

**B.Tech Electrical & Electronics Engineering (EVT)****Semester-III**

L-2, T-1, P-2, C-4

**BSEEE0600A: Introduction to Engineering Mathematics with Applications–III****Course Objective:**

- To understand basic knowledge of Laplace transform and Fourier transform with its applications for solving differential equations in their respective field.
- To understand the convergence of series and expansion of function using Fourier series for learning advanced Engineering Mathematics.
- To evaluate differentiation of functions of complex variables that is used in various techniques dealing with engineering problems.
- To apply the tools of integration of functions of complex variables that is used in various techniques dealing with engineering problems.

**Course Outcomes (COs)**

1. Understand the basic concept of Fourier series and Fourier transform.
2. Apply the concept of Laplace Transform to solve differential equations which are used in various engineering models.
3. Analyze the concepts of analyticity, Harmonicity of functions and conformal transformation.
4. Evaluate sequence and series of functions, Ratio test and Root test for finding the convergence of the series for various engineering models.
5. Evaluate the convergence of Legendre and polynomial and use this polynomial in solving second order differential equations which are used in many practical applications.

**Articulation Matrix**

(Program Articulation Matrix is formed by the strength of correlation of COs with POs and PSOs. The strength of correlation is indicated as 3 for substantial (high), 2 for moderate (medium) correlation, and 1 for slight (low) correlation)

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	1	1	-		1	-	-	2	2	1
CO2	3	2	1	1	2	1	1	-	-	1	1	-	2	2	1
CO3	2	3	2	2	1	1	1	-	-	-	1	1	2	-	-
CO4	1	3	2	2	1	1	-	-	-	1	1	1	2	-	-
CO5	1	3	2	2	2	1	1	-	-	1	1	1	2	2	1

High-3 Medium-2 Low-1

**Unit I: Fourier series and Fourier Transform****09 Hours**

Introduction of Fourier series, Fourier series for Discontinuous functions, Euler's formula, Dirichlet's conditions, Fourier series for even and odd function, Half range series, Parseval's formula, Complex form of Fourier series. Introduction of Fourier Transform, Properties of Fourier Transform, Sine and Cosine Transform, Convolution and Parseval's formula for Fourier Transform.

**Unit II: Laplace Transform****09 Hours**

Introduction of Laplace Transform, Laplace Transform of elementary functions, properties of Laplace Transform, Change of scale property, Second shifting property, Laplace Transform of the derivative, Inverse Laplace Transform & its properties, Convolution Theorem, Applications of L.T. to solve the ordinary differential equations.

**Unit III: Complex Variables****09 Hours**

Limit, continuity, differentiability and analyticity of functions, Cauchy- Riemann equations, line integrals in complex plane, Cauchy's integral theorem, independence of path, existence of indefinite integral, Cauchy's integral formula, derivatives of analytic functions, Taylor's series, Laurent's series, Zeros and singularities, Residue theorem, evaluation of real integrals.

**Unit IV: Sequence and Series****09 Hours**

Sequences and Series: Sequences and their limits, convergence of series, comparison test, Ratio test, Root test, Absolute and conditional convergence, alternating series, Power series.

**Unit V: Solution in Series****09 Hours**

Solution in series of second order linear differential equations, Bessel's and Legendre's equations and their solutions, Properties of Bessel function and Legendre's Polynomials.

**Total: 45 Hours****PRACTICALS**

1. Write a program to perform basic arithmetic operations in MATLAB.
2. Write a program to determine transpose, determinant and inverse of matrix.
3. Write a program to perform basic arithmetic operations of matrix in MATLAB.
4. Write a program to perform basic exponential, logarithmic functions in MATLAB.
5. Write a program to perform basic trigonometric functions in MATLAB.
6. Write a program to create array and perform its various operations in MATLAB.
7. Write a program to plot sin wave in MATLAB.
8. Write a program to determine the Laplace transform of given function.
9. Write a program to determine the inverse Laplace transform of given function.
10. Write a program to plot functions in MATLAB.

**Total: 75 Hours****Reference Books:**

1. Grewal, B. S., & Grewal, J. S. (1996). *Higher engineering mathematics. 2002*, Khanna Publishers, New Delhi. Dass.
2. Dass, H. K. (2019). *Advanced Engineering Mathematics, 22e*. S. Chand Publishing.
3. Brown, J. W., & Churchill, R. V. (2009). *Complex variables and applications*. McGraw-Hill.
4. Matthews, P. C. (2012). *Vector calculus*. Springer Science & Business Media.

**List of e-Learning Resources:**

1. <https://nptel.ac.in/>
2. <https://www.coursera.org/>
3. [https://www.youtube.com/results?search\\_query=Complex+variable+nptel](https://www.youtube.com/results?search_query=Complex+variable+nptel)

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**B.Tech - Electrical & Electronics Engineering (EVT)  
Semester-II**

L-2, T-1, P-0, C-3

**HSEEE0300A – Universal Human Values**

**Course Objectives:**

- To help students distinguish between values and skills, and understand the need, basic guidelines, content and process of value education.
- To help students initiate a process of dialog within themselves to know what they ‘really want to be’ in their life and profession.
- To help students understand the meaning of happiness and prosperity for a human being.
- To facilitate the students to understand harmony at all the levels of human living, and live accordingly.
- To facilitate the students in applying the understanding of harmony in existence in their profession and lead an ethical life.

