Haroon Ashfaq, "Control Systems", Dhanpat Rai & Co.,1st edn, reprint 2017
4. M. Gopal, "Control Systems: Principles and Design", McH, 4th Edn, 2012
5. S. Salivahanan et.al, "Control System Engineering", Pearson, 1st Edn, 2015.

| Semester: IV | |
|---|---|
| **Course Name: Electrical Motors and Synchronous Machines (PCI)** | |
| **Course Code: 21EEE143 L:T:P:J: 3:0:2:0** | **CIA Marks:** 50 |
| **Credits: 4** | **SEA Marks:** 50 |
| **Hours: 40 + 10 Lab** | **SEA Duration:** 03 Hours |

**Course Learning Objectives:**

- To understand the working of synchronous motor
- To understand the performance of DC machines and synchronous machines
- To understand the characteristics & starting of synchronous motor.
- To understand the construction, principle of working and application of special type of motors.

**Pre-Requisites:** Basic Electrical Engineering

**Course Outcomes:** After the completion of the course the students will be able to:

- Explain the working of synchronous motor and special machines
- Analyze the performance characteristics of DC machines and synchronous machines
- Explain the Synchronization of alternators with infinite bus bars

| Module-1: DC & PMDC Motors | RBT | Hrs |
|---|---|---|
| **Teaching component**:<br>**D.C. Motors**: Commutation, Losses, power flow diagram and efficiency, condition for maximum efficiency, speed control of DC shunt and series motor, illustrative examples, need for starters, 3-point, starters for Series motors, Electric braking-plugging, rheostatic braking, regenerative braking,performance curves of shunt and series DC motor, single quadrant, two quadrant and four quadrant operation<br>**PMDC:** Construction, principle of operation, performance characteristics, features, and applications.<br>**Self-study component:** Reasons for reduced dependency on dc generators. | **Understand** | **8** |
| **Module-2: Testing of DC Motors & Synchronous Generators** | **RBT** | **Hrs** |
| **Teaching component**:<br>**Testing of DC Motors:** Methods of testing - Direct load test, Swinburne's test, Hopkinson's test and retardation test, Fields Test on dc series machines, merits & Demerits of tests, Illustrative examples.<br>**Synchronous Generators:** Effect of distribution of winding and use of chorded coils. Distribution factor and chording (pitch) factor, problems on EMF equation with winding factors, armature reaction synchronous reactance, Equivalent circuit, and phasor diagram of non-salient type alternator. Illustrative examples<br>**Self-learning component:** Armature windings | **Apply** | **8** |
| **Module-3: Voltage Regulation of Non-salient & Salient pole alternators** | **RBT** | **Hrs** |
| **Teaching component**:<br>**Voltage Regulation**: EMF, MMF, ZPF methods. Short Circuit Ratio.<br>**Salient pole alternators:** Two reaction analysis, experimentaldetermination of $X_d$ and $X_q$ by slip test**,** power developed by synchronousgenerator, regulation, phasor diagrams on load, Illustrative examples<br>**Self-learning component:** Need for synchronization | **Apply** | **8** |

| Module-4: Synchronization of alternators & Synchronous Motors | RBT | Hrs |
|---|---|---|
| **Teaching component**:<br>**Synchronization of alternators with infinite bus bar** – Methods of synchronization, Concept of synchronizing power & torque, parallel operation of alternators and load sharing, Effect of change in excitation andmechanical power input. Power angle equations and characteristics of non- salient and salient pole alternators, Illustrative examples<br>**Synchronous Motors**: Theory of operation, equivalent circuit, phasor diagrams, power developed, torque & torque angle, effect of change in load, effect of change in excitation Variation of current and power factor with excitation (V and inverted V curves), hunting and its suppression – Methods of starting, Illustrative examples<br>**Self-learning component:** Applications of synchronous motor | **Apply** | **8** |
| **Module-5: Special electric motors** | **RBT** | **Hrs** |
| **Teaching component**:<br>**Stepper motor:** Construction, Principle of operation, Variable Reluctance (VR), permanent magnet and hybrid stepper motors, characteristics, comparison of stepper motor<br>**BLDC motors:** Construction, principle of operation, types, characteristics, features, and applications, Comparison of Conventional DC motor andBLDC.<br>PM Synchronous Motor (PMSM): Construction, principle of operation,characteristics, features, and applications, Comparison of Conventional synchronous motor and PMSM.<br>Synchronous Reluctance Motor (SRM): Construction, principle of operation, characteristics, features, applications.<br>**Self-learning component:** applications of stepper motor, hybrid stepper motor | **Understand** | **8** |
| **Laboratory Experiments:**<br>1. Load test on dc shunt motor to draw speed – torque and horsepower – efficiency characteristics<br>2. Swinburne's Test on dc motor.<br>3. Fields Test on dc series machines.<br>4. Retardation test on dc shunt motor.<br>5. Regenerative test on dc shunt machines.<br>6. Voltage regulation of an alternator by EMF and MMF methods.<br>7. Voltage regulation of an alternator by ZPF method.<br>8. Slip test – Measurement of direct and quadrature axis reactanceand predetermination of regulation of salient pole synchronousmachines.<br>9. Power angle curve of synchronous generator.<br>10. V & inverted V curves of synchronous motor<br>11. Demonstration of Synchronization of alternator by dark lamp method<br>12. Demonstration of Ward-Leonard method of speed control of DC motor | | |
| **References**<br>1. Electrical Machinery, J.B.Gupta, S K Kataria & Sons<br>2. Electric Machines, D P Kothari, I J Nagrath, TMH<br>3. Electrical Machines, Ashfaq Hussain, Dhanpat Rai & Co. Publications<br>4. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education<br>5. Special Electrical Machines, K Venkataratham, University Press<br>6. 6. Special Electrical Machines, E G Janardhan, PHI | | |

| Semester : IV | |
|---|---|
| **Course Name: Power Electronic Devices and Circuits [PCI]** | |
| **Course Code: 21EEE144 L:T:P:J 3:0:2:0** | **CIA Marks: 50** |
| **Credits: 4** | **SEA Marks: 50** |
| **Hours: 40hrs + 10 Labs** | **SEA Duration: 03 Hours** |

**Course Learning Objectives:**

- To study the operation, steady state and switching characteristics of solid state switches and their ratings
- To give an overview of applications power electronics, different types of power semiconductor devices,their switching characteristics.
- To analyze different types of Thyristors, their gate characteristics and gate control requirements.
- To understand the design, analysis techniques, performance parameters and characteristics of controlled rectifiers, DC- DC, DC -AC converters and Voltage controllers.
- To analyze the block diagrams of Power electronic converters used in UPS, Laptop and Electric Traction systems

**Pre-requisite:**

- Working principle of Semiconductors devices
- Electrical & Electronic Circuit analysis

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

- Analyse the steady state, switching characteristics, ratings, and operation of ideal and practical solid state switches
- Explain the working and operation of basic power electronic converter circuits
- Discuss the principle of operation of gate drive, protection and isolation circuits,
- Explain the working principle and operation of single phase and three phase rectifiers and AC Voltage controllers feeding R and RL loads
- Design Buck, Boost and Buck-boost switched mode regulators
- Discuss the operation of single phase and three phase inverters using step mode and SPWM techniques and their applications in home and Industrial appliances

| Module-1: Introduction & Applications of Power Electronics | RBT | Hrs |
|---|---|---|
| **Introduction:** Ideal and real switches, static performance and dynamic performance, Temperature rise-use of heat sink,<br>**Power Diodes:** available rating, types of diode, Junction structure, packing, reverse recovery characteristics, effect of reverse recovery transient, Schottky diodes andsnubber circuits<br>**Applications of Power Electronics:** Types of Power Electronic Converter Circuits and their applications<br>**Self-learning components:** Peripheral Effects of Power Electronic converters | **Understand** | **8** |
| **Module–2: BJT Family** | **RBT** | **Hrs** |
| **Power Bipolar Junction Transistors:** Types, ratings, Junction structure, static characteristics, proportional drive, safe operating area, switching times, base drive circuit for power transistors, switching aid circuits<br>**Power MOSFET and IGBT:** types, comparison with BJT, Junction structure, Principle of operation, output characteristics, safe operating area, Gate electrode capacitance,<br>Power MOSFET switching times, switching aid circuits, Gate drive circuits for power | **Understand** | **8** |

| | | |
|---|---|---|
| MOSFET, IGBT Comparison with BJT and MOSFET, Junction Structure, Principle of working, Switching times<br>**Self-learning components:** Gallium Nitride and Silicon Carbide power semiconductor switches | | |
| **Module–3: Thyristors** | **RBT** | **Hrs** |
| **Thyristors:** Junction structure, Packaging, circuit symbol, operating states of Thyristor, turn on switching, two transistor Analogy **(derivation for relationship between gate current and anode current),** problem in Turn-off by reverse gate pulse,rate of rise of forward voltage, switching characteristics, Thyristor classification according to Switching times and Thyristor selection according to Converter types,<br>**Gate circuit requirement for Thyristor:** Timing control and firing of Thyristors, Thyristor ratings and protection, Gate Turnoff Thyristors, Gate control circuit of GTO,TRIAC, Thyristor Firing Circuits, Unijunction Transistor<br>**Self-learning components: Integrated gate-commutated Thyristor rating & Applications** | **Understand** | **8** |
| **Module–4: Controlled Rectifiers & AC Voltage Controllers** | **RBT** | **Hrs** |
| Controlled Rectifiers: Introduction, Single-Phase Full Converters feeding R and RL load, Three- Phase Full Converters feeding R and RL load, Problems<br>AC Voltage Controllers: Introduction, Single-Phase Full-Wave Controllers with Resistive Loads, Single- Phase Full-Wave Controllers with Inductive Loads, Problems<br>Self-learning components: Synchronous rectifiers | **Apply** | **8** |
| **Module–5: Switched mode regulators & Inverters** | **RBT** | **Hrs** |
| **Switched mode regulators**: **Elements of switching mode regulators,** Buck Regulator, Boost Regulators, Buck Boost Regulators (derivations for voltage gain, peakripple currents, peak ripple voltages and problems**)**<br>**DC-AC converters**: Introduction, principle of operation single phase full bridge inverters, three phase bridge inverters for 180° and 120° conduction, SPWM technique, Current Source Inverters,<br>**Self-learning components:** Block diagram of Power electronics converters used in UPS, Laptop and Electric Traction systems | **Apply** | **8** |

| **Sl. No** | **Experiments** |
|---|---|
| 1 | Static Characteristics of SCR |
| 2 | Static Characteristics of MOSFET and IGBT |
| 3 | Characteristic of TRIAC |
| 4 | SCR turn on circuit using synchronized UJT relaxation oscillator |
| 5 | SCR digital triggering circuit for a single phase controlled rectifier and ac voltage regulator |
| 6 | Single phase controlled full wave rectifier with R load and R –L load |
| 7 | AC voltage controller using TRIAC and DIAC combination connected to R and RL loads |
| 8 | Speed control of stepper motor |
| 9 | Speed control of a separately excited D.C. Motor using an IGBT or MOSFET chopper |
| 10 | Single phase MOSFET/IGBT based PWM inverter |
| **Graduate Attributes**: Engineering knowledge, problem analysis, design and development of solutions, Individual & team work, Communication, Lifelong learning | |

| **Reference** | | | |
|---|---|---|---|
| Power Electronics, Principles and applications | Joseph Vithayathil | Tata Mc Graw Hill Edition | Third reprint-2011<br>ISBN-13: 978-0-07-070239-4 |
| Power Electronics: Circuits Devices and Applications | Mohammad H Rashid, | Pearson | 4th Edition, 2014 |
| Power Electronics: Converters, Applications and Design | Ned Mohan et al | Wiley | 3rd Edition, 2014 |
| Power Electronics | Daniel W Hart | McGraw Hill | 1st Edition, 2011 |
| Power Electronics | M.S. Jamil Asghar | PHI | Fifth print<br>ISBN-978-81-203-2396-4 |

| Semester : IV | |
|---|---|
| **Course Name: Simulation of Electrical & Electronic Circuits [PBL]** | |
| **Course Code: 21EEE145 L:T:P:J::0:0:2:2** | **CIA: 50** |
| **Credits: 2** | **SEA: 50** |
| **Hours: 20** | **SEA Duration: 03 Hours** |

**Course objectives:**

1. To use software package to simulate and understand working of Electrical & Electronics circuits.
2. To simulate and verify circuit theorems for AC and DC circuits.
3. To simulate and explore the behavior of RLC circuit when excited by Sinusoidal signal and Step input.
4. To simulate and explore the Op-Amp linear applications.
5. To simulate and explore the Op-Amp non-linear applications.
6. To design and build an application for a given requirement.

**Pre-requisites:** Concept of Electrical Circuit Analysis & Analog Electronic Circuits using Op-Amp.

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

1. Use software package for simulation of Electrical & Electronic Circuits.
2. Simulate DC & AC Circuits to verify circuit theorems.
3. Explore behavior of RLC circuit excited by sinusoidal and step input.
4. Design and simulate Op-Amp based non-linear applications.
5. Design and simulate Op-Amp based linear applications.
6. Design and build circuit for a given application

| Sl. No. | Experiments |
|---|---|
| 1 | Verification of KCL & KVL for DC and AC Circuits |
| 2 | Verification of Maximum Power Transfer Theorem & Reciprocity Theorem |
| 3 | Study the characteristics of series and parallel resonance for (i) Variable frequency (ii) Variableinductance and (iii) Variable capacitance. |
| 4 | Design of RLC circuit for time response due to step excitation |
| 5 | Testing of (i) Diode clipping (Single/Double ended) circuits for peak clipping, peak detection<br>(ii) Clamping circuits: positive clamping /negative clamping |
| 6 | Design & Verification of inverting and non-inverting amplifier using Op-Amp for<br>(i) Time Response (ii) Frequency Response |
| 7 | Design and verification of (i) Inverting Comparator (ii) Non-inverting Comparator & (iii) Window detector using Op-Amp |
| 8 | Design and verification of (i) Inverting Schmit Trigger (ii) Non-inverting Schmit Trigger using Op-Amp |
| 9 | Design & Verification of Square/Rectangular waveform Generation using Op-Amp Astable Multi-vibrator |
| 10 | Design & Verification of Triangular waveform Generation using Op-Amp |
| 11 | Design & Verification of Sinusoidal waveform Generation using Op-Amp RC phase shift Oscillator. |
| 12 | Design & Verification of (i) Low pass filter (ii) High pass filter using Op-Amp |

**Reference Books**

| | | | | |
|---|---|---|---|---|
| 1 | Engineering Circuit Analysis | William H. Hayt, Jr. et all | McGraw Hill | 8th Edition |
| 2 | Op Amp and Linear Integrated Circuits | Ramakant A. Gayakwad | PHI Learning Pvt. Ltd., New Delhi | 4th Edition |

| Semester: IV | | |
|---|---|---|
| **Course Name: Constitution of India and Professional Ethics (HSS)** | | |
| **Course Code: 21CIP146** | **L:T:P:J: 0:2:0:0** | **CIA Marks: 100** |
| **Credits:** | **1** | **SEA Marks: -** |
| **Hours:** | **15** | **SEA Duration: -** |

**Course Learning Objectives: The students will be able to**

| | |
|---|---|
| 1 | know the fundamental political codes, structure, procedures, powers, and duties of Indian government institutions, fundamental rights, directive principles, and the duties of citizens |
| 2 | know the Indian top civil service positions and the exams conducted by UPSC and SPSC for the same |
| 3 | Understand engineering ethics and their responsibilities; identify their individual roles and ethicalresponsibilities towards society. |

| MODULE 1: Introduction to Indian Constitution | RBT | Hrs |
|---|---|---|
| The Necessity of the Constitution, Introduction to Indian Constitution, The Making of the Constitution, Role of Constituent Assembly, Preamble and Salient features of the Constitution of India, Fundamental Rights and its Restriction and limitations in different complex situations, Directive Principles of State Policy,<br>Fundamental Duties. | **1,2,3** | **3** |
| **MODULE 2: System of Government, Central Government, State Government** | **RBT** | **Hrs** |
| System of Government-Parliamentary System, Federal System.<br>Central Government-Basic details, Powers and Functions of Union Executive. Parliament-LS and RS (Composition, Duration, Membership and Presiding officers of Parliament and their functions). Leaders in Parliament (Leader of the House and Leader of the Opposition). Sessions of Parliament (Summoning, Adjournment, Adjournment Sine Die, Prorogation, Dissolution). Quorum of House, Language in Parliament, Joint sitting of two Houses. State Government- Basic details, Powers and Functions of State Executive. State Legislature (Composition, Duration, Membership and Presiding officers of Parliament and their functions). | **1,2,3** | **3** |
| **MODULE 3: Judiciary, Amendments and Emergency Provisions** | **RBT** | **Hrs** |
| Supreme Court, High Court, Judicial Review, Judicial Activism. Methods in Constitutional Amendments (How and Why). Types of Emergencies and its Consequences, Recent Amendments to the Constitution. | **1,2,3** | **3** |
| **MODULE 4: Elections, Constitutional and Non Constitutional Bodies** | **RBT** | **Hrs** |
| Elections- Election Commission of India, Electoral Process.<br>Constitutional Bodies- Election Commission, Union Public Service Commission,State Public Service Commission, Goods and Service Tax Council.<br>Non Constitutional Bodies- Central Information Commission, State Information Commission. | **1,2,3** | **3** |
| **MODULE 5: Professional Ethics** | **RBT** | **Hrs** |

| | | |
|---|---|---|
| Scope & Aims of Engineering & Professional Ethics, Positive and Negative Faces of Engineering Ethics, Responsibilities in Engineering, the impediments to Responsibility. Trust and Reliability in Engineering, Risks, Safety and liability in Engineering, Clash of Ethics, IPRs (Intellectual Property Rights) | **1,2,3** | **3** |

**Course outcome:** On completion of this course, students will be able to,CO1: Have constitutional knowledge and legal literacy.
CO2: Have knowledge on All India Services and State Civil Services.
CO3: Understand Engineering and Professional Ethics and responsibilities of Engineers.

**Reference Books**

**Suggested Learning Resources:**


1. **Title of the Book - Indian Polity**
   Name of the Author - M Lakshmikanth
   Name of the Publisher-Mc Graw Hill EducationEdition and
   Year- 2019
2. **Title of the Book - Engineering Ethics**
   Name of the Authors - M. Govindarajan, S.Natarajan, V.S. SenthilkumarName of the
   Publisher- Prentice-Hall
   Edition and Year-2004
3. **Durga Das Basu (DD Basu):** "Introduction to the Constitution on India", (Students Edition.)Prentice –Hall EEE, 19th / 20th Edn., (Latest Edition) or 2008.
4. **Shubham Singles, Charles E. Haries, and Et al** : "Constitution of India and Professional Ethics" byCengage Learning India Private Limited, Latest Edition – 2018.
5. **M.Govindarajan, S.Natarajan, V.S.Senthilkumar**, "Engineering Ethics", Prentice –Hall of IndiaPvt. Ltd. New Delhi, 2004
6. **M.V.Pylee,** "An Introduction to Constitution of India", Vikas Publishing, 2002.
7. Latest Publications of **NHRC - Indian Institute of Human Rights**, New Delhi.


**Web Links and Video Lectures** www.unacademy.com/lesson/future-perfect-tense/YQ9NSNQZ https://successesacademy

| Semester: IV | | |
|---|---|---|
| **Course Name: Environmental Science (EVS)** | | |
| **Course Code: 21EVS147** | **L:T:P:J: 2:0:0:0** | **CIA Marks: 100** |
| **Credits:** | **2** | **SEA Marks: -** |
| **Hours:** | **30** | **SEA Duration: -** |

**Course Learning Objectives: The students will be able to**

| | |
|---|---|
| 1 | To identify the major challenges in environmental issues and evaluate possible solutions. |
| 2 | Develop analytical skills, critical thinking and demonstrate socio-economic skills for sustainable development. |
| 3 | To analyse an overall impact of specific issues and develop environmental management plan. |

| Module 1 – Environment | RBT | Hrs |
|---|---|---|
| **a) Environment**: Definition,<br>**b) Ecology and Ecosystems:**<br>(i) Biomes (ii) Ecosystems & Sustainable Ecosystem (iv) HumanActivities & Environment.<br>**c) Human activities and their Impact on Environment :**<br>(i) Agriculture (ii) Industry (iii) Transport (iv) mining.<br>(i) Environmental Impact Assessment (EIA) (ii) Sustainable Development | **1,2,3** | **6** |
| **Module 2 – Natural Resources** | **RBT** | **Hrs** |
| **Natural Resources**<br>**a) Forest Resources:**<br>(i) Forest wealth and its conservation (ii)Wood–Major renewableresources (iii) Biodiversity<br>**b) Water resources and its uses:**<br>(i) Quality (ii) Impurities – Fluoride etc<br>**c) Water borne diseases**<br>**d) Energy:**<br>(i) Conventional (ii) Non-conventional (iii) Wind, Solar, Tidal, HydroElectric, Biomass<br>& Biogas (iv) Alternate source – Hydrogen, Bio fuel, Hybrid & semihybrid vehicles, etc<br>**e) Life on Earth:**<br>(i) Wild life management, Nature, Genetically Modified (GMCrops), Balance of Nature<br>– Nature pyramid, Floods and droughts | **1,2,3** | **6** |
| **Module 3 – Pollution and Current Global issues** | **RBT** | **Hrs** |
| **a) Pollution**<br>(i) Types of pollutions, Environmental, Air, Water, Noise, land ,Effluents Public Health<br>(ii) Carbon foot print, Climate change, Ozone depletion (ChloroFloro carbon) Global warming, Greenhouse effect, Acid Rain.<br>(iii) Ground water pollution, (Earth summits for balancing effect onenvironment).<br>**b) Current Global Environmental issues:**<br>(i) Population<br>(ii) Local urbanization - concrete jungles.<br>(iii) waste water management.<br>(iv) Effect on natural drainage in cities, encroachment on lakes, etc. | **1,2,3** | **6** |

| Module 4 – Sustainable development | RBT | Hrs |
|---|---|---|
| **Sustainable development:**<br>(i) Solid waste, E-waste and Bio Medical waste management.<br>(ii) Waste Water treatment, Encouraging Green buildings.<br>(iii) Vermi compost, organic farming, adopting Subhash Palekar farmingmethods. | **1,2,3** | **6** |
| **Module 5 – Environmental policies, Protection & Laws** | **RBT** | **Hrs** |
| **Environmental policies, Protection & LawsRegulations & Laws**<br>(i) Forest, Wildlife, Water and Air.<br>(ii) Environmental movements, NGO's – Chipko, Silent valley, Narmada<br>(iii) Environmental Ethics.<br>(iv) Resource needs for future generations – for mankind other life forms on this planet.<br>(v) Role of individual in sustainable development. | **1,2,3** | **6** |

| Course Outcomes: After completing the course, the students shall | |
|---|---|
| 22EVS116/126.1 | CO1: Understand the concepts of ecology, environment and biodiversity and the consequences of their destruction. |
| 22EVS116/126.2 | CO2: Gain awareness about the advances in energy systems as well ways to manage natural resources. |
| 22EVS116/126.3 | CO3: Understand the different kinds of pollution, their impact and manage waste through recycling. |
| 22EVS116/126.4 | CO4: Gain awareness about the current environmental issues and their global impact on various aspects. |
| 22EVS116/126.5 | CO5:.Develop critical thinking and apply them to analyse a problem or question related to the environment. |

**Reference Books**

| Sl. No. | Title of the Book | Name of the Author/s | Name of the Publisher | Edition and Year |
|---|---|---|---|---|
| 1 | Environmental Studies | Anil Kumar De, Arnab Kumar De | New Age International (P) Limited, Publishers | 2018 |
| 2. | Environmental Studies | Benny Joseph | Tata Mc Graw – Hill. | 2nd Edition, 2012 |
| 3. | Environmental Science working with the Earth | G.Tyler Miller Jr. | Thomson Brooks /Cole, | 11th Edition, 2006 |

| Semester : IV | |
|---|---|
| Course Name: Soft Skill-2 (Advanced Leadership) Skills (AEC) | |
| **Course Code: 21SFT148 L:T:P:J:0:0:2:0** | **CIA: 100** |
| **Credits: 1** | **SEA: -** |
| **Hours: 15** | **SEA Duration: -** |

**Course Objectives**

1. To prepare students to exercise different types of communication by engaging them across various reallife and hypothetical scenarios.
2. To make students practically understand the essential aspects of communication that will aid them in becoming a leader.

**Pre-requisites:**

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

Understand their strengths and weakness
Develop analytical and creative ability to solve problems Become industry ready through practice of corporate etiquettes

| Module-1: | RBT | Session |
|---|---|---|
| **Understanding and Managing Self**<br>Self-Awareness, Self-Management, Anger Management, Time management, Change management.<br>Vision and goal setting - Diff between vision and goal, smart, stretched goal concept,case studies.<br>Personality analysis using Big 5 personality test.<br>Critical Thinking, Problem solving, Creativity and innovation Integrity, ethics, values. | | **7** |
| **Module–2:** | **RBT** | **Session** |
| **Corporate etiquettes**<br>Resume Writing, Basic etiquettes, Grooming etiquettes, Effective meeting skillsGroup discussion and Personal interview. | | **8** |

## MOOC Course:

**Leading Diverse Teams**

https://www.coursera.org/learn/leading-diverse-teams

## Practical component:

1. Mock GD and interview may be conducted at the end of the course to check their confidence. Students can prepare their SWOT analysis and present the same.

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## Department of Electrical and Electronics Engineering

| **Semester : IV** | |
|---|---|
| **Course Name: Internship-1/Innovative Project Lab** | |
| **Course Code: 21EEE149 L:T:P:J:0:0:2:2** | **CIA: 100** |
| **Credits: 1** | **SEA: -** |
| **Hours: 15 hrs** | **SEA Duration: -** |

**Course Objectives:**

- To encourage independent learning and innovative attitude of the students
- To inspire team working
- To expand Intellectual capacity, Credibility and Judgement.
- To develop Interactive attitude, Communication skills, Time management & Presentation skills.

All the students registered to II year of BE shall have to undergo mandatory internship of 4 weeks during IIsemester or III semester vacation. Semester End Assessment will be conducted in IV semester and the prescribed credit will be included. Internship shall be considered as a head of passing and shall be considered for the award of degree.

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# Department of Mathematics

## Syllabus

| Semester: IV | | | |
|---|---|---|---|
| **Course: BRIDGE MATHEMATICS– II**<br>**Course Code: 21MATDIP141**<br>(Mandatory Learning Course: Common to all Programmes)<br>(Abridge course for Lateral Entry students under Diploma quota to BE programmes) | | | |
| **L:T:P:J** | **3:0:0:0** | **CIA : 100** | |
| **Credits:** | **0** | **SEA : ---** | |
| **Hours:** | **30** | **SEA Duration : ---** | |

**Course Learning Objectives:** The students will be able to

| | |
|---|---|
| 1 | To provide essential concepts of linear algebra, second & higher order differential equations along With methods to solve them. |
| 2 | To provide an insight into elementary probability theory and numerical methods. |

| Module-1: Linear Algebra | No. of hours | Blooms cognitive Levels |
|---|---|---|
| Introduction - rank of matrix by elementary row operations - Echelon form. Consistency of system of linear equations - Gauss elimination method. Eigen values and Eigen vectors of a square matrix. Problems. | **06** | **Apply** |
| **Module-2: Numerical Methods** | | |
| Finite differences. Interpolation/extrapolation using Newton's forward and backward difference formulae-problems. Solution of polynomial and transcendental equations– Newton-Raphson method-problems. Numerical integration: Simpson's one third rule and Weddle's rule- problems (All formulas without proof) | **06** | **Apply** |
| **Module-3: Higher order ordinary differential equations** | | |
| Linear differential equations of second order equations with constant coefficients. Homogeneous /non-homogeneous equations. Inverse differential operators on $e^{ax}$, sinax , cosaxand a polynomial$P_n(x)$. | **06** | **Apply** |
| **Module-4:Partial Differential Equations (PDE)** | | |
| Formation of PDE by elimination of arbitrary constants and functions. Solution of non- homogeneous PDE by direct integration. Homogeneous PDE involving derivatives with respect to one independent variable only. | **06** | **Apply** |
| **Module-5: Probability** | | |
| Introduction. Sample space and events. Axioms of probability. Addition & multiplication theorems. Conditional probability, Bayes's theorem, problems | **06** | **Apply** |

**Reference Books:**

1. E. Kreyszig: Advanced Engineering Mathematics, John Wiley & Sons, 10th Ed.(Reprint), 2016.
2. B.S. Grewal: Higher Engineering Mathematics, Khanna Publishers, 44th Ed., 2017.
3. B.V.Ramana: "Higher Engineering Mathematics" llth Edition, Tata McGraw-Hill, 2010.
4. Srimanta Pal &Subobh C Bhunia: "Engineering Mathematics", Oxford University Press, 3rd Reprint, 2016

**Course Outcomes:** After completing the course, the students will be able to

CO 1: Solve systems of linear equations using matrix algebra

CO 2: Apply the knowledge of numerical methods in modelling and solving engineering problems.

CO 3: Make use of analytical methods to solve higher order differential equations.

CO 4: Classify partial differential equations and solve them by exact methods

CO 5: Apply elementary probability theory and solve related problems

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## Department of Electrical and Electronics Engineering

# V Semester Syllabus

# Department of Electrical and Electronics Engineering

| Semester: V | |
|---|---|
| **Course Name: Power System Analysis and Stability (PCC)**<br>**Course Code: 21EEE151** | |
| **Teaching Hours/Week (L:T:P:J) : (2 : 2 : 0 : 0 )** | **CIA Marks: 50** |
| **Credits: 3** | **SEA Marks: 50** |
| **Hours: 40** | **SEA Duration: 3 Hours** |

**Course Learning Objectives:**

- To introduce the per unit system and explain its advantages
- To draw single line diagram for various power system components and its implementation for power systems
- To explain the analysis of three phase symmetrical faults on Synchronous machine
- To understand the selection of circuit Breakers for fault condition
- To explain the symmetrical components and their advantages and calculate the symmetrical components of voltages and currents in a three-phase system
- To explain the sequence networks and sequence impedances of an unloaded synchronous generator, Transformer, Transmission lines and a complete power system
- To determine the symmetrical components of voltages and currents for various unsymmetrical faults
- To understand the concept of equal area criterion, power system steady state stability and transient stability

**Pre-Requisites:** Equivalent circuits of Synchronous Machines and Transformers, complex number calculations

**Course Outcomes:** After the completion of the course the students will be able to:

- Compute per unit values with the understanding of the concept of one line diagram & its implementation in power system network.
- Analyze short circuit on synchronous machine under no load and loaded conditions, effect of transients on a Transmission Line.
- Evaluate the sequence impedance & sequence networks of power system components, power system and parameters in un-balanced three phase circuits.
- Analyze three phase synchronous machine and simple power systems for single line to ground fault, line to line fault, double line to ground fault and open conductor fault using symmetrical components.
- Evaluate the stability of a simple system under fault conditions by equal area criterion with the knowledge of dynamics of synchronous machine, stability and types of stability.

| **Module-1: Representation of Power System Components/ Modeling of Power System Components** | **RBT** | **Hrs** |
|---|---|---|
| Introduction, Single-phase Representation of Balanced three phase Networks, Steady state model of Synchronous Machine, Equivalent Models of Transformer, Transmission lines, Representation of Loads, One line diagram, Impedance diagram and Reactance Diagram, Per Unit system. | **Apply** | **08** |
| **Module-2: Symmetrical Fault Analysis** | **RBT** | **Hrs** |
| Introduction, Transient on a Transmission Line, Short Circuit of a Synchronous Machine, Short Circuit of a Loaded Synchronous Machine, Problems, Selection of Circuit Breakers, Algorithm for short circuit studies, Problems. | **Apply** | **08** |
| **Module-3: Symmetrical Components** | **RBT** | **Hrs** |
| Introduction, Symmetrical Component Transformation, Phase shift in Star- Delta Transformers, Sequence Impedances of Transmission Lines, Sequence Impedances and Sequence Network of Synchronous Machine, Transmission Lines, Transformers, Power in terms of Symmetrical Components, Sequence Impedance and Networks of a Power System. | **Apply** | **08** |
| **Module-4: Unsymmetrical Fault Analysis** | **RBT** | **Hrs** |
| Introduction, Symmetrical Component Analysis of Unsymmetrical Faults, Single Line to Ground (LG) Fault Analysis, Line-to-Line (LL) Fault analysis, Double Line-to-Ground (LLG) Fault Analysis on | **Apply** | **08** |

| | | |
|---|---|---|
| Unloaded Generator and on a Power System, Open Conductor Faults, Problems. | | |
| **Module-5: Power System Stability** | **RBT** | **Hrs** |
| Introduction, Dynamics of a synchronous Machine, Power Angle Equation, Steady State Stability, transient stability, Swing Equation, Equal Area Criterion, Classical representation of Multi machine stability. | **Apply** | **08** |

Reference Books:


1. "Elements of Power System", William D Stevenson, McGraw Hill International Editions, 4th Edition, 1982
2. "Modern Power System Analysis", D P Kothari, I J Nagrath, Tata McGraw Hill, 4th Edition, 2011.
3. "Power System Analysis and Design", J Duncan Glover, Thomas J Overbye, Mulukutla S. Sarma, Cengage, 6th Edition
4. "Power System Analysis", Hadi Saadat, McGraw Hill, 2009.

| Semester: V | |
|---|---|
| **Course Name: Electromagnetic Fields and Wave Theory (PCC)**<br>**Course Code: 21EEE152** | |
| **Teaching Hours/Week (L:T:P:J) : ( 2 : 2 : 0 : 0 )** | **CIA Marks: 50** |
| **Credits: 3** | **SEA Marks: 50** |
| **Hours: 40** | **SEA Duration: 3 Hours** |

**Course Learning Objectives:**

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

- **Pre-Requisites:** Vector calculus Properties and behavior of passive elements

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

- Identify the methods of eliminating Electromagnetic interference in circuits
- Explain the concept of gradient, divergence and curl of a vector using Cartesian cylindrical & spherical coordinate systems.
- Determine electric fields produced by point, line, surface & volume charge configurations using Gauss Law.
- Determine energy, potential and capacitance effect produced by point, line, surface & volume charge configurations
- Determine the magnetic fields and magnetic flux density produced by circuit geometry
- Discuss the behavior of magnetic fields, magnetic force, magnetic materials and magnetic circuits
- Assess time varying fields and propagation of waves in free space & dielectric media
- Analyze the causes, effect & mitigation of electromagnetic radiation towards electronic circuits, humankind

| **Module-1: Electromagnetic Compatibility and Interference, Vector Analysis** | **RBT** | **Hrs** |
|---|---|---|
| **Electromagnetic Compatibility and Interference:** Introduction, designing for EMC, Typical noise path, use of network theory, Methods of noise coupling, Methods of eliminating Interference EM radiation effect of appliances and its effect on environment and human kind<br>**Vector Analysis:** Vector algebra, dot and cross products, Cartesian coordinate system, Cylindrical co-ordinate systems and spherical coordinate systems, differential line, area and volume, Coordinate system transformations, del operator on scalar and vectors, scalar and vector fields, Problems. | **Apply** | **8** |
| **Module-2: Electrostatics, Energy and Potential** | **RBT** | **Hrs** |
| **Electrostatics:** Gauss law and its applications. Gauss law in point form or Maxwell's first equation. Divergence theorem. Gauss divergence theorem, Problems.<br>**Energy and Potential:** Definition of potential and potential difference, The potential field of a point charge and of a system of charges. Potential gradient, Problems, Boundary conditions, Boundary between Conductor-dielectrics and dielectric-dielectric interfaces, capacitance calculations, capacitance due to cylindrical and spherical geometry, Energy density in the electrostatic field, problems | **Apply** | **8** |
| **Module-3: Poisson's and Laplace equations, Poisson's and Laplace equations** | **RBT** | **Hrs** |
| **Poisson's and Laplace equations:** Derivations and problems, Uniqueness theorem.<br>**Steady magnetic fields:** Biot - Savart's law, Ampere's circuital law. The Curl. Stokes theorem. Magnetic flux and flux density. Scalar and vector magnetic potentials. Problems. | **Apply** | **8** |

| Module-4: Magnetic forces, Magnetic materials and magnetism | RBT | Hrs |
|---|---|---|
| **Magnetic forces:** Force on a moving charge and differential current element. Force between differential current elements. Force and torque on a closed circuit. Problems.<br>**Magnetic materials and magnetism:** Nature of magnetic materials, magnetization and permeability. Magnetic boundary conditions. Magnetic circuit, inductance and mutual inductance. Problems | **Apply** | **8** |
| **Module-5: Time varying fields and Maxwell's equations, Uniform plane wave** | **RBT** | **Hrs** |
| **Time varying fields and Maxwell's equations:** Faraday's law, Displacement current. Maxwell's equations in point form and integral form. Problems.<br>**Uniform plane wave:** Wave propagation in free space and in dielectrics, Propagation in good conductors, skin effect, Pointing vector and power considerations, Problems. | **Apply** | **8** |