**Course Outcomes (COs):**

1. Understand the importance of value education in personal and professional life.
2. Understand the role of harmony among oneself.
3. Apply the sense of responsibility and belongingness among society.
4. Apply the ethical code of conduct in society.
5. Apply the ethical code of conduct in professional life.

**Articulation Matrix**

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CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

High-3 Medium-2 Low-1

**Unit 1: Introduction to Value Education**

**09 Hours**

- Value Education- Definition, Concept and Need.
- The Content and Process of Value Education.
- Basic Guidelines for Value Education.
- Self exploration as a means of Value Education.
- Happiness and Prosperity as parts of Value Education

**Unit 2: Harmony in the Human Being**

**09 Hours**

- Human Being is more than just the Body.
- Harmony of the Self (‘I’) with the Body.
- Understanding Myself as Co-existence of the Self and the Body.
- Understanding Needs of the Self and the needs of the Body.
- Understanding the activities in the Self and the activities in the Body.

**Unit 3: Harmony in the Family and Society and Harmony in the Nature**

**09 Hours**

- Family as a basic unit of Human Interaction and Values in Relationships.

- The Basics for Respect and today's Crisis: Affection, Guidance, Reverence, Glory, Gratitude and Love. 4. Comprehensive Human Goal: The Five Dimensions of Human Endeavour.
- Harmony in Nature: The Four Orders in Nature.
- The Holistic Perception of Harmony in Existence.

**Unit 4: Social Ethics**

**09 Hours**

- The Basics for Ethical Human Conduct.
- Defects in Ethical Human Conduct.
- Holistic Alternative and Universal Order.
- Universal Human Order and Ethical Conduct.
- Human Rights violation and Social Disparities.

**Unit 5: Professional Ethics**

**09 Hours**

- Value based Life and Profession.
- Professional Ethics and Right Understanding.
- Competence in Professional Ethics.
- Issues in Professional Ethics – The Current Scenario.
- Vision for Holistic Technologies, Production System and Management Models.

**References:**

1. A.N Tripathy, New Age International Publishers, 2003.
2. Bajpai. B. L ,New Royal Book Co, Lucknow, Reprinted, 2004
3. Bertrand Russell Human Society in Ethics & Politics
4. Gaur. R.R. , Sangal. R, Bagaria. G.P, A Foundation Course in Value Education, Excel Books, 2009.
5. Gaur. R.R. , Sangal. R , Bagaria. G.P, Teachers Manual Excel Books, 2009.
6. I.C. Sharma . Ethical Philosophy of India Nagin & co Julundhar
7. Mortimer. J. Adler, – Whatman has made of man
8. William Lilly Introduction to Ethic Allied Publisher

**List of e-Learning Resources:**

1. <https://www.ugc.gov.in/e-book/HUMAN%20VALUE%20English.pdf>
2. <https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHVE%202.0%20Class%20Notes%20Part%204%20of%204.pdf>

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## B.Tech. Electrical and Electronics Engineering (EVT) Semester-III

L-2, T-1, P-2, C-4

### PCEEE0100A: Electrical Machine-I

#### Course Objectives

- To define basics of transformer, tests performed on transformers and fundamental concepts of transformer.
- To understand the various applications of transformers.
- To define basics of three phase induction motor, tests performed and fundamental concepts of transformer.
- To develop the concepts about many effects on the performance of three phase induction motor.
- To define basics fundamental of single phase induction motor.

#### Course Outcomes (COs)

1. Understand the circuit, phasor diagrams, performing of tests for losses and efficiency of transformer.
2. Apply the winding connections and suitable three phase transformers for particular applications.
3. Analyze the speed characteristics with torque and power, performing of tests for losses and efficiency of three phase induction motor.
4. Analyze the methods of starting of induction motors with high starting torque and small armature resistance and speed control of the same.
5. Analyze the starting and working of different types of single phase induction motors.

#### Articulation Matrix

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	1	-	-	-	-	-	2	1	1
CO2	3	2	1	-	-	1	-	-	-	-	-	-	1	-	1
CO3	2	3	1	-	-	1	1	-	-	-	-	-	1	1	-
CO4	2	3	2	-	1	1	-	-	-	-	-	-	1	1	-
CO5	3	2	1	-	-	1	-	-	-	-	-	-	1	-	1

High-3 Medium-2 Low-1

#### UNIT I: Transformer-I

**9 Hours**

Working principle, e.m.f. equation, construction, phasor diagrams, equivalent circuit, voltage regulation, losses, separation of hysteresis and eddy current losses, efficiency, tests: open circuit and short circuit, condition for maximum efficiency, power and distribution transformer, all-day efficiency, auto transformer: working, advantages, its equivalent circuit, oil less (dry type) transformers, methods of oil filling

#### UNIT II: Transformer-II

**9 Hours**

Three phase transformer: Different types of winding connections; Scott connection; parallel operation of three phase transformers: application, advantages, requirement and load sharing; tap changers, Effect of operating temperature, cooling, conservator and breather, Energy efficiency and star ratings of transformers

#### UNIT III: Three Phase Induction Motor- I

**9 Hours**

Working principle, construction, comparison of slip ring and squirrel cage motors, concept of slip, steady state analysis, phasor diagram and equivalent circuit, power flow diagram, torque speed and power-speed characteristics, losses and efficiency, no load and block rotor test

**UNIT IV: Three Phase Induction Motor- II****9 Hours**

Starting methods of induction motors, Cogging & Crawling, double cage & deep bar induction motor, impact of unbalanced supply and harmonics on performance, speed control, braking, and induction generator, Applications

**UNIT V: Single Phase Motors****9 Hours**

Single phase induction motor; double revolving field theory, equivalent circuit and its determination, performance calculation, starting methods and types of single phase induction motors: their working principle and applications, comparison with three phases induction motor.