**Reference Books:**


Engineering Electromagnetics, William H Hayt et al, McGraw Hill, 8th Edition, 2014
Noise Reduction techniques in Electronic Systems, Henry W. Ott, Wiley, Second edition.
Engineering Electromagnetics, C.L. Wadhwa, New Age International Publishers.
Electromagnetic Fields, T.V.S. Arun Murthy, S. Chand publications.
Electromagnetic Field Theory, S Salivahanan,S Karthie, Vikas publications,2016.
Elements of Electromagnetic Fields, S.P Seth, Dhanpat Rai & Co.
Electromagnetic Field Theory, Rohit Khurana, Vikas publications, 1st Edition,2014.
Electromagnetics, J. A. Edminister, , McGraw Hill, 3rd Edition, 2010

# Department of Electrical and Electronics Engineering

**Semester: V**

**Course Name: Introduction to AI & ML (PCI)**
**Course Code:21EEE153**

| | |
|---|---|
| **Teaching Hours/Week (L: T: P: J): (3:0:2:0)** | **CIA Marks: 50** |
| **Credits :4** | **SEA Marks: 50** |
| **Hours: 40 hours Theory +10 lab sessions** | **Exam Hours: 03** |

**Course Learning Objectives:** This course will enable students to

- Gain a historical perspective of AI and familiar with basic principles
- Understand the basic theory underlying ML and differentiate supervised, unsupervised and reinforcement learning
- Understand the basic concepts of learning and decision trees.
- Understand Bayesian techniques for problems appear in machine learning
- Perform statistical analysis of machine learning techniques.

**Course outcomes:** The students will be able to

- Apply the knowledge of AI to write simple algorithm and to solve problems on search algorithm (Apply)
- Understand the concepts of Machine Learning (Understand)
- Analyze the data to understand the distribution of the data. (Analyze)
- Apply the classification techniques to classify the data. (Apply)
- Analyze the problems on Decision tree, Bayesian and Instant learning techniques. (Analyze)
- Develop an algorithm in ML for Electrical engineering application (Create)

| Module-1: Introduction to AI, Problem Spaces, and Search | RBT | Hrs |
|---|---|---|
| **Introduction to AI:** Artificial Intelligence problems, Underlying assumptions, AI problems, concept of AI technique, Level of the model, Criteria for success,<br>**Problems, Problem Spaces and Search:** Defining the problem as a State Space Search, Production systems, Problem characteristics, Production system characteristics, and Issues in the design of search programs.<br>**Reference Book 1:** Chapter 1 and 2 | **Apply** | **8** |
| **Module-2: Machine learning Landscape and End to end Project** | **RBT** | **Hrs** |
| **Machine learning Landscape:** Machine Learning concepts, uses of ML, Types of ML systems, Main challenges of ML.<br>**End to end Machine learning Project:** Working with real data, Look at the Big picture, Get the data, Discover and visualize the data, Prepare the data for ML Algorithm, Select and train a model, Fine tune your model.<br>**Reference Book 2:** Chapter 1 and 2 | **Apply** | **8** |
| **Module-3: Decision Tree Learning** | **RBT** | **Hrs** |
| Introduction, Decision Tree Representation, Appropriate Problem for Decision Tree Learning, The Basic Decision Tree Learning Algorithm, Issues in Decision Tree Learning.<br>**Reference Book 3:** Chapter 3 | **Apply** | **8** |
| **Module-4: Bayesian Learning** | **RBT** | **Hrs** |

| | | |
|---|---|---|
| **Bayesian Learning:** Introduction, Bayes theorem, Maximum Likelihood and Least Square Error Hypotheses, Naïve Bays Classifier.<br>**Reference Book 3:** Chapter 6 | **Apply** | **8** |
| **Module-5: Instance-Based Learning** | **RBT** | **Hrs** |
| **Instance Based Learning:** Introduction, k-Nearest Neighbor Learning, Locally Weighted Regression, Case Based Reasoning<br>**Reference Book 3:** Chapter 8 | **Apply** | **8** |

**Reference Books:**


1. Kevin Knight, Elaine Rich, B. Nair, "Artificial Intelligence", Tata McGraw Hill Education Private Limited, 3rd Edition, 2010.
2. Aurelien Geron, "Hands-on Machine Learning with Scikit-Learn, Keras, and TensorFlow", O'Reilly Media, 2nd Edition, 2019
3. Tom Mitchell, Machine Learning, McGraw Hill, 2017.
4. Yuxi (Hayden) Liu, "Python Machine Learning by Example", Packet Publishing Limited, 2017.
5. T. Hastie, R. Tibshirani, J. Friedman. The Elements of Statistical Learning, 2e, 2011.


| **PRACTICAL COMPONENT** | |
|---|---|
| **Sl.No** | **Experiments** |
| 1 | Write a Python program to analyze and visualize the data using NumPy and matplotlib Modules |
| 2 | Write a Python Program to represent and analyze data using the Scikit-learn package. |
| 3 | Write a Python Program to Implement a Breadth-First Search algorithm. |
| 4 | Write a python program to predict home prices using Linear Regression method. |
| 5 | Write a python program to predict the weather condition using linear regression. |
| 6 | Write a python code to implement an automated customer information system to direct the customer to correct department based on preference using Decision Trees algorithm. |
| 7 | Write a python program to decide whether a company's budget is exceeding or not with decision trees, with a sample dataset. |
| 8 | Implement python code to decide whether the person will be able to pay the insurance monthly or not using the decision trees algorithm. |
| 9 | Using KNN algorithm for linear regression, Develop a python code to get the fertilizer response for an agricultural experiment where the crop yield is tested against fertilizers. The response from crops is the variable. |
| 10 | Write a Python program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. |

| Semester: V | | |
|---|---|---|
| **Course: Digital Signal Processing (PCI)**<br>**Course Code: 21EEE154** | | |
| **Teaching Hours/Week (L:T:P:J) : (3:0:2:0)** | **CIA : 50** | |
| **Credits:03** | **SEA : 50** | |
| **Hours: 40 Hours Theory + 10 Lab Sessions** | **SEA Duration : 03 Hours** | |

**Course Learning Objectives:** The students will be able to

- To understand discrete Fourier transform and its properties.
- To study Fast Fourier Transform properties for both time and frequency domain signals.
- To understand the design of FIR filters and their realization.
- To understand the design of IIR filters and their realization.
- To understand the features of processors and their applications.

**Prerequisites**: Nil

**Course Outcomes:** After the completion of the course the students will be able to:

- Compute the Discrete Fourier transform of a given signal using its properties with linear filtering.
- Compute signal decimation in time domain and frequency domain using Fast Fourier Transform algorithm.
- Formulate FIR filters for Rectangular, Hamming, Hanning, Blackman windows based on desired frequency response and its digital realization.
- Formulate IIR filters using Butterworth and Chebyshev filters for a system using given analog / digital specification and its digital realization.
- Explain the features of Digital Signal processors and their applications.

| **Module-1: Time – Domain Representations for LTI Systems** | **RBT** | **Hrs** |
|---|---|---|
| Introduction to signals and systems, Classification of signals, problems only on Odd-Even signals, periodic and non-periodic signals, Classifications of systems, Problems on Linearity and Time Invariant systems, Impulse response, Convolution Integral and convolution sum, properties of LTI systems: Commutative, associative, distributive properties, causality, stability of LTI Systems, Step response of LTI systems | Apply | 8 |
| **Module-2: Discrete Fourier Transform** | **RBT** | **Hrs** |
| Properties of DFT: Periodicity, Linearity, Symmetry Properties, Multiplication of two DFTs, Circular Convolution, periodicity, circular time shift, time reversal, circular frequency shift properties of DFT, Linear Filtering Methods based on DFT (Filtering of long data sequences is excluded). | Apply | 8 |
| **Module-3: Fast Fourier Transforms Algorithms** | | |
| Efficient Computation of DFT: FFT Algorithms: Direct Computation of DFT, Radix – 2 FFT Algorithm, decimation in time Radix -2 FFT (2-point, 4-point and 8-point only), Decimation in frequency Radix-2 FFT, Comparison of DIT and DIF Radix -2 FFT, Application of DFT for Two Real Sequences and 2 N-point Real sequences. | Apply | 8 |
| **Module-4: Design of Digital IIR Filters** | | |
| Mathematical aspects of Conversion from Analog to Digital IIR Filters, Design of Butterworth and Chebyshev IIR Filter using Impulse invariance and Bilinear Transformation, Numerical Examples. | Apply | 8 |
| **Module-5: Design of Digital FIR Filters** | | |

| | | |
|---|---|---|
| Symmetric and Asymmetric FIR Filters, Design of Linear Phase FIR Filters using Windows, Numerical Examples.<br>**Digital Signal Processor**<br>TMS320C67x Processor: Introduction, Features, Internal architecture, **Applications of DSP:** Digital Audio system, Speech Coding and Compression, Compact-Disc recording system, Interference cancellation in electrocardiography, DTMF generation and detection. | Apply | 8 |


Reference Books

1. "Digital Signal Processing", John G. Proakis, Dimitris. G. Manolakis, Pearson Education India, 4th Edition, 2017.
2. "Digital Signal Processing", A. Nagoorkani, McGraw Hill,3rd Edition, 2021.
3. "Digital Signal Processing", S. Salivahanan, McGraw Hill 4th Edition, 2019.
4. "Digital Signal Processing – A Computer based approach", Sanjit K Mitra, Tata McGraw Hill,4th Editin,2013.
5. "Digital Signal Processing", Jhonny R. Jhonson, Pearson, 1st Edition, 2016.
6. "Digital Signal Processing using MATLAB", Vinay K Ingle. John G. Proakis, CL Engineering, 2nd Edition, 2006


| Sl. No. | Experiments |
|---|---|
| **Experiments using MATLAB** | |
| 1 | Verification of Sampling Theorem both in time domain and frequency domain. |
| 2 | To perform linear convolution of given sequences |
| 3 | To perform circular convolution of given sequences using (a) the convolution summation formula (b) the matrix method and (c) Linear convolution from circular convolution with zero padding. |
| 4 | Computation of N – point DFT and to plot the magnitude and phase spectrum. |
| 5 | Linear and circular convolution by DFT and IDFT method. |
| 6 | Calculation of DFT and IDFT by FFT |
| 7 | Design and implementation of IIR filters to meet given specification (Low pass, high pass, band pass and band reject filters) using Butterworth and Chebyshev filters. |
| 8 | Design and implementation of FIR filters to meet given specification (Low pass, high pass, band pass and band reject filters) using different window functions |
| **Experiments using DSP Trainer Kit** | |
| 9 | Linear convolution of two given sequences |
| 10 | Design and Implementation of FIR filter for the given specifications. |

# Department of Electrical and Electronics Engineering

| Semester: V | |
|---|---|
| **Course Name: Modeling and Simulation of Power Electronic Systems using MATLAB [PBL]**<br>**Course Code: 21EEE155** | |
| **Teaching Hours/Week (L:T:P:J): (0:0:2:2)** | **CIA: 50** |
| **Credits: 2** | **SEA: 50** |
| **Hours: 30** | **SEA Duration: 03 Hours** |

**Course Learning Objectives:**

- To find power losses in semiconductor switches
- To simulate and analyze non isolated and isolated DC to DC converter circuits
- To design PID controller for closed loop operation of Buck regulator
- To simulate single phase & three phase controlled rectifiers, AC voltage controller
- To simulate single phase and three phase step mode and PWM inverters with control circuits
- To design solar panel fed Boost converter using MPPT technique
- To control the speed of a BLDC motor fed by three phase Inverter circuit

**Pre-requisites:** Concept of Electrical Circuit Analysis & Power Electronic Device and control.

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

- Find static and dynamic power losses in semiconductor switches
- Simulate and analyze non-isolated and isolated DC to DC converter circuits
- Design PID controller for closed loop operation of Buck regulator
- Simulate single phase & three phase controlled rectifiers and AC voltage controller
- Simulate single-phase and three-phase step mode and PWM inverters with control circuits
- Design solar panel fed Boost converter using MPPT technique
- Control the speed of a BLDC motor fed by three phase Inverter circuit

| Sl. No. | Experiments |
|---|---|
| 1 | Find the static and dynamic power losses in semiconductor switches (i) BJT (ii) MOSFET (iii) SCR |
| 2 | Design a Non-isolated Buck regulator and simulate to (i) plot output voltage versus duty ratio (ii) calculate ripple voltage and current (iii) Plot efficiency versus duty ratio |
| 3 | Design a Non-isolated Boost regulator and simulate to (i) plot output voltage versus duty ratio (ii) calculate ripple voltage and current (iii) Plot efficiency versus duty ratio |
| 4 | Design closed loop Buck regulator using PID controller and simulate to show load regulation |
| 5 | Design and simulate single phase fully controlled rectifier feeding R and RL Load with and without filter capacitor |
| 6 | Design and simulate three phase fully controlled rectifier feeding R Load with and without filter capacitor |
| 7 | Design and simulate a single-phase SPWM-based inverter circuit |
| 8 | Simulate three-phase six-step inverter at $180^{o}$ conduction feeding R load |
| 9 | Simulate three-phase SPWM inverter feeding R load |
| 10 | Plot Speed, torque, and armature current of BLDC motor fed by the three-phase inverter circuit |

| Sl. No. | List of indicative Projects |
|---|---|
| 1 | Design, Simulation, and Implementation of Buck Chopper for a DC load application. |
| 2 | Design, Simulation, and Implementation of Boost Chopper for a DC load application. |
| 3 | Design, Simulation, and Implementation of Buck-Boost Chopper for a DC load application. |
| 4 | Design and Implementation of Fan Regulator using Bluetooth Technology. |
| 5 | Design and Implementation of 100W single-phase Inverter for rural application. |
| 6 | Design and Conversion of Bicycle to Electric Bicycle. |
| 7 | Design and Implementation of SPWM based single-phase inverter. |
| 8 | Design a charging circuit for lithium ion batteries |

| | |
|---|---|
| 9 | Simulate a three phase inverter using SPWM technique |
| 10 | Simulate three-phase six-step inverter at 120$^{o}$ conduction |

| **Reference Books** | | | | |
|---|---|---|---|---|
| 1 | Getting started with MATLAB | Rudra Pratap | Oxford University Press | I$^{st}$ Edition, 2010 |
| 2 | Matlab and Simulink | Dr. Shailender Gupta and Bharat Bhushan. | Katson Books | I$^{st}$ Edition. |
| 3 | Power Electronics: Circuits Devices and Applications | Mohammad H Rashid, | Pearson | 4th Edition, 2014 |
| 4 | Power Electronics: Converters, Applications and Design | Ned Mohan et al | Wiley | 3rd Edition, 2014 |

# Department of Electrical and Electronics Engineering

| Semester: V | |
|---|---|
| **COURSE: Energy Audit and Energy Management System (POE)**<br>**Course Code:21EEE1561** | |
| **Teaching Hours/Week (L:T:P:J) : (3:0:0:0)** | **CIA Marks:** 50 |
| **Credits: 3** | **SEA Marks:** 50 |
| **Hours: 40** | **SEA Duration: 0**3 Hours |

**Course Learning Objectives: The students will be able to**

- Understand the energy scenario, environmental aspects of electrical energy generation
- Understand the concept of energy conservation and methods of energy auditing
- Understand the need and methods for demand-side management
- Understand the deregulation of electric energy and cogeneration

**Pre-Requisites: ---**

**Course Outcomes: After completing the course, the students will be able to**

- Understand the current energy scenario in India and the factors affecting power generation.
- Understand the environmental impact of electric power generation and energy conservation
- methodology and measures
- Understand methodology for energy auditing, audit process for industries, illumination system, HVAC, Electrical system
- Understand the principles of DSM and the tariff options to promote DM
- Understand electricity deregulation and cogeneration using waste heat.