**Total 45 Hours****PRACTICAL**

1. To Study Constructional Features of Single Phase Transformer.
2. To perform Open Circuit test on single phase transformer.
3. To perform Short Circuit test on single phase transformer.
4. To Perform Polarity Test on Two Single Phase Identical Transformers.
5. To Perform Parallel Operation on Two Single Phase Identical Transformers.
6. To Study Constructional Features of Induction Motor.
7. To Perform Starting of Single Phase Induction Motor.
8. To perform no-load test on single phase induction motor.
9. To Perform Starting of Three Phase Induction Motor by Star-Delta Starter.
10. To perform blocked rotor test on single phase induction motor.

**Total: 75 Hours****Reference(s)**

1. M. G. Say, 'Alternating Current Machines', (5th Ed.) ELBS, 1986.
2. V. Del Toro, "Electrical Machines & Power Systems", 1985, Prentice-Hall, Inc., Englewood Cliffs.
3. Cliffs.
4. V. Del Toro, "Electromechanical Devices for Energy Conversion & Control Systems", PHIPvt. Ltd., 1975.
5. Electrical Machines by Dr.P.S.Bimbhra (Khanna).
6. Electrical Machines by Ashfaq Hussain. (Dhanpat Rai).
7. Electrical Machines by Nagrath and Kothari (TMH).
8. A.C. Machines by Langsdorf (McGraw-Hill)

**List of e-Learning Resources:**

1. <https://nptel.ac.in/>
2. <https://www.coursera.org/>

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**B.Tech. Electrical and Electronics Engineering (EVT)**  
**Semester-III**

L-2 T-1 P-2 C-4

**PCEEE0200A: Electronics Devices & Circuits**

**Course Objectives:**

- To identify different diodes on their construction, characteristics and applications.
- To prepare different types of rectifier and filter circuits.
- To learn different configurations of Bipolar Junction Transistor circuits.
- To explain the constructional and characteristic difference of different types of FET's.
- To identify different types of FET biasing circuit.
- To learn various types of oscillator circuits.

**Course Outcomes:**

1. Understand and Apply the concept of semiconductor physics.
2. Apply the concepts of basic diodes to design various circuits.
3. Understand operation of Transistors (BJT&FET) in order to design basic circuits.
4. Analyze the concept of biasing and stability
5. Analyze Optoelectronic devices and their circuits

**Articulation Matrix**

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CO/PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	1	1	1	-	-	-	2	-	-	1	2	2	2
CO2	3	2	2	2	3	1	-	-	2	-	1	1	2	1	1
CO3	2	2	1	2	2	-	-	-	1	1	1	2	2	2	2
CO4	3	3	2	2	1	-	-	-	1	-	2	1	2	1	1
CO5	3	2	3	1	3	1	2	-	2	-	1	1	1	1	1

High-3 Medium-2 Low-1

**Unit I Semiconductors**

**12 Hour**

Energy Bands in Solids (Metal, Semiconductor and Insulators), Intrinsic and Extrinsic Semiconductors: N-Type and P-Type, Mobility of Charge Carriers, Recombination, Life Time, Drift Current, Diffusion Current, Fermi Levels. Semiconductor Diodes: PN Diodes, Forward and Reverse Biasing, I-V Characteristics, Zener Diode, Varactor Diode, Schottky Diode, Tunnel Diode. Testing of Semiconductor Diodes using multimeter.

**Unit II Semiconductor Diode & Applications**

**8 Hour**

Diffusion and Transition Capacitance, PIV Rating of a Diode, Rectifiers, Ripple and Efficiency of Half Wave & Full Wave Rectifiers, Filter Circuits, Clipping and Clamping Circuits, Zener Diode as a Voltage Regulator.

**Unit III Bipolar Junction Transistors (BJT)**

**12 Hour**

PNP and NPN Transistors, Symbols, Transistor Action, CB and CE Configurations: Input and Output Characteristics, Current Gains and their Relationship, Comparison of CB, CE and CC Configurations. Transistor as a Switch, Transistor as an Amplifier, Testing of Transistor.

**Field Effect Transistors (FET):** JFET: Construction and Working, Channel Formation, Pinch-off Voltage, Transfer Characteristics, MOSFET: Construction and Working, I-V Characteristics, Enhancement and Depletion Modes, UJT.

#### **Unit IV Transistor Biasing and Stabilizing**

**7 Hour**

Transistor Biasing: Need for Biasing, DC Load Line and Operating Point, Thermal Instability, Stability Factor, Fixed Bias, Collector to Base Bias, Emitter Bias, Voltage Divider Bias.

#### **Unit V Optoelectronic Devices**

**6 Hour**

PN Photo Diode and Its Applications, Photoconductive Cells, PIN Photodiodes, Photovoltaic Effect, Solar Cells, LED, Alpha-Numeric Display, LCD.

**Total 45 Hours**

#### **Practical List:**

1. To draw V-I characteristics of PN Junction Diode
2. To draw V-I characteristics of Zener Diode.
3. To obtain load regulation and efficiency of Half-wave Rectifier
4. To obtain load regulation and efficiency of Full-Wave Rectifier
5. To Study the input-output Characteristics of BJT in CB Mode.
6. To Study the input-output Characteristics of BJT in CE Mode.
7. To Study drain/ Transfer characteristics FET Characteristics.
8. To Study UJT Characteristics.
9. To obtain frequency response of EC circuit using Low pass filter
10. To obtain frequency response of EC circuit using High pass filter

**Total: 75 Hours**

#### **Reference Books:**

1. Electronics Devices & Circuits by A. Salivahanan & A Vallavaraj
2. Electronics Principles by Malvino
3. Integrated Electronics by Millian & Halikyas

#### **List of e-Learning Resources:**

1. <https://nptel.ac.in/courses/117103063/>
2. <https://www.slideshare.net/rawatsap/edcelectronics-devices-and-circuits>
3. [https://mrcet.com/downloads/digital\\_notes/EEE/EDC%20Lecture%20Notes.pdf](https://mrcet.com/downloads/digital_notes/EEE/EDC%20Lecture%20Notes.pdf)
4. <http://edcforu.blogspot.com/p/notes.html>

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**B.Tech - Electrical & Electronics Engineering (EVT)**  
**Semester-III**

L-2 T-1 P-2 C-4

**PCEEE0300A: Network Analysis**

**Course Objectives**

- To define basics of the circuit's elements, electrical sources and laws of network
- To understand the different theorems to solve the circuits
- To define the basics of the circuits under different initial conditions
- To develop the concepts about Laplace Transform
- To define fundamental of two port network

**Course Outcomes (COs)**

1. Understand the concepts of circuit abstraction and analysis of the circuit
2. Understand the different types of theorems used to solve the networks
3. Apply the time domain response of series RL, RC and RLC Circuits
4. Analyze the working of Laplace Transform for solving network problems
5. Evaluate the working of two-port network

**Articulation Matrix**

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CO/PO/ PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	1	-	-	-	-	-	-	-	-	1	-	-	2
CO2	2	3	2	-	-	-	-	-	-	-	-	1	-	-	2
CO3	2	1	3	-	-	-	-	-	-	-	-	1	1	-	1
CO4	1	3	2	1	-	-	-	-	-	-	-	1	1	1	1
CO5	1	2	3	1	1	-	-	-	-	-	-	1	2	1	1

High-3 Medium-2 Low-1

**Unit I Basic Circuits Analysis****09 Hours**

Introduction to circuit elements and their characteristics. Electrical Sources and their conversion. Ohm's Law, Kirchhoff's Laws for DC and AC Circuits. Resistors in Series and Parallel. Nodal and Mesh Analysis of Circuits Containing Resistors, Inductor, Capacitor and Independent & Dependent Sources. Steady State Analysis. Concept of Phasor & Vector, Impedance & Admittance, Network Topology, Concept of Network Graph, Tree, Tree Branch & Link, Incidence Matrix, Cut Set and Tie Set Matrices..

**Unit II Network Theorems****09****Hours**

Thevenin's, Norton's, Superposition, Reciprocity, Compensation, Substitution, Maximum Power Transfer, Millman's and Tellegen's Theorem, Problems with Dependent & Independent Sources. Duality Theorem and Duality between Electricity and Magnetism.

**Unit III Time Domain Response of series RL, RC and RLC Circuits****09 Hours**

DC Response of First Order Circuits. Discharging of a Capacitor through an Inductor. Initial Conditions in Elements, Procedure for Evaluating Initial Conditions, Solution of Circuit Equations by Using Initial Conditions.

**Unit IV Laplace Transform Analysis: Circuit and Transfer Function Applications 09****Hours**

Notions of Impedance and Admittance. Notions of Transfer Function. Nodal and Loop Analysis in the S-Domain. Introduction to transfer function: Poles, Zeros in S-Plane.

**Unit V Network Function & Two Port Networks****09****Hours**

:-Concept of Complex Frequency, Network & Transfer Functions for One Port & Two Ports, Poles and Zeros, Necessary Condition for Driving Point & Transfer Function. Two Port Parameters –Z, Y, ABCD and Hybrid Parameters. Relationship Between Parameters, Interconnection of Two Ports Networks, Terminated Two Port Networks.

**Total 45 Hours****PRACTICALS:-**

1. To study and verify Kirchoff's current law.
2. To study and verify Kirchoff's voltage law.
3. To study and verify Thevenin's theorem.
4. To study and verify Norton's theorem.
5. To study and verify maximum power transfer theorem.
6. To verify Millman's Theorem.
7. To verify Reciprocity Theorem.
8. To determine Open Circuit and Short Circuit Parameters of a Two Port Network.
9. To determine A, B, C, D Parameters of a Two Port Network.
10. To determine H parameters of a Two Port Network.