| Module-1: Energy Scenario & Load curve | RBT | Hrs |
|---|---|---|
| **Introduction:** Electrical energy sources, Energy scenario in India, Indian Electricity Act 2003, Indian Energy conservation act 2001.<br>**Load and Load curves**: Maximum Demand, Group Diversity factor, Peak Diversity factor, Load factor, Capacity factor, Utilization factor, Type of load, Load duration curve, Base load and peak load plants, the effect of voltage & frequency on loads. | Understand | 8 |
| **Module–2: Energy Conservation** | **RBT** | **Hrs** |
| Environmental Aspects of Electrical Energy Generation, Energy conservation: Introduction, Principles of Energy Conservation, Energy Conservation planning, Energy conservation in Large and Medium Industries, Energy conservation in small scale industries. | Understand | 8 |
| **Module–3: Energy Audit** | **RBT** | **Hrs** |
| Energy Conservation and Impact: Aim of Energy Audit, Energy flow diagram, Strategy for Energy Audit, Energy management team, Considerations in implementing Energy conservation programs, Periodic progress review for optimization of energy use. Instruments for Energy Audit. Energy Audit for illumination systems, Electrical systems, HVAC, Compressed air systems, and Buildings, Certifying agencies in India. | **Apply** | **8** |
| **Module–4: Demand Side Management** | **RBT** | **Hrs** |
| Scope of Demand Side Management (DSM), DSM planning and implementation, Load management as DSM strategy, Application of load control, Issues, and Tariff options for DSM. Customer acceptance and implementation issues, Energy efficient motors, and Availability based tariff. | **Understand** | **8** |

| Module–5: Electricity Deregulation and Cogeneration | RBT | Hrs |
|---|---|---|
| **Electricity deregulation**: Need for electricity deregulation, power planners, metering for the deregulated market, energy billing in the deregulated regime, revenue sharing, value-added network, fault repair service, benefits of deregulation, power sector reforms, and restructuring in India.<br>**Cogeneration:** Definition and scope, Topping and bottoming cycle, Cogeneration techniques, industries suitable for cogeneration, electrical power plant reject heat, agricultural use of waste heat, use of power plant reject heat for wastewater treatment, the potential of cogeneration in India. | **Understand** | **8** |

| **Reference Books** |
|---|
| 1. B R Gupta, "Generation of Electrical Energy", S Chand, 7th edition, 2017. |
| 2. Umesh Rathore, "Energy Management", S K Kataria and Sons, 2nd edition, 2019 |
| 3. Sonal Desai, "Handbook on Energy Audit", McGraw Publications, 1st edition, 2005 |
| 4. www.beeindia.gov.in/en/programmes |

| Semester: V | | |
|---|---|---|
| **Course Name: Non-Conventional Energy Resources (POE)**<br>**Course Code: 21EEE1562** | | |
| **Teaching Hours/Week (L: T: P: J): ( 3 : 0 : 0 : 0 )** | **CIA Marks: 50** | |
| **Credits: 3** | **SEA Marks: 50** | |
| **Hours: 40** | **SEA Duration: 3 hours** | |
| **Course Learning Objectives:** | | |
| ❖ To discuss energy resource and its classification<br>❖ To explain sun – earth geometric relationship, Earth – Sun Angles and their Relationships and solar thermal applications.<br>❖ To discuss wind turbines, wind resources, site selection for wind turbine<br>❖ To discuss geothermal systems, their classification and geothermal based electric power generation<br>❖ To discuss biomass production, types of biomass gasifiers, properties of producer gas.<br>❖ To discuss tidal energy resources, energy availability, power generation.<br>❖ To explain principles of ocean thermal energy conversion and production of electricity | | |
| **Pre-Requisites: Basic knowledge of Physics** | | |
| **Course Outcomes:** After the completion of the course the students will be able to:<br>❖ Discuss the energy resource and its classification<br>❖ Discuss sun – earth geometric relationship, Earth – Sun Angles and their Relationships and solar thermal applications<br>❖ Discuss the production of wind energy, advantages, disadvantages and applications.<br>❖ Discuss the production of energy from biomass, tidal energy resources, energy availability and power generation<br>❖ Discuss the generation of power from geothermal & ocean thermal energy | | |
| **Module-1: Introduction to Energy Sources** | **RBT** | **Hrs** |
| Energy Resources and Classification, Renewable energy – Worldwide renewable energy availability, Renewable energy in India, Introduction to solar energy, wind power, tidal power, ocean thermal energy, geothermal energy, Biomass energy.<br>**R1: Chapter 1 (1.9, 1.14)** | **Understand** | **08** |
| **Module-2: Energy from the Sun** | **RBT** | **Hrs** |
| Sun-Earth geometric Relationship, Earth-sun angles and their relationships – Hour angle, equation of time, declination angle, Latitude angle, Solar altitude angle, Solar elevation angle, Surface azimuth angle, Relationship between different sun-earth angles, Direct thermal applications, illustrative problems.<br>**R1: Chapter 2 (2.1, 2.3.1 - 2.3.8, 2.5.3)** | **Understand** | **08** |
| **Module-3: Wind Energy** | **RBT** | **Hrs** |
| Energy availability in the wind, Considerations and guidelines for site selection, Wind Turbine Power Output Variation with Steady Wind Speed, Classification and description of wind machines, Principle of wind energy conversion, Mathematical model of extraction of energy from the wind, illustrative problems.<br>**R1: Chapter 6 (6.3, 6.5.2 – 6.5.3, 6.6, 6.7, 6.8)** | **Understand** | **08** |
| **Module-4: Biomass energy & Tidal energy** | **RBT** | **Hrs** |

| | | |
|---|---|---|
| **Biomass energy** - Biomass production, Biomass gasification, Theory of gasification, Gasifier and their classifications, Fluidized bed gasification.<br>**Tidal energy** - Tidal energy Resource, Tidal energy Availability, Tidal power basin – single basin system, two-basin system, co-operating two basin systems (Excluding problems).<br>**R1: Chapter 9 (9.1, 9.3, 9.4, 9.5, 9.10), Chapter 11 (11.2, 11.3, 11.7)** | **Understand** | **08** |
| **Module-5: Geothermal & Ocean thermal energy systems** | **RBT** | **Hrs** |
| **Geothermal energy** - Geothermal systems, Geothermal-Based Electric Power Generation – Dry steam based, flash geothermal, binary-cycle based, electrical and mechanical features, operation of geothermal plants.<br>**OTEC** - Principle of Ocean Thermal Energy Conversion, Ocean thermal energy conversion plants, Closed cycle, Open cycle and Hybrid cycle OTEC plant<br>**R1: Chapter 7 (7.1, 7.5), Chapter 13 (13.2, 13.3, 13.5)** | **Understand** | **08** |

**Reference Books**


1. "Non-conventional energy Resources", Shobh Nath Singh, Pearson, 1st Edition, 2015
2. "Non-conventional energy resources", B.H.Khan, TMH, 3nd edition.
3. " Renewable Energy; power for a sustainable future" Godfrey Boyle,Oxford, 3rd Edition, 2012


**Web links and Video Lectures:**

- https://archive.nptel.ac.in/courses/121/106/121106014/
- https://www.coursera.org/specializations/renewable-energy

# Department of EEE

| Semester: V | |
|---|---|
| **Course Name: Fundaments of Hybrid and Electric Vehicles (POE)**<br>**Course Code: 21EEE1563** | |
| **L:T:P:J: 3 : 0 : 0 : 0** | **CIA Marks: 50** |
| **Credits: 3** | **SEA Marks: 50** |
| **Hours: 40** | **SEA Duration: 3 hours** |

**Course Learning Objectives:**

- To Understand the fundamental laws and vehicle mechanics.
- To Understand the working of Electric Vehicles and recent trends.
- To understand the working of DC and AC motors used in Electric Vehicles.
- To understand different energy storage systems used in electric vehicles

**Pre-Requisites:**

**Course Outcomes:** After the completion of the course the students will be able to:

- Explain the roadway fundamentals, laws of motion, vehicle mechanics and propulsion system design.
- Explain the working of electric vehicles and hybrid electric vehicles in recent trends.
- Model batteries, Fuel cells, PEMFC and supercapacitors.
- Explain the working of DC and AC motors used for electric vehicle applications.

| Module-1: Fundamentals of Electric and Hybrid Vehicles | RBT | Hrs |
|---|---|---|
| **Introduction**, Electric Vehicles, Hybrid Electric Vehicles, Electric and Hybrid Vehicle components, Electric Motor and Engine ratings, Recent EVs and HEVs, EV/ICEV Comparison, Electric Vehicle Market<br>**Vehicle Dynamics**: Roadway Fundamentals, Laws of Motion, Vehicle Kinetics, Dynamics of Vehicle Motion, Propulsion power, Force-Vehicle Characteristics, Maximum Gradability, Velocity, and acceleration Constant, Level Road, Vehicle profile, Distance traversed, Tractive power Energy requirement (Excluding Derivations) | **Understand** | **08** |
| **Module-2: Electric and Hybrid Electric Vehicles** | **RBT** | **Hrs** |
| Configuration of Electric Vehicles, Performance of Electric Vehicles, Traction motor characteristics, Tractive effort and Transmission requirement, Vehicle performance, Tractive effort in normal driving, Energy consumption.<br>Concept of Hybrid Electric Drive Trains, Architecture of Hybrid Electric Drive Trains, Series Hybrid Electric Drive Trains, Parallel hybrid electric drive trains (Excluding classification) | **Understand** | **08** |
| **Module-3: Energy storage for EV and HEV** | **RBT** | **Hrs** |
| Energy storage requirements, Battery parameters, Types of Batteries, Modelling of Battery, Fuel Cell basic principle and operation, Types of Fuel Cells, Proton Exchange Membrane Fuel Cell (PEMFC) and its operation, Modelling of PEMFC, Supercapacitors. | **Understand** | **08** |
| **Module-4: Electric Propulsion** | **RBT** | **Hrs** |
| Introduction, DC motor Drives, the principle of operation, speed control using armature voltage, and field control method.<br>Special Electric Motors: Permanent Magnet BLDC Motor Drives, Basic principles of BLDC Motor Drives, BLDC Machine Construction, and Classification, introduction to SRM Motor Drives. | **Understand** | **08** |

| Module-5: Design of Electric and Hybrid Electric Vehicles | RBT | Hrs |
|---|---|---|
| **Series Hybrid Electric Drive Train Design:** Introduction, Operating patterns, control strategies, Maximum State Of Charge of Peaking Power Source Control Strategy, Engine On–Off or Thermostat Control Strategy, Sizing of major components, power rating of traction motor, power rating of engine/generator, design of PPS<br>**Parallel Hybrid Electric Drive Train Design:** Control strategies of parallel hybrid drive train, Maximum SOC-of-PPS Control Strategy, Engine On–Off (Thermostat) Control Strategy, Constrained Engine On–Off Control Strategy, Fuzzy Logic Control Technique. | **Understand** | **08** |

**Reference Books:**

1. Electric and Hybrid Vehicles: Design Fundamentals Iqbal Husain CRC Press, Third Edition.
2. Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design M. Ehsani, Y. Gao, S.Gay and Ali Emadi CRC Press 2005.

**Web links and Video Lectures:**

- https://nptel.ac.in/courses/108106170

# Department of EEE

| Semester: V | |
|---|---|
| **Course Name: Sensors and Transducers (POE)**<br>**Course Code: 21EEE1564** | |
| **Teaching Hours/Week (L:T:P:J) : (3:0:0:0)** | **CIA: 50** |
| **Credits: 3** | **SEA: 50** |
| **Hours: 40** | **SEA Duration: 03Hours** |

**Course Learning Objectives:** The students will be able to

- Understand various Transducers, their construction, applications and principles of operation, standards and units of measurement.
- Discuss the basics of signal conditioning and signal conditioning equipment
- Discuss the configuration of the Data Acquisition System and data conversion
- Explain the measurement of various non-electrical quantities
- Discuss recent trends in sensor technology and their selection.
- Develop basic skills in the design of electronic equipment

**Pre-Requisites: ---**

**Course Outcomes:** After the completion of the course the students will be able to:

- Explain the need for transducers, their classification, advantages, and disadvantages
- Explain the working of various transducers and sensors.
- Outline the recent trends in sensor technology and their applications.
- Analyze the signal conditioning and signal conditioning equipment
- Illustrate different configurations of the Data Acquisition System and data conversion.
- Explain the measurement of non-electrical quantities -temperature, flow, speed, force, torque, power, and viscosity

| **Module-1: Introduction, Passive Electrical Transducers** | **RBT** | **Hrs** |
|---|---|---|
| **Introduction to transducers**-Classification, Advantages, Disadvantages, Actuating mechanisms. **Passive Electric Transducers**-Resistance Transducers-Linear and angular motion potentiometers, Thermistors and resistance thermometers, Variable Inductance Transducers-Self generating type and passive type, Capacitive Transducers-Capacitive thickness transducers, Capacitive displacement transducers, Proximity transducers, Capacitive Strain transducers. | **Understand** | **8** |
| **Module-2: Active Electrical Transducers** | **RBT** | **Hrs** |
| **Thermo-Electric Transducers**- Common thermoelectric phenomena, Common thermos-couple systems.<br>**Piezoelectric Transducers**-Piezo electric materials-desirable properties, Working, Advantages and disadvantages, and piezoelectric accelerometer.<br>**Hall-effect transducers**-working principle, Applications<br>**Electromechanical Transducers**-Tachometers | **Understand** | **8** |
| **Module-3: Developments in sensors Technology** | **RBT** | **Hrs** |
| **Smart sensors**-Definition and configuration,<br>**Microsensors**-micro size microphone, inertial sensors, Hall Effect sensor,<br>**IR radiation Sensors**-Basics, Thermal Detectors, Quantum detectors, IR thermometry. | **Understand** | **8** |

| | | |
|---|---|---|
| **Ultrasonic sensors**-Basics, Sensing system, Ultrasonic flow meters, Doppler flowmeter.<br>**Biosensors**- structure, composition, Quartz crystal microbalance. | | |
| **Module-4: Signal conditioning and DAQ systems** | **RBT** | **Hrs** |
| **Signal Condition:** Introduction, Functions of Signal Conditioning Equipment, Amplification, Types of Amplifiers, Mechanical Amplifiers, Fluid Amplifiers, Optical Amplifiers, Electrical and Electronic Amplifiers.<br>**Data Acquisition Systems and Conversion:** Introduction, Objectives and Configuration of Data Acquisition System, Data Acquisition Systems, Data Conversion. | **Understand** | **8** |
| **Module-5: Measurement of Non – Electrical Quantities** | **RBT** | **Hrs** |
| Pressure Measurement, Temperature Measurement, Electromagnetic Flow meters, Ultrasonic Flow Meters, Thermal Flow Metes. Measurement of Displacement, Measurement of Velocity/ Speed, Measurement of Acceleration, Measurement of Force, Measurement of Torque, Measurement of Shaft Power, Measurement of Liquid Level. Measurement of viscosity. | **Understand** | **8** |

**Reference Books:**


1. D.V.S. Murty, "Transducers and Instrumentation", Prentice Hall India
2. Electrical and Electronic Measurements and instrumentation , R.K Rajput, S.Chand,3rd Edition, 2013.
3. D. Patranabis, ―Sensors and Transducers‖, 2nd Edition, Prentice Hall of India, 2010.
4. Shawhney A. K. "A Course In Electrical and Electronics Measurements and Instrumentation", Dhanpat Rai& Sons, 11th Ed., 1999
5. A course in electronics and electrical measurement and instrumentation, J.B Gupta, Katson books, 13th edition,2008


**Web links and Video Lectures:**

1. https://archive.nptel.ac.in/courses/108/108/108108147/
2. https://alison.com/course/application-of-sensors-in-mechatronics

# B N M Institute of Technology

## An Autonomous Institution under VTU

## Department of Training & Placement

### Syllabus

**Course Name: Employability Skills-1 [21EEE157]** **Credits: 01 [0:2:0:0]**

**Class: V Semester** **Year of Study: 2023-24**

**(Tentative) Faculty Name:**

**Course Objectives:** This course will enable students to

- ability to apply programing techniques/languages to solve complex problems.
- understand the course specific technical topics in view of the industry requirements.

| Module | Topics to be covered | No of Hours |
|---|---|---|
| **General Technical Training**<br><br>**(All Branches)** | **Programming Languages**<br>C, Java, Python (Platforms to be used Hacker Rank, Leet Code and Github) | **10 Hours** |
| **General Employability Skills** | Complex problem Solving and Critical Thinking Skills | **2 Hours** |
| **Course Specific Technical Training** | **CSE, ISE & AIML**<br>Algorithms, Data Structures, DBMS, Computer Organisation, Computer Networks, Operating Systems & AIML. | **12 Hours** |
| | **Electronics & Communication Engineering**<br>Matlab, SCADA, System Verilog, VLSI, & Embedded Systems, Computer Organisation, Introduction to Data Structures & Operating Systems | |
| | **Electrical & Electronics & Engineering**<br>Power Electronics, Power Systems, Introduction to Robotic Process Automation (RPA), Introduction to Data Structures & EV Vehicles. | |
| | **Mechanical Engineering**<br>Thermodynamics, Aerodynamics, Automobile & Engines, Solidworks, Ansys, Industrial Automation, Mechatronics, & EV Vehicles | |

**Course Outcome: (CO)**

By end of the course the students will be able to:

1. apply the appropriate coding techniques to solve problems.
2. analyze the problem and solve it within the allocated time span.
3. implement out of the box solutions for complex problems.

**CO-PO/PSO Mapping:**

| CO No. | Statement | Bloom's Cognitive level | POs |
|---|---|---|---|
| 1 | apply the appropriate coding techniques to solve problems. | **Apply** | PO1, PO2 & PO12 |
| 2 | analyze the problem and solve it within the allocated time span | **Analyze** | PO1 & PO2 |
| 3 | implement out of the box solutions for complex problems. | **Analyze** | PO1 & PO2 |

# B.N.M. Institute of Technology

**An Autonomous Institution under VTU**

## Department of EEE

| **Semester: V** | |
|---|---|
| **Course Name: Internship -2**<br>**Course Code: 21EEE158** | |
| **L:T:P:J 0:0:4:0** | **CIA: 100** |
| **Credits: 02** | **SEA: --** |
| **Hours: --** | **SEA Duration: --** |

**Course Learning Objectives:**

Internship provide students the opportunity of hands-on experience that include personal training, time and stress management, interactive skills, presentations, budgeting, marketing, liability and risk management, paperwork, equipment ordering, maintenance, responding to emergencies etc.