**Total: 75 Hours****Reference(s)**

1. M.E. Van Valkenburg, Network Analysis, Pearson
2. William H Hayt & Jack E. Kemmerly, Steven M Durbin; Engineering Circuit Analysis; McGraw-Hill
3. Richard C Dorf, James A Svoboda, Introduction to Electric Circuits, Wiley India, 2015
4. Charles K. Alexander & Matthew N.O. Sadiku: Electrical Circuits; McGrawHill
5. J David Irwin, Robert M Nelms, Engineering Circuit Analysis, Wiley India, 2015

**List of e-Learning Resources:**

3. <https://nptel.ac.in/>
4. <https://www.coursera.org/>

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## B.Tech Electrical & Electronics Engineering Semester-III

L-2, T-1, P-2, C-4

### PEEEE0101A: Utilization of Electrical Energy

#### Course Objectives:

- To know terms related to illumination, Law's of illumination and about various gaseous discharge lamps.
- To understand heating, welding methodologies and the process of electrolysis.
- To differentiate braking methods and understand the mechanics of train movement.
- To know the various components of electric vehicle.

#### Course Outcomes:

1. Understand the terms related to illumination and explain various types of gas discharge lamps.
2. Understand the concept of electrical heating and welding.
3. Understand the operating principles and characteristics of traction motors with respect to speed, temperature, loading condition
4. Apply various electrical drives and domestic appliances.
5. Analysis the function of each component of electric vehicle.

#### Articulation Matrix

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CO2	3	2	1	1	-	-	-	-	-	-	-	-	2	2	1
CO3	3	2	2	2	2	2	-	-	-	-	-	-	1	2	-
CO4	2	1	1	1	-	1	-	-	-	-	-	-	2	1	1
CO5	2	1	2	1	1	-	-	-	-	-	-	-	1	2	1

High-3 Medium-2 Low-1

#### Unit-I Illumination

**9 Hours**

Nature of Light, Sensitivity of the Eye, Definition of terms related to illumination, Production of Light, Law's of illumination, lighting calculations, - Polar curves of different types of sources, Incandescent lamp, Gaseous discharge lamp (Sodium Vapour, Mercury vapour, Fluorescent lamp), Methods of lighting control, Types of lighting scheme, Street lighting, Flood lighting.

#### Unit-II Heating, Welding & Electrolysis

**9 Hours**

Salient features of electric heating, Classification of heating methods, resistance heating, induction heating (Core & Coreless), High frequency eddy current heating, Dielectric heating Arc Furnaces - Construction and fields of application - control equipment, methods of electrical welding, resistance and arc welding, control devices and welding equipment. Laws of Electrolysis, Electroplating, Anodizing-Electro-Cleaning, Power Supply for Electrolytic Process,

#### Unit-III Electric Traction

**9 Hours**

System of electric traction and track electrification. Review of existing electric traction systems in India. Special features of traction motor, methods of electric braking- plugging, rheostatic braking and regenerative braking. Mechanics of train movement. Speed-time curves for different services –

trapezoidal and quadrilateral speed time curves, Tractive effort, Specific energy consumption, recent trend in electric traction

## Unit-IV Electric Drives

9 Hours

Basic concept of electric drives, choice of electric drives, fundamental torque equation, speed torque convention and multi quadrant operation, equivalent values of drive parameters, concept of load torque, types of industrial loads, continuous, Intermittent and variable loads, Review of torque-speed characteristics of AC and DC motors.

## Unit-V Introduction to Electric Vehicles

9 Hours

Configuration and Performance of Electrical Vehicles, Traction Motor Characteristics, Tractive Effort, Transmission Requirement, Vehicle Performance and Energy Consumption.

**Total 45 Hours**

## PRACTICALS

1. Identify the different lighting accessories required for various types of lamps.
2. Identify the different lighting accessories required for various types of lamp fittings.
3. Measure illumination at different places in college using luxmeter.
4. Identify the different components required for various types of heating furnaces.
5. Observe construction and working of various heating furnaces by watching video programmes.
6. Identify the different accessories and safety devices required for various types of welding system.
7. Prepare a report of specification of various electrical welding machines available in college workshop.
8. Visit a small manufacturing unit to observe various electrical drives and prepare a technical report.
9. Prepare a comparative chart of two different manufacturing companies in India for any two Lift/Elevator with technical data.
10. Visit a railway loco shed to observe various components and working of electric locomotive and prepare a technical report.
11. Prepare a report /chart on various types of traction systems.
12. Prepare a report/chart on speed time curves.
13. Improve the power factor of available inductive load using static capacitor.
14. Prepare a report based on comparative study of various tariff structure of Madhya Pradesh.
15. Prepare Energy Bill based on energy consumption of residence/ Institute.

**Total 75 Hours**

## References

1. Open Shaw, Taylor, Utilization of Electrical Energy., Orient Longmans, 1962.
2. H. Pratap, Art and Science of Utilization of Electrical Energy
3. Gupta, J.B., Utilization of Elect. Energy, Katariya and sons, New Delhi
4. Garg, G.C., Utilization of Elect. Power and Elect. Traction
5. NV Suryanarayan, Utilization of Elect. Power Including Electric Drives and Elect. Traction, New Age International
6. Hancock NN, Electric Power Utilisation, Wheeler Pub.
7. Mehrdad, Ehsani, Yimin Gao, Sebastien.E. Gay, Ali Emadi, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles", CRC Press.
8. Gopal K. Dubey, Fundamentals of Electrical Drives, Alpha Science International Limited, 2001
9. Generation, Distribution and Utilization of electrical Energy – by C.L. Wadhwa, New Age International (P) Limited, Publishers, 1997.
10. S. C. Tripathy, Electric Energy Utilisation and Conservation, Tata McGraw Hill, 1991.

## List of e-Learning Resources:

1. Illumination engineering and electric utility services.
2. URL: <http://nptel.ac.in/courses/108105060/>

3. Centre for Railways Research at IIT Kharagpur.
4. [Nptel.ac.in/courses/108105058/](http://Nptel.ac.in/courses/108105058/)
5. [Nptel.ac.in/courses/108105060/](http://Nptel.ac.in/courses/108105060/)

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**Subject Expert**

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**Academic Coordinator**

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**HoD**

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## B.Tech Electrical & Electronics Engineering (EVT) Semester-III

L-2, T-1, P-2, C-4

### PEEEE0102A: Smart Grid

#### Course Objectives:

- To enable the students, acquire knowledge on smart grid
- To understand the architectural design and communication technology for various aspects of smart grid
- To analysis and stability analysis in smart grid renewable energy sources and storage integration with smart grid.

#### Course Outcomes:

1. Understand the concepts and design of Smart grid.
2. Understand the various communication and measurement technologies in smart grid.
3. Apply the stability of smart grid.
4. Analysis the renewable energy resources and storages integrated with smart grid.
5. Evaluate the high-performance computing for Smart Grid applications

#### Articulation Matrix

(Program Articulation Matrix is formed by the strength of correlation of COs with POs and PSOs. The strength of correlation is indicated as 3 for substantial (high), 2 for moderate (medium) correlation, and 1 for slight (low) correlation)

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	2	1	-	1	-	-	-	-	-	-	1	2	-
CO2	3	2	1	1	-	-	-	-	-	-	-	-	2	2	1
CO3	3	2	2	2	2	2	-	-	-	-	-	-	1	2	-
CO4	2	1	1	1	-	1	-	-	-	-	-	-	2	1	1
CO5	2	1	2	1	1	-	-	-	-	-	-	-	1	2	1

High-3 Medium-2 Low-1

#### UNIT-I INTRODUCTION TO SMART GRID

**9 Hours**

Evolution of Electric Grid, Concept, Definitions and Need for Smart Grid, Smart grid drivers, functions, opportunities, challenges and benefits, Difference between conventional & Smart Grid, Concept of Resilient & Self-Healing Grid, Present development & International policies in Smart Grid, Divers perspectives from experts and global Smart Grid initiatives.

#### UNIT-II SMART GRID TECHNOLOGIES

**9 Hours**

Technology Drivers, Smart energy resources, Smart substations, Substation Automation, Feeder Automation, Transmission systems: EMS, FACTS and HVDC, Wide area monitoring, Protection and control, Distribution systems: DMS, Volt/VAR control, Fault Detection, Isolation and service restoration, Outage management, High Efficiency Distribution Transformers, Phase Shifting Transformers, Plugin Hybrid Electric Vehicles(PHEV).

#### UNIT-III SMART METERS

**9 Hours**

Introduction to Smart Meters, Advanced Metering infrastructure (AMI) drivers and benefits, AMI protocols, standards and initiatives, AMI needs in the smart grid, Phasor Measurement Unit (PMU), Intelligent Electronic Devices (IED) & their application for monitoring & protection.

#### UNIT-IV POWER QUALITY MANAGEMENT IN SMART GRID

**9 Hours**

Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit.

#### UNIT-V HIGH PERFORMANCE COMPUTING

**9 Hours**

Local Area Network (LAN), House Area Network (HAN), Wide Area Network (WAN), Broadband over Power line (BPL), IP based Protocols, Basics of Web Service and CLOUD Computing to make Smart Grids smarter, Cyber Security for Smart Grid.

**Total 45 Hours**

## **Practical List:**

1. Study and testing of following relays i. Overcurrent relay ii. Over voltage relay iii. Under Voltage relay
2. Relay coordination in smart grid protection scheme for Radial Circuit Topology
3. Relay coordination in smart grid protection scheme for Bidirectional Circuit Topology
4. Study and testing of islanding protection in microgrids
5. Protection of active distribution network
6. Programmable Relay design and operation of relay with PMU data extracted from PDC in HIL PMU environment
7. Protection of distributed generation sources (wind and solar power generators)
8. Testing of Fault Ride Through (FRT) capability of wind energy source
9. Testing of Fault Ride Through (FRT) capability of solar energy source
10. Islanding detection in an active distribution system
11. Optimal PMU placements for proper monitoring of power system
12. DC state estimation
13. Hybrid state estimation
14. Design of virtual PMU in MATLAB
15. Data capturing from PMU using HIL- PMU setup using C-37 protocol
16. PMU data-based power system health monitoring
17. Programmable Relay design and operation of relay with PMU data extracted from PDC in HIL PMU environment
18. Wide area control of Two area Kundur system
19. Real time wide area control of two area system
20. Attack Detection using DC state estimation

**Total 75 Hours**

## **References**

1. Vehbi C. Gungör, Dilan Sahin, Taskin Kocak, Salih Ergüt, Concettina Buccella, Carlo Cecati, and Gerhard P. Hancke, Smart Grid Technologies Communication Technologies and Standards IEEE Transactions On Industrial Informatics, Vol.7, No. 4, November 2011.
2. Xi Fang, Satyajayant Misra, Guoliang Xue, and Dejun Yang “Smart Grid– The New and Improved Power Grid: A Survey”, IEEE Transaction on Smart Grids, 2011.
3. Stuart Borlase “Smart Grid: Infrastructure, Technology and Solutions”, CRC Press 2012.