The objectives are further,

- To put theory into practice.
- To expand thinking and broaden the knowledge and skills acquired through course work in the field.
- To relate to, interact with, and learn from current professionals in the field.
- To gain a greater understanding of the duties and responsibilities of a professional.
- To understand and adhere to professional standards in the field.
- To gain insight to professional communication including meetings, memos, reading, writing.

**Pre-Requisites: ---**

**Course Outcomes:** After the completion of the course the students will be able to:

- Acquire practical knowledge of the industry in which the internship is done.
- Apply knowledge and skills learned to classroom work.
- Develop a greater understanding about career options while more clearly defining personal career goals.
- Experience the activities and functions of professionals.
- Develop and refine oral and written communication skills

**Internship:** Students under the guidance of internal guide/s and external guide shall take part in all the activities regularly to acquire as much knowledge as possible without causing any inconvenience at the place of internship.

Seminar: Each student, is required to

- Present the seminar on the internship orally and/or through power point slides.
- Answer the queries and involve in debate/discussion.
- Submit the report duly certified by the external guide.

The participants shall take part in discussion to foster friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident

# *B.N.M. Institute of Technology*

**An Autonomous Institution under VTU**

## Department of Electrical and Electronics Engineering

# VI Semester Syllabus

# Department of Electrical and Electronics Engineering

| Semester: VI | |
|---|---|
| **Course Name: Power System Protection (PCC)**<br>**Course Code: 21EEE161** | |
| **Teaching Hours/Week (L:T:P:J) : (2:2:0:0)** | **CIA Marks: 50** |
| **Credits:3** | **SEA Marks: 50** |
| **Hours: 40** | **SEA Duration: 3 Hours** |

**Course Learning Objectives:**

- To explain over current protection using static relays and over current protective schemes.
- To discuss effect of arc resistance, power swings, line length and source impedance on performance of distance relays.
- To discuss pilot protection; wire pilot relaying and carrier pilot relaying.
- To discuss construction, operating principles and performance of various differential relays for differential protection.
- To discuss protection of generators, motors, Transformer and Bus Zone Protection.
- To explain the principle of circuit interruption and operation of circuit breakers.
- To describe the construction and operating principle of fuses and to give the definitions of different terminologies related to a fuse.
- Protection of transmission line and substations against effect of lightening.
- To discuss protection recent trends in power system protection

**Pre-Requisites:** Fundamentals of Mathematics, Electrical and Electronics Engineering and Power Systems.

**Course Outcomes:** After the completion of the course the students will be able to:

- Discuss the principle of operation and construction of numerical and static relays.
- Explain the working principle of Over current, Distance and Differential protection schemes.
- Discuss the protection of generators, motors, transformers, Bus Zone Protection and modern trends in power system protection.
- Explain the principle of circuit interruption, construction of oil, vacuum, air, and SF6 circuit breakers and characteristics of fuse, protection against overvoltage.
- Describe the Gas Insulated Substation (GIS) and FPGA-based relays.

| Module-1: Introduction to Power System Protection | RBT | Hrs |
|---|---|---|
| **Introduction to Power System Protection:** Need for protective schemes, Nature and Cause of Faults, Types of Faults, Effects of Faults, Fault Statistics, Zones of Protection, Primary and Backup Protection, Essential Qualities of Protection, Performance of Protective Relaying, Classification of Protective Relays.<br>**Relay Construction and Operating Principles:** Introduction, Static Relays – Merits and Demerits of Static Relays, Numerical Relays, Comparison between Static Relays and Numerical Relays. | **Understand** | **8** |
| **Module-2: Overcurrent Protection & Distance Protection** | **RBT** | **Hrs** |
| **Overcurrent Protection:** Introduction, Time – Current Characteristics, Current Setting, Time Setting, Overcurrent Protective Schemes, Reverse Power or Directional Relay, Protection of Parallel Feeders, Protection of Ring Mains, Earth Fault and Phase Fault Protection, Directional Earth Fault Relay, Static Overcurrent Relays, Numerical Overcurrent Relays.<br>**Distance Protection:** Introduction, Impedance Relay, Reactance Relay, Mho Relay, Effect of Arc Resistance on the Performance of Distance Relays, Reach of Distance Relays. Effect of Power Surges (Power Swings) on Performance of Distance Relays. | **Understand** | **8** |
| **Module-3: Differential Protection, Generator, Transformer and Buszone Protection** | **RBT** | **Hrs** |

| | | |
|---|---|---|
| **Differential Protection**: Introduction, Differential Relays, Simple Differential Protection, Percentage or Biased Differential Relay, Differential Protection of 3 Phase Circuits, Balanced (Opposed) Voltage Differential Protection.<br>**Generator Protection:** Introduction, Protection of Generators.<br>**Transformer and Buszone Protection:** Introduction, Transformer Protection, Buszone Protection, Frame Leakage Protection**.** | **Understand** | **8** |
| **Module-4: Circuit Breakers** | **RBT** | **Hrs** |
| **Circuit Breakers:** Introduction, Fault Clearing Time of a Circuit Breaker, Arc Voltage, Arc Interruption, Restriking Voltage and Recovery Voltage, Current Chopping, Interruption of Capacitive Current, Classification of Circuit Breakers, Air – Break Circuit Breakers, Oil Circuit Breakers, Air – Blast Circuit Breakers, SF6 Circuit Breakers, Vacuum Circuit Breakers, High Voltage Direct Current Circuit Breakers, Rating of Circuit Breakers, Testing of Circuit Breakers. | **Understand** | **8** |
| **Module-5: Protection against Overvoltage & Modern Trends in Power System Protection** | **RBT** | **Hrs** |
| **Protection against Over voltages:** Causes of Overvoltages, Lightning phenomena, Wave Shape of Voltage due to Lightning, Klydonograph and Magnetic Link, Protection of Transmission Lines against Direct Lightning Strokes, Protection of Stations and Sub – Stations from Direct Strokes,<br>**Modern Trends in Power System Protection:** Introduction, gas insulated substation/switchgear (GIS), Field Programmable Gate Arrays (FPGAs) based relays. | **Understand** | **8** |

**Reference Books:**

Bhuvanesh Oza Nirmal Kumar Nair Rashesh Mehta Vijay Makwana, "Power system protection & Switchgear", McGraw-Hill Education, 1st edition, 2010.

Y.G.Paithankar, S.R. Bhide, "Fundamentals of Power System Protection", PHI, 1st Edition, 2009

J Badariram& D.N Vishwa Kharma, "Power system protection & Switchgear", McGraw Hill, 2nd Edition

**Weblinks and Video Lectures:**

- https://electrical-engineering-portal.com/commissioning-tests-protection-relays-at-site
- https://onlinecourses.nptel.ac.in/noc20_ee73/unit?unit=16&lesson=17
- https://www.youtube.com/watch?v=Dwa30Ijs-lI
- https://www.youtube.com/watch?v=PDwtmQJnp18
- https://electrical-engineering-portal.com/substation-bus-overcurrent-differential-protection
- https://www.youtube.com/watch?v=FR0zXWmnw1U
- https://www.youtube.com/watch?v=dW2YYABJAac
- https://www.youtube.com/watch?v=FXq3SzmjwQA

# Department of Electrical and Electronics Engineering

| Semester: VI | |
|---|---|
| **Course Name: Computer Techniques in Power System (PCI)**<br>**Course Code: 21EEE162** | |
| **Teaching Hours/Week (L:T:P:J) : ( 3 : 0 : 2 : 0 )** | **CIA Marks: 50** |
| **Credits: 4** | **SEA Marks: 50** |
| **Hours: 40 Hours Theory + 10 lab sessions** | **SEA Duration: 3 Hours** |

**Course Learning Objectives:**

- To introduce the concept of Graph theory and its terminologies
- To explain Incidence matrices, Bus Incidence Matrix, and Primitive network.
- To compute the Bus Incidence matrix for a given system
- To solve load flow problems for a given power system using Gauss-Siedel, Newton Raphson and Fast decoupled load flow methods.
- To evaluate optimal generation scheduling with and without losses
- To formulate Z-Bus using Z-bus building algorithm.
- To explain numerical solution of swing equation for multi-machine stability.

**Pre-Requisites:**

**Course Outcomes:** After the completion of the course the students will be able to:

- Develop network matrices and models for solving load flow problems.
- **Solve** steady state power flow of power system networks using Gauss-Seidel, Newton-Raphson and Fast decoupled iterative methods & optimal power flow analysis.
- Evaluate Optimum Generation scheduling of Power System.
- Compute Z-bus matrix using Z bus building algorithm
- Solve swing equation by point-by-point method and Runge - Kutta method.

| **Module-1: Network Topology** | **RBT** | **Hrs** |
|---|---|---|
| Introduction, Graphs, terminologies of Graph Theory, Introduction to Incidence Matrices, Bus Incidence Matrix, Primitive Networks – Impedance and Admittance forms, Formation of Y-Bus using Inspection Method and Singular Transformation Method, Problems. | **Apply** | **08** |
| **Module-2: Load Flow Studies** | **RBT** | **Hrs** |
| Introduction, Power flow Equations, Types of Buses, operating constraints, Data for Load Flow Studies, Solution technique, Gauss- Siedel (G-S) Method – Algorithm and Flow chart for Load flow solution using G-S Method, Acceleration Factor, Problems. | **Apply** | **08** |
| **Module-3: Load Flow Studies** | **RBT** | **Hrs** |
| Newton Raphson (N-R) Method for Load flow solution (Rectangular and Polar co-ordinates), Problems, Fast Decoupled Load flow (FDLF) studies, Problems, Flow chart and Algorithm for N-R method and FDLF method, Comparison of Load Flow Methods. | **Apply** | **08** |
| **Module-4: Economic Operation of Power System** | **RBT** | **Hrs** |
| Introduction, Economic generation scheduling neglecting losses, Economic generation scheduling considering losses and generator limits, Lambda Iterative method – Algorithm, Derivation of Transmission loss formula, Problems. | **Apply** | **08** |
| **Module-5: Z-bus Formation and Power System Stability** | **RBT** | **Hrs** |

| | | |
|---|---|---|
| Z-Bus formation using Z-Bus Building Algorithm (Both the addition of Branch and Link). Problems.<br>Factors affecting Transient Stability, Numerical Solution of Swing Equation by Point-by-Point method and Runge Kutta Method. Illustrative examples | **Apply** | **08** |

**Reference Books:**


1. "Computer Methods in Power System Analysis", Glenn W. Stagg, Ahmed H Ei-Abiad, MEDTECH, Scientific International Pvt. Ltd., 1st Edition, 2019
2. "Modern Power System Analysis", D P Kothari, I J Nagrath, Tata McGraw Hill, 4th Edition, 2011.
3. "Computer Techniques in Power System Analysis", M.A. Pai, McGraw Hill, 2nd Edition, 2012.
4. "Power System Analysis", Hadi Saadat, McGraw Hill, 2009


**Web links and Video Lectures:**

**List Of Experiments**

| | |
|---|---|
| 1 | Formation of Y-Bus for power systems using Inspection Method. |
| 2 | Formation of Y-Bus for power systems using Singular Transformation Method |
| 3 | Formation of Z-Bus using Z-Bus Building Algorithm |
| 4 | Determination of Line Current, Line power flow, Bus Current, Bus Power, and losses for a given Power system |
| 5 | Load Flow Analysis using Gauss-Siedel Method. |
| 6 | Symmetrical and Unsymmetrical fault analysis on a power system using MiPower software package |
| 7 | Determination of critical clearing time and critical clearing angle for a single machine connected to Infinite Bus using MiPower software package |
| 8 | Load Flow Analysis using MiPower software package |
| 9 | Fault analysis in a single transmission line system using MiPower software package |
| 10 | Economic Operation on power plants using MiPower software package |

Experiments 1 to 5 are conducted using MATLAB

# Department of Electrical and Electronics Engineering

| Semester: VI | |
|---|---|
| **Course Name: High Voltage Engineering (PCI)**<br>**Course Code: 21EE163** | |
| **Teaching Hours/Week (L:T:P:J): ( 3:0:2:0)** | **CIA Marks: 50** |
| **Credits: 3** | **SEA Marks: 50** |
| **Hours: 40 Hours Theory+10 Lab sessions** | **SEA Duration: 03 hours** |

**Course Learning Objectives:**

- To discuss conduction and breakdown in gases, liquid dielectrics.
- To discuss the breakdown in solid dielectrics.
- To discuss generation of high voltages and currents and their measurement.
- To discuss the overvoltage phenomenon and insulation coordination in electric power systems
- To discuss high-voltage testing of electric apparatus
- To explain the impact of high voltage systems on society

**Pre-Requisites: Basic Electrical Engineering, Transmission and Distribution**

**Course Outcomes:** After the completion of the course the students will be able to:

- Describe the breakdown phenomenon of gaseous, liquid and solid dielectrics.
- Explain the equivalent circuit models of the generation of high voltage direct current voltages, high alternating voltages, impulse voltages, impulse currents and impulse generators.
- Explain the measurement of HVDC, HVAC, impulse voltage and impulse current.
- Discuss the causes of over voltages, switching surges, system faults and principles of insulation co-ordination in high voltage and extra voltage power systems.
- Discuss non-destructive testing of materials and high voltage testing of electrical apparatus.
- Explain the impact of high voltage systems on society

| Module-1: Conduction and Breakdown in Dielectrics | RBT | Hrs |
|---|---|---|
| **Conduction and Breakdown in Gases:** Gases as Insulating Media, Collision Process, Ionization Processes, Townsend's Current Growth Equation, Current Growth in the Presence of Secondary Processes, Townsend's Criterion for Breakdown, Time Lags for Breakdown, Streamer Theory of Breakdown in Gases, Paschen's Law, Breakdown in Non-Uniform Fields and Corona Discharges.<br>**Conduction and Breakdown in Liquid Dielectrics:** Introduction, Definition of Pure Liquids and Commercial Liquids, Conduction and Breakdown in Commercial Liquids.<br>**Breakdown in Solid Dielectrics:** Introduction, Electromechanical Breakdown, Thermal Breakdown, Internal Discharge | **Understand** | **8** |
| **Module-2: Generation of High Voltage and Current** | **RBT** | **Hrs** |
| **Generation of HVDC**: Half and full wave rectifier, voltage doubler, Cockcroft-Walton voltage multiplier circuit, Van de Graaff generator.<br>**Generation of HVAC**: Cascaded transformer, Resonant Transformers, High frequency AC high voltages generator .<br>**Generation of Impulse Voltage and Current:** Standard impulse waveshape, Wave shape control, Marx circuit, Generation of switching surges, Impulse current generation, Tripping and control of impulse generator. | **Understand** | **8** |
| **Module-3: Measurement of High Voltage and Current** | **RBT** | **Hrs** |

| | | |
|---|---|---|
| **Measurement of HVDC:** Series resistance microammeter, Resistance potential divider, Generating voltmeter, Electrostatic Voltmeter.<br>**Measurement of HVAC and Impulse Voltages:** Series impedance voltmeter, Series Capacitance voltmeter, Capacitance potential divider and Capacitive voltage transformer, Peaking reading AC voltmeter.<br>**Measurement Impulse Voltages:** Spark gap measurement, Resistance potential divider, Capacitance voltage divider, Pure capacitance divider, Mixed RC divider, Different connection employed with potential divider, LV arm of the measuring system. | **Understand** | **8** |
| **Module-4: Overvoltage phenomenon and insulation coordination in electric power systems** | **RBT** | **Hrs** |
| **Overvoltage phenomenon:** Natural Causes: Charge formation on clouds, Mechanism of lightning stroke, Mathematical model for lightning, Travelling waves on transmission lines, Reflection and Transmission of waves at Transition points, Reflection lattice of travelling wave, Switching over voltages in EHV and UHV system, Power frequency over voltages in power system Power frequency over voltages in power system.<br>**Insulation Coordination:** Protection against lightning over voltages and switching surges of short duration, Principles of insulation coordination, on high voltage and extra high voltage power systems, surge diverters, Insulation coordination in EHV and UHV systems. | **Understand** | **8** |
| **Module-5: High voltage testing of electrical apparatus** | **RBT** | **Hrs** |
| **Non-Destructive Testing:** Introduction, Measurement of dielectric constant and loss factor, Schering Bridge arrangement for power frequency method, grounded capacitor, high charging current and dissipation factors, Partial discharge measurement using straight and balanced detector.<br>**Destructive Testing:** Introduction, Testing of insulators and bushings, Testing of isolators and circuit breakers, Testing of cables, and Testing of transformers. | **Understand** | **8** |

**Reference Books:**


1. High Voltage Engineering, M.S. Naidu and Kamaraju, McGraw Hill, 5th Edition, 2013.
2. High Voltage Engineering Fundamentals, E.Kuffel, W.S Zaengl, J. Kuffel, Newness, 2nd Edition, 2000
3. High Voltage Engineering, C.L. Wadhwa, New Age International, 3rd Edition, 2012
4. High-Voltage Test and Measuring Techniques, Wolfgang Hauschild, Eberhard Lemke, Springer, 1st Edition, 2014
5. High Voltage Engineering, Farouk A.M. Rizk, CRC Press, 1st Edition, 2014


**Web links and Video Lectures:**

1. NPTEL course on "High Voltage Engineering" coordinated by IIT Kanpur, https://archive.nptel.ac.in/courses/108/104/108104048/
2. NPTEL course on "Advances in Ultra High Voltage Transmissio and Distribution" coordinated by IISc Bangalore, https://archive.nptel.ac.in/courses/108/108/108108099/#

| **List of lab experiments** |
|---|
| 1. Protection of Transformer using Differential Relay (Merz Price Protection) |
| 2. Operation of Negative Sequence Relay using REF601 |
| 3. DMT and IDMT characteristics of over current and earth fault protection of feeders using SPAJ 140C relay |
| 4. DMT and IDMT characteristics of over voltage and under voltage using microprocessor (REU610) based relay |
| 5. IDMT Characteristics of Over-Current Electromechanical type Relay (ICM21) |
| 6. Over current and earth fault protection of motors using SPAM 150C relay. |
| 7. Spark-Over Characteristics of Air Insulation for HVAC |
| 8. Spark-Over Characteristics of Air Insulation for HVDC |

| |
|---|
| 9. Measurement of HVAC and HVDC using Standard Sphere Gap Assembly |
| 10. Measurement of Break Down Strength, Flash and Fire Point of Transformer Oil |
| 11. Measurement of Viscosity of Transformer Oil *(Extra Experiment)* |

# Department of Electrical and Electronics Engineering

| Semester: VI | |
|---|---|
| **COURSE: Microcontrollers and IoT (PBL)**<br>**Course Code: 21EEE164** | |
| **Teaching Hours/Week (L:T:P:J) : (0:0:2:2)** | **CIA Marks:** 50 |
| **Credits: 2** | **SEA Marks:** 50 |
| **Hours: 30** | **SEA Duration: 0**3 Hours |
| **Pre-Requisites:** | |

| **Course Learning Objectives: The students will be able to** | |
|---|---|
| 1 | Understand and program using ARM cortex M3 microcontroller |
| 2 | Understand the fundamentals of IoT and the various wireless technologies |
| 3 | Understand and Program Arduino for IoT applications |

**Course Outcomes: After completing the course, the students will be able to**

- ❖ write assembly language program using ARM instructions
- ❖ write programs using ARM Thumb instructions
- ❖ Build projects using microcontrollers and IoT concepts for a real life problems

| Sl.No | Experiments |
|---|---|
| 1 | Discussion on Architecture of ARM microcontroller |
| 2 | Discussion on Architecture of ARM microcontroller |
| 3 | Write an ALP to i) multiply two 16-bit binary numbers. ii) Add two 64-bit numbers. |
| 4 | Write an ALP to find the sum of first 10 integer numbers. |
| 5 | Write an ALP to find factorial of a number. |
| 6 | Write an ALP to add an array of 16-bit numbers and store the 32-bit result in internal RAM. |
| 7 | Write an ALP to find the largest/smallest number in an array of n- numbers. |
| 8 | Write an ALP to arrange a series of 32-bit numbers in ascending/descending order. |
| 9 | Interface a Stepper motor and rotate it in clockwise and anti-clockwise direction. |
| 10 | Interface a DAC and generate Triangular and Square waveforms. |
| 11 | Controlling LED Bluetooth module ESP8266 |
| 12 | Temperature and humidity measurement using Blynk Application |

| Sl. No. | List of indicative Projects |
|---|---|
| 1 | IoT Based 12V Battery Monitoring System with ESP8266 |
| 2 | IoT Based Sound Pollution Monitoring System – Measure and Track Decibels (dB) using NodeMCU |
| 3 | IoT Based Automatic Vehicle Accident and Rash Driving Alert System |
| 4 | IoT Based Smart Energy Meter |
| 5 | IoT based Flood Monitoring System |
| 6 | IOT based Transformer Health monitoring system |
| 7 | IoT-Based Electrical Load Forecasting for Smart Grid |
| 8 | Real-time visualisation of residential load flexibility for advanced demand side management using IoT |
| 9 | The remote monitor of farmland irrigation three-phase motor based on the IOT network. |
| 10 | Power Saving Mechanism for Street Lights using IOT |

| **Reference Books** |
| --- |
| 1. Andrew N Sloss, Dominic Symes and Chris Wright, "ARM System Developers Guide", Elsevier,Morgan Kaufman publisher, 1st Edition, 2008. |
| 2. Srinivasa K G, Siddesh G M, Hanumantha Raju R, " Internet of Things", Cengage, 1st edition, 2017 |

| Semester: VI | |
|---|---|
| **Renewable Energy Sources (PEC)**<br>**Course Code: 21EEE1651** | |
| **Teaching Hours/Week (L:T:P:J):** ( 3:0:0:0) | **CIE Marks:** 50 |
| **Credits: 3** | **SEE Marks:** 50 |
| **Hours: 40** | **SEE Duration:** 03 Hours |

**Course Learning Objectives:**

- To discuss the conventional and non-convectional energy sources
- To explain sun – earth geometric relationship, Earth – Sun Angles and their Relationships, solar energy reaching the Earth's surface
- To discuss types of solar collectors, their configurations, and their applications, components of a solar cell system, equivalent circuit of a solar cell, its characteristics, and applications.
- To discuss the production of hydrogen energy, biomass energy, biogas
- To discuss the availability of wind energy, geothermal energy, tidal energy and OTEC
- To discuss the various types of renewable energy-based power generation

**Pre-Requisites: Nil**

**Course Outcomes:** After the completion of the course the students will be able to:

- Explain conventional and non-convectional energy sources
- Understand the sun – earth geometric relationship, Earth – Sun Angles and their Relationships, solar energy reaching the Earth's surface
- Explain types of solar collectors, their configurations, and their applications, components of a solar cell system, equivalent circuit of a solar cell, its characteristics, and applications.
- Understand the different forms of production of hydrogen energy, biomass energy, and biogas & their applications
- Explain the availability of wind energy, geothermal energy, tidal energy, OTEC and their types, classification, and power generation.

| Module-1: Introduction to Energy Sources & Solar radiation and its measurement | RBT | Hrs |
|---|---|---|
| **An Introduction to Energy Sources:** Energy consumption as a measure of Prosperity, commercial or conventional energy sources, non-conventional sources, energy plantation, advantages of renewable energy. Energy scenario world & India<br>**Solar radiation and its measurement:** Introduction, Solar Constant, Solar Radiation at the Earth's Surface, Solar Radiation Geometry, Local Solar Time, (excluding derivation) illustrative problems | **Understand** | **8** |
| **Module-2: Solar Energy Collectors, Solar Cells and applications** | **RBT** | **Hrs** |
| **Solar Energy Collectors:** Introduction, Flat-Plate Collectors, Concentrating Collector: Focusing Type, Advantages and Disadvantages of Concentrating Collectors Over Flat-Plate collectors<br>**Solar Cells:** Elements of Silicon Solar Cell, Solar Cell materials, Practical Solar Cells, I – V Characteristics of Solar Cells, Efficiency of Solar Cells, Photovoltaic panels (series and parallel arrays). Simple Illustrative problems of series and parallel arrays<br>**Applications of Solar Energy:** Solar Water Heating Systems, Active Solar Space Cooling, Solar Dryers, Crop Drying, Solar Cookers | **Understand** | **8** |
| **Module-3: Wind, Geothermal and Hydrogen Energy** | **RBT** | **Hrs** |
| **Wind Energy:** Introduction, Basic Principles of Wind Energy Conversion, Site Selection Considerations, Basic components of WECS, Advantages and Disadvantages of WECS | **Understand** | **8** |

| | | |
|---|---|---|
| **Geothermal Energy:** Introduction, Geothermal Sources, Hydrothermal (Convective) Resources, Advantages and Disadvantages of Geothermal Energy over other Energy Forms, Applications<br>**Hydrogen Energy:** Introduction, Hydrogen Production, Hydrogen Storage, Utilization of Hydrogen Gas | | |
| **Module-4: Energy from Biomass** | **RBT** | **Hrs** |
| **Energy from Biomass:** Introduction, Biomass Conversion Technologies, Biogas Generation, Floating Dome Type Plant -KVIC digester, Advantages & disadvantages of floating drum type, Fixed Dome Type Plant – Deenabhandu biogas plant, Advantages & disadvantages of fixed drum type, Biomass as a Source of energy – Introduction, Classification of Biomass Gasifiers, Pyrolysis | **Understand** | **8** |
| **Module-5: Energy from Ocean, Tides and Ocean Waves** | | |
| **Energy from Ocean:** Introduction, OTEC – open type & closed type OTEC System<br>**Energy from Tides:** Introduction, Basic principle of Tidal Power, Components of Tidal Power, single basin & double basin arrangement, Advantages, and limitations of Tidal Power<br>**Ocean Waves:** Introduction, Advantages and Disadvantages of Wave energy, Wave energy conversion Devices | **Understand** | **8** |

**Reference Books**


1. "Non- conventional Energy Sources" / G.D. Rai / Dhanpat Ral and Sons. 6th Edition
2. "Nonconventional Energy Resources," Shobh Nath Singh Pearson 1st Edition, 2015
3. "Nonconventional Energy Resources," B.H. Khan McGraw Hill 3rd Edition
4. "Renewable Energy Sources" Twidell & Weir / Taylor and Francis / 2nd Special Indian Edition.
5. "Renewable Energy Sources and Emerging Technologies" D.P. Kothari, K.C. Singal Rakesh Ranjan
6. "Renewable Energy Resources" Tiwari and Ghosal Narosa.

| Semester: VI | | |
|---|---|---|
| **Course: Sensors and Transducers (PEC)**<br>**Course Code: 21EEE1652** | | |
| **Teaching Hours/Week (L:T:P:J): (3:0:0:0)** | **CIA : 50** | |
| **Credits: 03** | **SEA : 50** | |
| **Hours: 40** | **SEA Duration : 03 Hours** | |

**Course Learning Objectives:** The students will be able to

- Understand various Transducers, their construction, applications, and principles of operation, standards, and units of measurement.
- Discuss the basics of signal conditioning and signal conditioning equipment
- Discuss the configuration of the Data Acquisition System and data conversion
- Explain the measurement of various non-electrical quantities.
- Discuss recent trends in sensor technology and their selection
- Develop basic skills in the design of electronic equipment

**Pre-Requisites: Nil**

**Course Outcomes:** After the completion of the course the students will be able to:

- Explain the need for transducers, their classification, advantages, and disadvantages
- Explain the working of various transducers and sensors.
- Outline the recent trends in sensor technology and their selection.
- Analyze the signal conditioning and signal conditioning equipment
- Illustrate different configurations of the Data Acquisition System and data conversion.
- Explain the measurement of non-electrical quantities -temperature, flow, speed, force, torque, power, and viscosity

| **Module-1: Introduction to transducers and Resistive transducers** | **RBT** | **Hrs** |
|---|---|---|
| **Introduction to transducers**-Classification, Performance Characteristics, Errors in Measurement, Calibration, and Standards.<br>**Resistive Transducers**- Resistance thermometers, Hotwire resistance transducers, Resistive displacement transducers, Resistive strain transducers, Resistive pressure transducers, and Resistive moisture transducers. | **Understand** | **8** |
| **Module-2: Inductive, capacitive transducers, signal conditioning & Data acquisitions** | **RBT** | **Hrs** |
| **Inductance Transducers**-Self generating type and passive type.<br>**Capacitive Transducers**-Using a change in the area of plates, change in distance between the plates. Capacitive tachometers.<br>**Signal Condition, Data Acquisition Systems, Conversions:** Functions of Signal Conditioning Equipment, Objectives and Configuration of Data Acquisition System, Data Conversion. | **Understand** | **8** |
| **Module-3: Active Electrical Transducers** | **RBT** | **Hrs** |
| **Thermoelectric Transducers**-Common thermoelectric phenomena, Common thermos-couple systems.<br>**Piezoelectric Transducers**-Piezo electric materials-Phenomenon, Materials, Piezoelectric Force Transducers, Piezoelectric Strain Transducers Piezoelectric Torque Transducers, Piezoelectric Pressure Transducers, Piezoelectric Acceleration Transducers.<br>**Hall-effect transducers**-Principle, Applications, **Photoelectric transducers**-Phenomenon, Photoconductive Transducers, Photovoltaic Transducers, Photo Emissive Transducers. | **Understand** | **8** |
| **Module-4: Developments in sensors technology** | **RBT** | **Hrs** |

| | | |
|---|---|---|
| **Smart sensors**-Definition and configuration, **Microsensors-**micro size microphone, inertial sensors, Hall Effect sensor, **IR radiation Sensors**- Basics, Thermal Detectors, Quantum detectors, IR thermometry. **Ultrasonic sensors**-Basics, Sensing system, Ultrasonic flow meters, Doppler flowmeter.**Chemical sensors**-Introduction Semiconductor Gas detectors, Ion selective electrodes, Conductometer sensors, Mass sensors. | **Understand** | **8** |
| **Module-5: Measurement of Non – Electrical Quantities** | **RBT** | **Hrs** |
| Pressure Measurement, Temperature Measurement, Electromagnetic Flow meters, Ultrasonic Flow Meters, Thermal Flow Metes. Measurement of Displacement, Measurement of Velocity/ Speed, Measurement of Acceleration, Measurement of Force, Measurement of Torque, Measurement of Shaft Power, Measurement of Liquid Level. Measurement of viscosity. | **Understand** | **8** |

**Reference Books:**


1. D.V.S. Murty, "Transducers and Instrumentation", Prentice Hall India
2. Electrical and Electronic Measurements and instrumentation, R.K Rajput, S.Chand,3rd Edition, 2013.
3. D. Patranabis, ―Sensors and Transducers‖, 2nd Edition, Prentice Hall of India, 2010.
4. Shawhney A. K. "A Course in Electrical and Electronics Measurements and Instrumentation", Dhanpat Rai& Sons, 11th Ed., 1999
5. A course in electronics and electrical measurement and instrumentation, J.B Gupta, Katson books, 13th edition,2008

| Semester: VI | |
|---|---|
| **Course Name: Fundaments of Hybrid and Electric Vehicles (PEC)**<br>**Course Code: 21EEE1653** | |
| **Teaching Hours/Week (L:T:P:J): (3:0:0:0)** | **CIA Marks: 50** |
| **Credits: 3** | **SEA Marks: 50** |
| **Hours: 40** | **SEA Duration: 3 hours** |

**Course Learning Objectives:**

- To Understand the fundamental laws and vehicle mechanics.
- To Understand working of Electric Vehicles and recent trends.
- Ability to analyze different power converter topology used for electric vehicle application.
- Ability to develop the electric propulsion unit and its control for application of electric vehicles
- To understand different energy storage systems used in electric vehicles.

**Pre-Requisites:**

**Course Outcomes:** After the completion of the course the students will be able to:

- Explain the roadway fundamentals, laws of motion, vehicle mechanics, and propulsion system design.
- Explain the working of electric vehicles and hybrid electric vehicles in recent trends.
- Model batteries, Fuel cells, PEMFC, and supercapacitors.
- Analyze DC and AC drive topologies used for electric vehicle applications.
- Develop the electric propulsion unit and its control for the application of electric vehicles.

| Module-1: Fundamentals of Electric and Hybrid Vehicles | RBT | Hrs |
|---|---|---|
| **Introduction**: Electric Vehicles, Hybrid Electric Vehicles, Electric and Hybrid Vehicle components, Electric Motor and Engine ratings, Recent EVs and HEVs, EV/ICEV Comparison, Electric Vehicle Market.<br>**Vehicle Dynamics**: Roadway Fundamentals, Laws of Motion, Vehicle Kinetics, Dynamics of Vehicle Motion, Propulsion power, Force-Vehicle Characteristics, Maximum Gradability, Velocity, and acceleration Constant, Level Road, Vehicle profile, Distance traversed, Tractive power Energy requirement. | **Understand** | **08** |
| **Module-2: Electric and Hybrid Electric Vehicles** | **RBT** | **Hrs** |
| Configuration of Electric Vehicles, Performance of Electric Vehicles, Traction motor characteristics, Tractive effort and Transmission requirement, Vehicle performance, Tractive effort in normal driving, Energy consumption.<br>Concept of Hybrid Electric Drive Trains, Architecture of Hybrid Electric Drive Trains, Series Hybrid Electric Drive Trains, Parallel hybrid electric drive trains (Excluding classification). | **Understand** | **08** |
| **Module-3: Energy storage for EV and HEV** | **RBT** | **Hrs** |
| Energy storage requirements, Battery parameters, Types of Batteries, Modelling of Battery, Fuel Cell basic principle and operation, Types of Fuel Cells, Proton Exchange Membrane Fuel Cell (PEMFC) and its operation, Modelling of PEMFC, Supercapacitors. | **Understand** | **08** |
| **Module-4: Electric Propulsion** | **RBT** | **Hrs** |
| Introduction, Dc motor Drives, the principle of operation, speed control using armature voltage, and field control method, and Chopper control of DC motors.<br>Induction motor drives, basic operation principles of induction motors, constant volt/Hertz control. Permanent Magnet BLDC Motor Drives, Basic principles of BLDC Motor Drives, BLDC Machine | **Understand** | **08** |

| | | |
|---|---|---|
| Construction, and Classification. | | |
| **Module-5: Design of Electric and Hybrid Electric Vehicles** | **RBT** | **Hrs** |
| **Series Hybrid Electric Drive Train Design:** Introduction, Operating patterns, control strategies, Maximum State Of Charge of Peaking Power Source Control Strategy, Engine On–Off or Thermostat Control Strategy, Sizing of major components, power rating of traction motor, power rating of engine/generator, design of PPS<br>**Parallel Hybrid Electric Drive Train Design:** Control strategies of parallel hybrid drive train, Maximum SOC-of-PPS Control Strategy, Engine On–Off (Thermostat) Control Strategy, Constrained Engine On–Off Control Strategy, Fuzzy Logic Control Technique | **Understand** | **08** |

**Reference Books:**

1. Electric and Hybrid Vehicles: Design Fundamentals Iqbal Husain CRC Press, third Edition.
2. Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design M. Ehsani, Y. Gao, S.Gay and Ali Emadi CRC Press 2005

**Web links and Video Lectures:**

- https://nptel.ac.in/courses/108106170

| Semester: VI | | |
|---|---|---|
| **Course: Embedded Systems (PEC) Course Code: 21EEE1654** | | |
| **Teaching Hours/Week (L:T:P:J): (3:0:0:0)** | **CIA : 50** | |
| **Credits: 03** | **SEA : 50** | |
| **Hours: 40** | **SEA Duration : 03 Hours** | |

**Course Learning Objectives:** The students will be able to

- Understand fundamental concepts of design principles of embedded system
- Learn about the software aspects of Embedded systems.
- Learn about the Hardware aspects of Embedded systems.
- Under the RTOS-based design of the embedded system.