## **List of e-Learning Resources:**

1. [https://www.youtube.com/watch?v=JwRTpWZReJk&list=PLzcxA4YJjE1s6NOlhCA34vrsFCeokjs9\\_](https://www.youtube.com/watch?v=JwRTpWZReJk&list=PLzcxA4YJjE1s6NOlhCA34vrsFCeokjs9_)
2. <https://iit.edu/news/iittoday/?tag=smart-grid>

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**B. Tech - Electrical & Electronics Engineering (EVT)****Semester-III****PEEEE0103A Electric & Hybrid Vehicles**

L-2 T-1 P-2 C-4

**Course Objectives**

- To Learn about basics of electric vehicles.
- To Understand the concepts of the motors & drives for electric vehicles.
- To Define and understand electronics and sensors in electric vehicles.
- To Analysis of the various constructional features of hybrid vehicles.
- To Examine the working of various fuel cell for electric vehicles.

**Course Outcomes (COs)**

1. Understand the fundamental concepts of electrical vehicles.
2. Understand the need of motors in electric vehicles.
3. Analyze of sensors in electric vehicle.
4. Evaluate and analyze different types of hybrid vehicles.
5. Design and examine the various fuel cells.

**Articulation Matrix**

(Program Articulation Matrix is formed by the strength of correlation of COs with POs and PSOs. The strength of correlation is indicated as 3 for substantial (high), 2 for moderate (medium) correlation, and 1 for slight (low) correlation)

CO/PO/PSO	PO1	PO2	PO3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	-	-	-	-	-	-	-	-	1	-	-	-
CO2	1	3	2	-	-	-	-	-	-	-	-	-	1	-	-
CO3	1	2	3	-	-	-	-	-	-	-	-	1	-	-	-
CO4	1	2	2	2	-	-	-	-	-	-	-	-	-	1	-
CO5	1	1	2	1	1	-	-	-	-	-	-	-	-	-	-

High-3 Medium-2 Low-1

**Unit-I****09 Hours**

**Introduction to Electric Vehicles:-** Electric Vehicle – Need - Types – Cost and Emissions – End of life. Electric Vehicle Technology – layouts, cables, components, Controls. Batteries – overview and its types. Battery plug-in and life. Ultra-capacitor, Charging – Methods and Standards. Alternate charging sources – Wireless & Solar.

**Unit-II****09 Hours**

**Electric Vehicle Motors:-** Motors (DC, Induction, BLDC) – Types, Principle, Construction, Control. Electric Drive Trains (EDT) – Series HEDT (Electrical Coupling) – Power Rating Design, Peak Power Source (PPS); Parallel HEDT (Mechanical Coupling) – Torque Coupling and Speed Coupling. Switched Reluctance Motors (SRM) Drives – Basic structure, Drive Convertor, Design.

**Unit-III****09 Hours**

**Electronics and Sensor-less control in EV:-** Basic Electronics Devices – Diodes, Thyristors, BJTs, MOSFETs, IGBTs, Convertors, Inverters. Safety – Risks and Guidance, Precautions, High Voltage safety, Hazard management. Sensors - Autonomous EV cars, Self-drive Cars, Hacking; Sensor less – Control methods- Phase Flux Linkage-Based Method, Phase Inductance- Based, Modulated Signal Injection, Mutually Induced Voltage-Based, Observer-Based.

**Unit-IV****09 Hours**

**Hybrid Vehicles :-** Hybrid Electric vehicles – Classification – Micro, Mild, Full, Plug-in, EV. Layout and Architecture – Series, Parallel and Series-Parallel Hybrid, Propulsion systems and components. Regenerative Braking, Economy, Vibration and Noise reduction. Hybrid Electric Vehicles System – Analysis and its Types, Controls. UNIT

## Unit-V

**09 Hours**

**Fuel Cells for Electric vehicles:-** Fuel cell – Introduction, Technologies & Types, Obstacles. Operation principles, Potential and I-V curve, Fuel and Oxidation Consumption, Fuel cell Characteristics – Efficiency, Durability, Specific power, Factors affecting, Power design of fuel Cell Vehicle and range capacity. Lifetime cost of Fuel cell Vehicle – System, Components, maintenance.