**Prerequisites**: Nil

**Course Outcomes:** After the completion of the course the students will be able to:

- Understand the fundamental concepts of embedded system
- Understand the various hardware components used in embedded systems.
- Apply software aspects and programming concepts to the design of Embedded System.
- Understand different concepts of RTOS, sensors, memory interface, communication interface
- Discuss testing, debugging, and tools used in embedded systems.
- Case studies on embedded design and development for real-world applications

| **Module-1: Introduction to Embedded System** | **RBT** | **Hrs** |
|---|---|---|
| Definition of Embedded Systems, Embedded Systems Vs General Computing Systems, History and Classification of Embedded Systems, Major Application Areas, Purpose of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems. Embedded System-Application and Domain-Specific case studies. | **Understand** | **8** |
| **Module-2: The Typical Embedded System** | **RBT** | **Hrs** |
| The core of the Embedded System: General Purpose and Domain Specific Processors, ASICs, PLDs, Commercial Off-The-Shelf Components (COTS), Memory: ROM, RAM, Memory according to the type of Interface, Memory Interfacing techniques, Memory Shadowing, Memory shadowing, Memory selection for Embedded Systems, Communication Interface: Onboard and External Communication Interfaces, Other system components: Reset Circuit, Brown-out Protection circuit, Real-Time clock, Watch-dog timer, Sensors and Actuators | **Understand** | **8** |
| **Module-3: Embedded Firmware Design and Development** | **RBT** | **Hrs** |
| Embedded Firmware Design, Embedded Firmware Development Languages, Hardware Software Co-design and Program Modelling: Fundamental Issues, Computational Models in Embedded Design. Introduction to unified Modelling Language (UML), Programming in Embedded C, hardware-software trade-offs | **Understand** | **8** |
| **Module-4: RTOS-Based Embedded System Design** | **RBT** | **Hrs** |
| Operating System basics, Types of Operating Systems, Tasks, Processes, Threads, Multiprocessing and Multi-tasking, Task Scheduling, Threads-Processes-Scheduling putting them together, Task Communication, Task Synchronization, Device Drivers, how to choose an RTOS, Qualities of good RTOS | **Understand** | **8** |

| Module-5: Testing, Debugging Techniques, and Tools | RBT | Hrs |
|---|---|---|
| Integration and testing of embedded hardware, Testing Method, Debugging Techniques, Laboratory Tools, and Target hardware Debugging.<br>Design Case Studies: Battery-operated smart card reader, Automated meter reading system, Digital camera. | **Understand** | **8** |

**Reference Books:**


1. Introduction to Embedded Systems, Shibu K V ,Tata McGraw Hill Education Private Ltd, New Delhi, Sixth Reprint,2012.
2. Embedded Systems: Architecture, Programming and Design, Raj Kamal, Third Edition, Tata McGraw Hill Education Private Ltd, New Delhi.
3. Embedded Systems: An integrated approach, Lyla B Das, Pearson India, Education Services Pvt.Ltd,2017.

| Semester: VI | | |
|---|---|---|
| **Course: Introduction to UNIX Programming (PEC)**<br>**Course Code: 21EEE1655** | | |
| **Teaching Hours/Week (L:T:P:J): (3:0:0:0)** | **CIA : 50** | |
| **Credits: 03** | **SEA : 50** | |
| **Hours: 40** | **SEA Duration : 03 Hours** | |

**Course Learning Objectives:** The students will be able to

- Interpret the features of UNIX and basic commands.
- Demonstrate different UNIX files and permissions.
- Implement shell programs.
- Explain UNIX process, IPC and signals

Prerequisites:

**Course Outcomes:** After completing the course, the students will be able to

- Explain Unix Architecture, File system and use of Basic Commands
- Illustrate Shell Programming and to write Shell Scripts
- Categorize, compare and make use of Unix System Calls
- Build an application/service over a Unix system.

| **Module-1: Introduction** | **RBT** | **Hrs** |
|---|---|---|
| **Introduction**, Brief history. Unix Components/Architecture. Features of Unix. The UNIX Environment and UNIX Structure, Posix and Single Unix specification. The login prompt. General features of Unix commands/command structure. Command arguments and options. Understanding of some basic commands such as echo, printf, ls, who, date, passwd, cal, Combining commands. Meaning of Internal and external commands. The type command: knowing the type of a command and locating it. The man command knowing more about Unix commands and using Unix online manual pages. | **Understand** | **8** |
| **Module-2: Unix files**. | **RBT** | **HRs** |
| **Unix files**. Naming files. Basic file types/categories. Organization of files. Hidden files. Standard directories. Parent child relationship. The home directory and the HOME variable. Reaching required files- the PATH variable, manipulating the PATH, Relative and absolute pathnames. Directory commands – pwd, cd, mkdir, rmdir commands. The dot (.) and double dots (..) notations to represent present and parent directories and their usage in relative path names. File related commands – cat, mv, rm, cp, wc and od commands. File attributes and permissions and knowing them. The ls command with options. | **Understand** | **8** |
| **Module-3: The vi editor** | **RBT** | **Hrs** |
| The vi editor. Basics. The .exrc file. Different ways of invoking and quitting vi. Different modes of vi. Input mode commands. Command mode commands. The ex mode commands. Illustrative examples Navigation commands. Repeat command. Pattern searching. The search and replace command. The set, map and abbr commands. Wild cards and file name generation. Removing the special meanings of wild cards. Three standard files and redirection. Connecting commands: Pipe. Splitting the output: tee. Command substitution | **Understand** | **8** |
| **Module-4: Shell programming** | | |

| | | |
|---|---|---|
| **Shell programming**. Ordinary and environment variables. The .profile. Read and read only commands. Command line arguments. exit and exit status of a command. Logical operators for conditional execution. The test command and its shortcut. The if, while, for and case control statements. The set and shift commands and handling positional parameters. The here ( << ) document and trap command. Simple shell program examples. | **Understand** | **8** |
| **Module-5: Meaning of a process.** | **RBT** | **8** |
| **Meaning of a process.** Mechanism of process creation. Parent and child process. The ps command with its options. Executing a command at a specified point of time: at command. Executing a command periodically: cron command and the crontab file. Signals. The nice and nohup commands. Background processes. The bg and fg command. The kill command. The find command with illustrative example. Structure of a perl script. Running a perl script. Variables and operators. String handling functions. Default variables - $_ and $. – representing the current line and current line number. | **Understand** | **8** |

**Reference Books**


1. Sumitabha Das., Unix Concepts and Applications., 4thEdition., Tata McGraw Hill ( Chapter 1,2 ,3,4,5,6,8,13,14)
2. W. Richard Stevens: Advanced Programming in the UNIX Environment, 2nd Edition, Pearson Education, 2005 ( Chapter 3,7,8,10,13,15)
3. Unix System Programming Using C++ - Terrence Chan, PHI, 1999. ( Chapter 7,8,9,10)
4. M.G. Venkatesh Murthy: UNIX & Shell Programming, Pearson Education.
5. Richard Blum , Christine Bresnahan : Linux Command Line and Shell Scripting Bible, 2ndEdition, Wiley,2014.

| Semester: VI | | |
|---|---|---|
| **Course Name: AI techniques applied to electrical systems (PEC)**<br>**Course Code: 21EEE1656** | | |
| **Teaching Hours/Week (L:T:P:J): (3:0:0:0)** | **CIA Marks: 5 0** | |
| **Credits: 3** | **SEA Marks: 50** | |
| **Hours: 40** | **SEA Duration: 3 Hours** | |
| **Course Learning Objectives:**<br>❖ To understand the fundamentals of Neural Network<br>❖ To understand the fundamentals of Fuzzy Logic<br>❖ To understand the implementation of Artificial Intelligence for distance protection in Transmission systems and maximum power tracking in PV system<br>❖ To understand the application of Artificial Intelligence in Electric Vehicles | | |
| **Pre-Requisites:** | | |
| **Course Outcomes:** After the completion of the course the students will be able to:<br>❖ Understand the fundamentals of Neural Network and Fuzzy Logic<br>❖ Understand the implementation of Artificial Intelligence for distance protection in Transmission systems<br>❖ Understand maximum power tracking in PV system using AI Technique<br>❖ Understand the application of Artificial Intelligence in Electric Vehicles. | | |
| **Module-1: Artificial Neural Network** | **RBT** | **Hrs** |
| Fundamentals of Neural Networks (NN): Basic concepts of NN, Model of an Artificial Neuron, NN Architecture, Characteristics of NN, Learning Methods, History of NN, Architecture of a Back propagation network, Back propagation learning, Back propagation algorithm | **Understand** | **08** |
| **Module-2: Fuzzy Logic** | **RBT** | **Hrs** |
| Fuzzy versus Crisp, Crisp Sets, Fuzzy Sets – Membership Function, Basic Fuzzy Set Operations, Properties of Fuzzy Sets, Crisp Relations, Fuzzy Relations, Laws of Propositional Logic, Inference in Propositional Logic, Inference in Propositional logic, Predicate logic, Fuzzy rule based system, Defuzzification. | **Understand** | **08** |
| **Module-3: Artificial Intelligence Applications in Electrical Transmission systems protection** | **RBT** | **Hrs** |
| Introduction, Basic Concepts of Distance protection, AI Based Fault Diagnosis System- Training data for ANN, Feed forward ANN, Support Vector Machine as an example, Convolution Neural Network as an example of Deep learning | **Apply** | **08** |
| **Module-4: Intelligent Maximum Power Tracking System** | **RBT** | **Hrs** |
| Introduction, PV Model, PV- wind Hybrid system model, MPPT for PV, Perturb & Observe(P & O) method, P&O MPPT Method –Flow chart, Fuzzy Logic Controller implementation of MPPT Control, MPPT for Permanent magnet Synchronous Generator (PMSG) Wind, MPPT control based on Fuzzy Logic, Direct torque control. | **Apply** | **08** |

| Module-5: Artificial Intelligence in Electric Vehicles | RBT | Hrs |
|---|---|---|
| **Brushless Direct Current Motor Drive Using Artificial Intelligence for Optimum Operation of the ElectricVehicle:** Basics of Artificial Intelligence, Advantages of Artificial Intelligence in EV, Brushless DC Motor, Mathematical Representation Brushless DC Motor, Closed-Loop Model of BLDC Motor Drive, PID Controller, Fuzzy Control, Auto-Tuning Type Fuzzy PID Controller, Fuzzy Control, Auto-Tuning Type Fuzzy PID Controller | **Apply** | **08** |

**Reference Books:**


1. "Neural Networks, Fuzzy Logic and Genetic Algorithms - Synthesis and Applications", S. Rajasekaran, G.A. Vijayalakshmi Pai, Eastern Economy Edition, PHI, 2009.
2. "Artificial Intelligence Applications in Electrical Transmission and Distribution Systems Protection", Edited by Almoataz Y.Abdelaziz, Shady Hossam Eldeen Abdel Aleem, Anamika Yadav, Taylor & Francis, CRC Press, 2022.
3. "Artificial Intelligence Techniques in Renewable systems", Springer, Mustapha Hatti

| Semester: VI | | |
|---|---|---|
| **Course: STRATEGIC MANAGEMENT (PEC)**<br>**Course Code: 21EEE1657** | | |
| **Teaching Hours/Week (L:T:P:J): (3:0:0:0)** | **CIA : 50** | |
| **Credits: 03** | **SEA : 50** | |
| **Hours: 40** | **SEA Duration : 03 Hours** | |

**Course Learning Objectives:** The students will be able to

- To provide a framework for students to understand strategic management concepts and conduct external analysis for competitive advantage.
- To help students understand the different strategy options available for organizations in a complex and dynamic environment
- To acquaint students with essential factors in strategy implementation
- To provide basic understanding of how to establish and exert strategic control

**Prerequisites**: Nil

**Course Outcomes:** After completing the course, the students will be able to

- Understand strategic management concepts and how to conduct external analysis for competitive advantage
- Apply selected models of internal analysis to evaluate an organization.
- Understand and analyze the different strategy options available for organizations in a complex and dynamic environment.
- Appreciate the essential factors in strategy implementation
- Understand how to establish and exert strategic control.
- Understand and analyse blue and red ocean strategies crafted and executed by Organizations

| Module-1: Introduction | RBT | Hrs |
|---|---|---|
| **Module-1: Introduction to Strategic Management and External Analysis** Meaning and Characteristics of Strategic Management; The Strategic Management Process. **External Analysis**– PESTLE analysis, Environment Threat and Opportunity Profile (ETOP); Industry Analysis –Porter's Dominant Economic Features, Porter's Five Forces Model, Strategic Group Mapping; Industry Key Success Factors, Key Performance Indicators and Key Result Areas. | Understand | 8 |
| **Module-2: Internal Analysis** | | |
| Strategic Vision, Mission, Goals, Long-Term and Short-Term Objectives and their Value to the Strategic Management Process; Organizational Capability Profile – Resource Based View of the firm (RBV) and VRIN; Business Portfolio Analysis – BCG / Growth Share Matrix, GE 9 Cell Model; Balanced Score Card, SWOC Analysis, Value Chain Analysis, Benchmarking. | Understand | **8** |
| **Module-3: Strategy Formulation** | | |
| **Corporate Strategies:** Growth Strategies – Internal Growth, External Growth (Integration, Diversification, Mergers, Joint Ventures, Strategic Alliances), Product/Market Expansion grid / Ansoff's Matrix; Stability Strategies – No Change, Profit and Proceed with Caution. | Understand | **8** |
| **Module-4: Strategy Implementation** | | |
| Facilitators for implementation of the strategy: Organisational Structures – matching structure to strategy, McKinsey's 7S, Changing structure and processes (Business Process Reengineering, Six Sigma); Strategic Leadership; Organisational Culture – Learning organizations, MBO, TQM. | Understand | **8** |
| **Module-5: Strategic Control** | | |

| | | | |
|---|---|---|---|
| Focus of Strategic Control, Establishing Strategic Controls (Premise Control, Strategic Surveillance, Special Alert Control, Implementation Control), and Exerting Strategic Control (through Competitive Benchmarking, Performance and Formal and Informal Organisations). | Understand | **8** |

| Sl No | Title of the book | Name of the Author/s | Publisher Name | Edition and year |
|---|---|---|---|---|
| 1 | Crafting and Executing Strategy: The Quest for Competitive Advantage – Concepts and Cases | Arthur A. Thompson Jr. Margaret A. Peteraf John E. Gamble A. J. Strickland III Arun K. Jain | McGraw Hill Education | 19th Ed, 2017 |
| 2 | Contemporary Strategy Analysis | Robert M Grant | Wiley | 11th Ed, 2021 |
| 3 | Contemporary Strategic Management | Robert M Grant | Wiley | India 6th Ed, 2011 |
| 4 | Strategic Management: A South Asian Perspective | Michael A. Hitt R. Duane Ireland Robert E. Hoskisson S. Manikutty | Cengage Learning | 9th 2016 |
| 5 | Strategy: Theory & Practice | Stewart Clegg,Chris Carter Marting Kornberger Jochen Schweitzer | Sage Publications | 3rd Ed, 2020 |
| 6 | Strategy Management: Theory & Practice | John Parnell | Biztantra | 2004 |
| 7 | Strategic Management: Planning for Domestic and Global Competition | John A. Pearce | Robinson McGraw Hill Education | 14th Ed, 2015 |

| Semester: VI | |
|---|---|
| **Course Name: PLC & SCADA Systems (POE)**<br>**Course Code: 21EEE1671** | |
| **Teaching Hours/Week (L:T:P:J): (3:0:0:0)** | **CIA Marks: 50** |
| **Credits: 3** | **SEA Marks: 50** |
| **Hours: 40** | **SEA Duration: 03 Hours** |

**Course Learning Objectives: The student should be able to**

- Gain the Knowledge of various skills necessary for Industrial applications of Programmable logic controller (PLC)
- Understand the basic programming concepts and various logical Instructions used in Programmable logic controller (PLC)
- Solve the problems related to I/O module, Data Acquisition System and Communication Networks using Standard Devices.
- Design and analysis of general structure of an automated process for real time applications using Programmable logic controller (PLC) and SCAD

**Pre-Requisites:**

**Course Outcomes:** After the completion of the course the students will be able to:

- Understand the basic knowledge of Programmable Logic Controller domain on various Logical Operation and Various Advanced Logical Instruction, I/O Module, Sensor, Actuator, Communication and Measurement System.
- Understand the basic programming concepts and various logical Instructions used in Programmable logic controller (PLC).
- Compute the extent and nature of electronic circuitry in Programmable logic controller (PLC) and SCADA including monitoring and control circuits for Communication and Interfacing.
- Design and analyze the general structure of an automated process for real time industrial applications

| Module-1: Programmable logic controllers (PLCs): An Overview | RBT | Hrs |
|---|---|---|
| Introduction, Definition and history of the plc, Manufacturing and Assembly processes, PLC advantages and disadvantages, overall PLC system, CPUs and programmer/monitors, PLC input and output modules<br>**PLC a look inside:**<br>PLC as a computer, the central processing unit, solid state memory, the processor, I/O modules(Interfaces), power supplies | **Understand** | **8** |
| **Module-2: PLC Programming procedures and devices** | **RBT** | **Hrs** |
| **General PLC Programming procedures:** Programming Equipment, Programming Formats, Proper construction of PLC Ladder diagrams, Process Scanning considerations, PLC operation faults<br>**PLC Arithmetic functions:** PLC Addition and subtraction, PLC repetitive clock, PLC multiplication, Division and square root, PLC trigonometric and Log functions, Other PLC arithmetic functions | **Understand** | **8** |
| **Module-3: Number systems and conversion functions** | **RBT** | **Hrs** |
| **Timers and Counters:**<br>PLC timer functions, Examples of Timer Functions Industrial Applications, Industrial Process Timing Application, PLC counters, Examples of counter function Industrial Applications<br>**Numbering Systems and conversions:**<br>Introduction, PLC basic comparison functions and its applications, PLC advanced comparison functions**,** Decimal, Binary and BCD, PLC Conversion between decimal and BCD, Octal and Hexadecimal Numbering systems, other numbering and code systems | **Understand** | **8** |

| Module-4: PLC programming and Ladder diagram fundamentals | RBT | Hrs |
|---|---|---|
| PLC input instructions, Output: Coils, Indicators and others, Operational Procedures, Contacts and coils Input / Output programming Examples, A look at fail-safe circuits, Industrial Process Examples<br>**Digital Gate:** Digital Logic gates, Boolean Algebra PLC programming, Conversion Examples<br>**Ladder Diagram:** Introduction, Ladder diagram and sequence listing, Large Process Ladder diagram construction, Flowcharting as a Programming method | **Understand** | **8** |
| **Module-5: SCADA SYSTEMS** | **RBT** | **Hrs** |
| Introduction, definition and history of Supervisory Control and Data Acquisition, typical SCADA System Architecture, Communication Requirements, Desirable properties of SCADA system, Features, advantages, disadvantages and applications of SCADA.<br>SCADA Architecture (First generation- Monolithic, Second Generation-Distributed, Third Generation-Networked Architecture), SCADA systems in operation and control of interconnected power system, Power System Automation, Petroleum Refining Process, Water Purification System, Chemical Plant | **Understand** | **8** |

**Reference Books:**


1. John W Webb, Ronald A Reis,"Programmable Logic Controllers : Principles and Application", PHI Learning, New Delhi, 5 th Edition
2. Ronald L Krutz, "Securing SCADA System", Wiley Publication
3. John R Hackworth, Frederick D Hackworth, "Programmable Logic Controllers ", Pearson Eduction,
4. Gary Dunning,"Introduction to Programmable Logic Controllers", Thomson, 2nd Edition
5. Madhu chhandan Gupts and SamarjitSen Gupta "PLC and Industrial application",pernram international publication. (Indian) Pvt. Ltd., 2011
6. Stuart A Boyer, "SCADA Supervisory Control and Data Acqusition", ISA, 4 th Revised edition.