**Total 45 Hours**

## PRACTICALS:-

1. Study of 3 phase induction motor.
2. Study of various elements of vehicle transmission systems such as clutch, differentials & gearbox.
3. Calculate & compare brake power, torque & and mechanical efficiency of IC engine & Electrical Motor of same configuration
4. Study of various types of braking systems
5. Case Study: Tesla Model X
6. Case Study: Tata Nexon
7. Case Study: BRTS Electric Bus & Charging Infrastructure
8. Simulation of AC to DC Conversion
9. Simulation of AC to AC Conversion
10. Simulation of DC to AC Conversion

**Total: 75 Hours**

## Reference(s)

1. Jack Erjavec and Jeff Arias, “Hybrid, Electric and Fuel Cell Vehicles”, Cengage Learning, 2012. S.N. Singh , Basic Electrical Engineering, P.H.I.,2013
2. Jack Erjavec and Jeff Arias, “Alternative Fuel Technology – Electric, Hybrid and Fuel Cell Vehicles”, Cengage Learning Pvt. Ltd., New Delhi, 2007
3. Mehrdad Ehsani, Yimin Gao, sebastien E. Gay and Ali Emadi, “Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design”, CRC Press, 2009.

## List of e-Learning Resources:

5. <https://nptel.ac.in/>
6. <https://www.coursera.org/>

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**B. Tech - Electrical & Electronics Engineering (EVT)**  
**Semester-III**  
**PEEEE0104A Non-Conventional Energy Resources**

L-2 T-1 P-2 C-4

**Course Objectives**

- To Learn about basics of current energy scenario.
- To Understand the concepts of the solar energy.
- To Define and understand the concept of wind energy.
- To Analysis of the various energy sources.
- To Examine the working of energy storage systems.

**Course Outcomes (COs)**

1. Understand about the different types of renewable energy sources and their utilities.
2. Understand the generating energy through alternate energy sources.
3. Analyze of wind energy generation techniques.
4. Evaluate and analyze the different types of energy generation techniques.
5. Create energy storage systems.

**Articulation Matrix**

*(Program Articulation Matrix is formed by the strength of correlation of COs with POs and PSOs. The strength of correlation is indicated as 3 for substantial (high), 2 for moderate (medium) correlation, and 1 for slight (low) correlation)*

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CO2	1	3	1	-	-	-	-	-	-	-	-	-	1	-	-
CO3	1	2	3	1	-	-	-	-	-	-	-	1	-	-	-
CO4	1	1	2	2	-	-	-	-	-	-	-	-	-	1	-
CO5	1	1	2	1	1	-	-	-	-	-	-	-	-	-	-

High-3 Medium-2 Low-1

**Unit-I Energy Scenario****09 Hours**

Classification of Energy Sources, Energy resources (Conventional and nonconventional), Energy needs of India, and energy consumption patterns. Worldwide Potentials of these sources. Energy efficiency and energy security. Energy and its environmental impacts. Global environmental concern, Kyoto Protocol, Concept of Clean Development Mechanism (CDM) and Prototype Carbon Funds (PCF). Factors favoring and against renewable energy sources, IRP.

**Unit-II Solar Energy****09 Hours**

Solar thermal Systems: Types of collectors, Collection systems, efficiency calculations, applications. Photo voltaic (PV) technology: Present status, - solar cells, cell technologies, Characteristics of PV systems, equivalent circuit, array design, building integrated PV system, its components, sizing and economics. Peak power operation. Standalone and grid interactive systems.

**Unit-III Wind Energy****09 Hours**

Wind speed and power relation, power extracted from wind, wind distribution and wind speed predictions. Wind power systems components, Types of Turbine, Turbine rating, Choice of generators, turbine rating, electrical load matching, Variable speed operation, maximum power

operation, control systems, system design features, stand alone and grid connected operation.

#### Unit-IV Other energy sources

**09 Hours**

Biomass – various resources, energy contents, technological advancements, conversion of biomass in other form of energy – solid, liquid and gases. Gasifiers, Biomass fired boilers, Cofiring, Generation from municipal solid waste, Issues in harnessing these sources. Hydro energy – feasibility of small, mini and micro hydel plants scheme layout economics. Tidal and wave energy, Geothermal and Ocean-thermal energy conversion. (OTEC) systems – schemes, feasibility and viability.

#### Unit-V Energy storage

**09 Hours**

Battery – types, equivalent circuit, performance characteristics, battery design, charging and charge regulators. Battery management. Fly wheel-energy relations, components, benefits over battery. Fuel Cell energy storage systems. Ultra Capacitors.

**Total: 45 Hours**

#### PRACTICAL'S

1. Measurement of direct solar radiation using pyrheliometer / pyranometer
2. Measurement of efficiency of solar flat plate collector
3. Performance testing of solar cooker unit
4. Study of solar cell characteristics
5. Effect of tilt angle on the efficiency of solar photovoltaic panel.
6. Study on solar photovoltaic panel in series/parallel combination.
7. Estimation of wind speed using anemometer.
8. Study the characteristics of wind.
9. Determination of characteristics of a wind generator.
10. Study the effect of number and size of blades of a wind turbine on electric power output.

**Total: 75 Hours**

#### Reference(s)

1. Renewable energy technologies - R. Ramesh, Narosa Publication
2. Non-conventional Energy Systems – Mittal, Wheelers Publication.
3. John F Walker & Jenkins. N, Wind Energy Technology., John Wiley and Sons

#### List of e-Learning Resources:

7. <https://nptel.ac.in/>
8. <https://www.coursera.org/>

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