**Web links and Video Lectures:**

1. https://www.udemy.com/course/scada-from-scratch-to-hero-indusoft-and-tia-portal/
2. https://instrumentationtools.com/
3. https://www.technicalsymposium.com/

| Semester: VI | |
|---|---|
| **Course Name: Fuel Cell Technology (POE)**<br>**Course Code: 21EEE1672** | |
| **Teaching Hours/Week (L:T:P:J): (3:0:0:0)** | **CIA Marks: 5 0** |
| **Credits: 3** | **SEA Marks: 50** |
| **Hours: 4** | **SEA Duration: 3 Hours** |

**Course Learning Objectives:**

- To understand the principle of operation of Fuel cells
- To understand the Fuel Cell modeling
- To understand the control strategy of Hybrid Fuel Cell Power system
- To study different types of Fuel Cells.
- To understand the control strategy and parametric design of Fuel cells
- To understand the Power Electronics Interface of Fuel Cell.
- To understand the various applications of Fuel Cell Technology in the field of Air craft, Space, Military and Ultra High temperature environments.

**Pre-Requisites:**

**Course Outcomes:** After the completion of the course the students will be able to:

- Understand the principle of operation of fuel cells.
- Understand the Fuel cell modeling
- Learn the different types of Fuel cells
- Understand the control strategy, parametric design and power electronics interface of Fuel cells
- Understand the applications of Fuel Cell Technology in the field of Air craft, Space, Military and Ultra High temperature environments.

| **Module-1: Fuel Cells** | **RBT** | **Hrs** |
|---|---|---|
| Operation Principle of Fuel Cells, Electrode Potential and current- voltage curve, Fuel and oxidant consumption, Fuel cell system characteristics, Fuel Cell Technologies, Fuel Supply, Non-Hydrogen Fuel Cells. (R1) (Ch-15) | **Understand** | **08 Hrs** |
| **Module-2: Fuel Cells Energy Storage System** | **RBT** | **Hrs** |
| Introduction to Fuel Cells, Fuel Cell Modeling, Hybrid Fuel Cell Energy Storage systems, Control Strategy of Hybrid Fuel Cell Power system. (R2) | **Understand** | **08 Hrs** |
| **Module-3: Overview of Fuel Cell Types** | **RBT** | **Hrs** |
| Introduction, Phosphoric Acid Fuel Cell, Polymer Electrolyte Membrane Fuel Cell, Alkaline Fuel Cell, Molten Carbonate Fuel Cell, Solid Oxide Fuel Cell, Other Fuel Cells (R3) | **Understand** | **08** |
| **Module-4: Fuel Cell Technology for Hybrid Electric Vehicles** | **RBT** | **Hrs** |
| Configuration, Control Strategy, Parametric Design, Design Example (R1) (Ch-16)<br>Introduction, Power train configuration, Power Component modeling, Fuel cell system, Concept of Fuel Cell Plug-in HEV – Architecture (R4) | **Understand** | **08** |
| **Module-5: Fuel Cell Applications** | **RBT** | **Hrs** |

| | | |
|---|---|---|
| Fuel Cells for Aircraft Applications, Fuel Cells for commercial, Military and Space Applications, Fuel cells capable of operating in Ultra-High Temperature environments and for Electric Power Plant Applications | **Understand** | **08** |

Reference Books:


1. "Modern Electric, Hybrid Electric and Fuel Cell Vehicles", Mehrdad Ehsani, Yimin Gao, Stefana Longo, Kambiz Ebrahimi, Third Edition, CRC Press, Taylor & Francis Group, 2018.
2. "Hybrid Electric Vehicles: Principles and applications with Practical Perspectives", Chris Mi, Abul Masrur David Wenzhong Gao, Wiley Publication,
3. "Fuel Cell Fundamentals", Ryan O'Hayke, Suk-won Cha, Whitney Colella, Fritz B Prinz, 3rd Edition, Wiley.
4. "Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles", Sheldon S. Williamson, Springer, 2013.
5. 'Next-Generation Batteries and Fuel Cells for Commercial, Military and Space Applications", A. R.Jha, CRC Press, 1st Edition, 2012.

# Department of Electrical and Electronics Engineering

| Semester: VI | |
|---|---|
| **Course Name: Industrial Motor control and Automation (POE)**<br>**Course Code: 21EEE1673** | |
| **Teaching Hours/Week (L:T:P:J): (3:0:0:0)** | **CIA Marks: 50** |
| **Credits: 3** | **SEA Marks: 50** |
| **Hours: 40** | **SEA Duration: 03 Hours** |

**Course Learning Objectives: The student should be able to**

- To understand the safety in industrial workplace, grounding and electric symbols
- To analyze the DC and AC motor drive concepts
- To understand and analyze the operation of PLC and industrial automation

**Pre-Requisites: Fundamentals of magnetism, motors and digital logic circuits,**

**Course Outcomes:**

- Discuss the safety in industrial workplace, grounding and electric symbols
- Explain the motor terminal connections, motor working principle and speed control of DC motor drives
- Explain the concept of AC drives, motor selection, installation
- Analyze the operation of PLC and industrial internet of things
- Analyze the industrial automation and Industry 4.0

| **Module-1: Safety in the Industrial Workplace and understanding Electrical Drawings** | **RBT** | **Hrs** |
|---|---|---|
| Protecting against Electrical Shock, Electrical Shock, Arc Flash Hazards, Personal Protective Equipment<br>Grounding—Lockout—Codes, Grounding and Bonding, Lockout and Tagout, Electrical Codes and Standards<br>Symbols—Abbreviations—Ladder Diagrams, Motor Symbols, Abbreviations for Motor Terms, Motor Ladder Diagrams | **Understand** | **8** |
| **Module-2: Motor Terminal connections and DC motor drives** | **RBT** | **Hrs** |
| **Motor Terminal Connections,** Motor Classification, DC Motor Connections, AC Motor Connections<br>**Motor working principle,** Magnetism, Electromagnetism, Generators, Motor Rotation, Direct Current Motors, Permanent-Magnet DC Motor, Series DC Motor, Shunt DC Motor, Compound DC Motor, Direction of Rotation, Speed Regulation, Varying DC Motor Speed, DC Motor Drives | **Understand** | **8** |
| **Module-3: AC motor drives, motor selection and motor installation** | **RBT** | **Hrs** |
| **Alternating Current Motor Drives**: Variable-Frequency Drive, Inverter Duty Motor,<br>**Motor Selection,** Mechanical Power Rating-Current, Code Letter, Design Letter, Efficiency, Energy-Efficient Motors, Frame Size, Frequency, Full-Load Speed, Load Requirements, Motor Temperature Ratings, Duty Cycle, Torque, Motor Enclosures, Metric Motors,<br>**Motor Installation:** Foundation, Mounting, Motor and Load Alignment, Motor Bearings, Electrical Connections, Grounding, Conductor Size, Voltage Levels and Balance, Built-in Thermal Protection | **Understand** | **8** |
| **Module-4: Programmable Logic Controllers and future of PLC** | **RBT** | **Hrs** |
| **Programmable Logic Controllers (PLCs),** PLC Sections and Configurations, Ladder Logic Programming, Programming Timers, Programming Counters.<br>**Future of PLC:** PLC-Based Automation, PLC and Programmable Automation Controller, Unified Human-Machine Interface, Plug and Play Solution, Wireless Link of PLC, Enterprise Resource Planning with PLC, Industrial Internet of Things and PLC | **Understand** | **8** |
| **Module-5: Industrial process automation** | **RBT** | **Hrs** |
| Industrial Process Automation: Definition of Process, Meaning of Automation and Control, Necessity and Evolution of Automation, Role of Automation in Process Industry, Architecture of Industrial Automation Network, Types of Automation Systems, Role of Information Technology in | **Understand** | **8** |

| | | |
|---|---|---|
| Process Automation, Process Automation with Smart and Intelligent Instruments, Challenges of Process Automation, Industry 1.0 to Industry 4.0 | | |

**Reference Books:**


1. Electric Motors and Control Systems, Frank D. Petruzella, McGraw-Hill Education, 2016 **(Module 1, 2, 3 and 4)**
2. Industrial Automation Technologies, Chanchal Dey and Sunit Kumar Sen, 2020 Taylor & Francis Group, LLC CRC Press **(Module 4 and 5)**
3. Programmable Logic Controllers, Khaled Kamel & Eman Kamel, 2014 by McGraw-Hill Education


**Web links and Video Lectures:**

1. https://youtu.be/zsajTNtxfAE
2. https://youtu.be/DfW0qISkvqo
3. https://youtu.be/m5KS0fS1VNc
4. https://youtu.be/bNfZWqDLW0Q
5. https://youtu.be/Fj02iTrWUx0

| Semester: VI | |
|---|---|
| **Course Name: Solar Photovoltaic Systems (POE)**<br>**Course Code: 21EEE1674** | |
| **Teaching Hours/Week (L:T:P:J): (3:0:0:0)** | **CIA Marks: 50** |
| **Credits: 3** | **SEA Marks: 50** |
| **Hours: 40** | **SEA Duration: 3 hours** |

**Course Learning Objectives:**

- To understand the position of Photovoltaics in World Energy Scenario
- To understand the concept, working of solar cells
- To discuss about the series and parallel connection of solar cells into modules and its repercussion onto mismatching
- To discuss about the connection of Photovoltaic system and its applications

**Pre-Requisites: Basic knowledge of Physics, Renewable Energy Sources, Power Electronics.**

**Course Outcomes:** After the completion of the course the students will be able to:

- Discuss about the requirement and production of Photovoltaic in world energy scenario
- Understand the concepts on sun-earth angles, movement and will be able to study the characteristics of solar cells
- Enumerate the connection of solar cells into modules
- Understand the balance of system which includes all the components of a photovoltaic system with the exception of photovoltaic panels
- Discuss difference between stand alone, grid connected PV system and its applications

| Module-1: Place of PV in World Energy Scenario | RBT | Hrs |
|---|---|---|
| World energy requirement, Need for Sustainable Energy Sources, Sustainable Sun's Energy, Current Status of Renewable Energy Sources, Place of Photovoltaics in Energy Supply, World Production of Solar PV modules and cost<br>**R1: PART I: Solar cell fundamentals (1.1 – 1.6)** | **Understand** | **08** |
| **Module-2: Solar Radiation and Solar Cells** | **RBT** | **Hrs** |
| **Solar Radiation**: The Sun and the Earth – extra-terrestrial solar radiation, solar spectrum at the earths surface, The Sun-Earth Movement<br>**An Introduction to Solar Cells**: P-N Junction under illumination: Solar Cell – Generation of Photo voltage, Light generated current, I-V Equation of solar cells, Solar Cell characteristics<br>**Design of Solar Cells**: Upper limits of Cell Parameters – Short Circuit current, Open circuit voltage, Fill Factor, Efficiency<br>**R1: PART III: Solar Photovoltaic applications (12.1, 12.2),PART I: 4. An introduction to solar cells (4.4.1 – 4.4.4), 5. Design of solar cells (5.1).** | **Understand** | **08** |
| **Module-3: Solar Photovoltaic Modules** | **RBT** | **Hrs** |
| Solar PV Modules from Solar Cells – series and parallel connection of cells, mismatch in cell/module, Mismatch in series connection – hot spots in the module, bypass diode, Mismatching in parallel connection, Design and structure of PV Modules – number of solar cells in a module, wattage of modules, fabrication of PV modules, PV Module Power output – I-V equation of PV modules, rating of PV modules, I-V and power curve of module, effect of solar irradiation, effect of temperature<br>**R1: PART III: 13. Solar Photovoltaic modules (13.1 – 13.5)** | **Understand** | **08** |
| **Module-4: Balance of Solar PV Systems** | **RBT** | **Hrs** |
| Batteries for PV System – lead acid batteries, Ni-CD batteries, Comparison of batteries, DC to DC Converters – Buck type, Boost type, Buck-boost type DC-DC Converters, Charge Controllers – commonly used set points, types of charge controllers, DC to AC Converter – single phase, three phase DC to AC Converter. | **Understand** | **08** |

| R1: PART III: 14. Balance of Solar PV systems (14.3, 14.4, 14.5, 14.6) | | |
|---|---|---|
| **Module-5: Photovoltaic System and Applications** | **RBT** | **Hrs** |
| Introduction to Solar PV Systems, Stand-alone PV System Configuration – Type a,b,c,d,e, Wire sizing in PV Systems, Precise sizing of PV Systems, Hybrid PV Systems – Why hybrid systems?, types of Hybrid PV systems, issues with hybrid systems, Grid-Connected PV Systems<br>**R1: PART III: 15. Photovoltaic system design and Applications (15.1, 15.2, 15.4, 15.5, 15.6, 15.7)** | **Understand** | **08** |

**Reference Books:**

1.Chetan Singh Solanki, SOLAR PHOTOVOLTAICS Fundamentals, Technologies and Applications, PHI Learning, Pvt Ltd, Third Edition

2. Dr. Sundaravadivelu S , Solar Photovoltaic Power Systems : Principles Design And Applications, ISBN: 9781642497090

**Web links and Video Lectures:**

- https://archive.nptel.ac.in/courses/115/107/115107116/
- https://archive.nptel.ac.in/courses/117/108/117108141/

# B N M Institute of Technology

## An Autonomous Institution under VTU

## Department of Training & Placement

### Syllabus

**Course Name: Employability Skills-2 [21EEE168]** **Credits: 1 [0:2:0:0]**

**Class: VI Semester** **Year of Study: 2023-24**

**(Tentative) Faculty Name:**

**Course Objectives:** This course will enable students to

- ability to understand fundamentals of trending technologies currently used in the industry.
- understand the importance of professional etiquettes.
- to be prepared for group discussions and various modes of interviews.
- to solve company simulated aptitude and technical question papers related to campus recruitments.

| Module | Topics to be covered | No of Hours |
|---|---|---|
| **Introductory Courses** | Data Science (Data Analytics & Visualization), Cyber Security, Industrial Automation 4.0, & IOT, AWS, & Cloud Computing | **10 Hours** |
| **Personality & Grooming Training** | Dressing & Group Discussion Etiquettes, Interview Skills, Resume Building (should include introduction to Github, Hackerrank, LeetCode, Codechef), Email & Telephone Etiquettes, Social Media Etiquettes, & LinkedIn Profiling. | **6 Hours** |
| **Interview Preparation Training** | **Pre-Preparation Formalities**<br>• Training session on Pre-Preparation formalities of Campus Selection should be conducted Job Profiles analysis must be done.<br>• Understanding the salary breakups & other perks, researching about the Company and the work culture through their websites & other digital platforms like Glassdoor & LinkedIn.<br>• Rewriting resumes keeping the job profiles in view. | |
| | **Group Discussion & Personal Interview**<br>• Pre-Placement Talk, Mock GD & Personal Interview training sessions for each individual student should be conducted by the Industry Experts and they should brief students on the area of improvements, presentation & behavioral skills required during the campus selection process. | |

| | | |
|---|---|---|
| **Assessment Tests** | Company Specific Aptitude and Technical Tests | **6 Hours** |

**Course Outcome: (CO)**

By end of the course the students will be able to:

1. analyze the problem and solve it within the allocated time span.
2. apply the professional etiquettes during the recruitment drives.
3. implement the techniques and skills during the group discussions and various interview skills.

**CO-PO/PSO Mapping:**

| CO No. | Statement | Bloom's Cognitive level | POs |
|---|---|---|---|
| 1 | analyze the problem and solve it within the allocated time span. | **Apply** | PO1, PO2 & PO12 |
| 2 | apply the professional etiquettes during the recruitment drives. | **Analyze** | PO1, PO2 & PO12 |
| 3 | implement the techniques and skills during the group discussions and various interview skills. | **Analyze** | PO1, PO2 & PO12 |