`

COURSE STRUCTURE (R23)
AND
DETAILED SYLLABUS
(II YEAR)

ELECTRICAL AND ELECTRONICS ENGINEERING

For
B.Tech., Four Year Degree Course
(Applicable for the batches admitted from 2023-24)

LENDI INSTITUTE OF ENGINEERING AND TECHNOLOGY
An Autonomous Institution
Approved by AICTE & Permanently Affiliated to JNTUGV, Vizianagaram
Accredited by NAAC with "A" Grade and NBA (CSE,ECE, EEE & ME)
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COURSE STRUCTURE AND DETAILED SYLLABUS
B.TECH- ELECTRICAL AND ELECTRONICS ENGINEERING

II Year I Semester						
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**Credits**
1.	R23BSH-MA2103	Transforms and Numerical Methods	3	0	0	3
2.	R23BSH-HM2101	Universal Human Values : Understanding Harmony and Ethical Human Conduct	2	1	0	3
3.	R23EEE-ES2101	Electromagnetic Field Theory	3	0	0	3
4.	R23EEE-PC2101	Electrical Circuit Analysis-II	3	0	0	3
5.	R23EEE-PC2102	DC Machines & Transformers	3	0	0	3
6.	R23EEE-PC2103	Electrical Circuit Analysis-II and Simulation Lab	0	0	3	1.5
7.	R23EEE-PC2104	DC Machines & Transformers Lab	0	0	3	1.5
8.	R23CSE-SC2101	Data Structures using C Lab (Skill Oriented Course)	1	0	2	2
9.	R23BSH-MC2101	Environmental Science (Mandatory Course)	2	0	0	0
		Total	**17**	**1**	**8**	**20**

II Year II Semester						
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**Credits**
1.	R23BSH-HM2201	Managerial Economics & Financial Analysis	2	0	0	2
2.	R23BSH-MA2202	Complex Variables and Statistical Methods	3	0	0	3
3.	R23EEE-PC2201	Power Systems-I	3	0	0	3
4.	R23EEE-PC2202	Induction and Synchronous Machines	3	0	0	3
5.	R23EEE-PC2203	Control Systems	3	0	0	3
6.	R23EEE-PC2204	Induction and Synchronous Machines Lab	0	0	3	1.5
7.	R23EEE-PC2205	Control Systems Lab	0	0	3	1.5
8.	R23CSE-SC2202	Python Programming Lab (Skill Oriented Course)	1	0	2	2
9.	R23EEE-ES2201	Design Thinking & Innovation	1	0	2	2
10	R23BSH-MC2201	English for Employability Skills(Mandatory Course)	2	0	0	0
		Total	**18**	**0**	**10**	**21**
Honor Course-1						
Community Service Project (During the Summer Vacation after Second Year & Evaluated in III-I Semester)						

Honors Track offered by EEE

Honors Course – 1						
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**Credits**
1	R23EEE-HN2201	Renewable Energy Systems & Sources	3	0	0	3
2	R23EEE-HN2202	Electric Vehicle Technology and Mobility	3	0	0	3
3	R23EEE-HN2203	Embedded System Design	3	0	0	3

Honors Course – 2						
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**Credits**
1	R23EEE-HN3101	Flexible AC Transmission Systems	3	0	0	3
2	R23EEE-HN3102	Modelling and Analysis of Electrical Machines	3	0	0	3
3	R23EEE-HN3103	VLSI Design Technology	3	0	0	3

Honors Course – 3						
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**Credits**
1	R23EEE-HN3101	Advanced Power System Protection	3	0	0	3
2	R23EEE-HN3102	Modeling and Analysis of Power Semiconductor Devices and Converters	3	0	0	3
3	R23EEE-HN3103	Digital Signal Processing	3	0	0	3

Honors Course – 4						
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**Credits**
1	R23EEE-HN3201	Power Quality Management	3	0	0	3
2	R23EEE-HN3202	Modern Power Electronics Converters	3	0	0	3
3	R23EEE-HN3203	Advanced Microcontroller based Systems	3	0	0	3

Honors Course –5						
S.No	**Course Code**	**Course Name**	**L**	**T**	**P**	**Credits**
1	R23EEE-HN4101	Distributed Generation and Micro Grid	3	0	0	3
2	R23EEE-HN4102	Grid Interface of Electric Vehicles	3	0	0	3
3	R23EEE-HN4103	Industrial Electronics	3	0	0	3

Exit Policies

The students can choose to exit the four-year programme at the end of first/second/third year.

(a) Additional 10 Credits requirement for Undergraduate Certificate in Engineering after completion of II Semester

S. No.	Course code	Subjects	Category	L	T	P	Credits
1	R23EEE-SC2A01	PCB Design/Certificate Course*	SC	1	0	2	2
2	R23EEE-SC2A02	Introduction to MATLAB and PSPICE/ Certificate Course*	SC	1	0	2	2
3	R23EEE-SI2A01	Internship	SI	0	0	0	6

* Any certificate course offered by industries/Professional bodies/APSSDC or any other accredited bodies as approved by the BoS.

(b) Additional 10 Credits requirement for Undergraduate Diploma Certificate in Engineering after Completion of IV Semester

S. No.	Course code	Subjects	Category	L	T	P	Credits
1	R23EEE-SC3A01	Electrical CAD/ Certificate Course*	SC	1	0	2	2
2	R23EEE-SC3A02	Photovoltaic System Design/ Certificate Course*	SC	1	0	2	2
3	R23EEE-SI3A01	Internship	SI	0	0	0	6

* Any certificate course offered by industries/Professional bodies/APSSDC or any other accredited bodies as approved by the BoS.

(c) Bachelor of Science (in Field of Electrical and Electronics Engineering) i.e., B.Sc. Engineering in (Electrical and Electronics Engineering) - Programme duration: First three years (first six semesters) of the undergraduate programme require120 credits.

B.Tech II Year - I Semester

Course code	Course Title	L	T	P	Credits
R23BSH-MA2103	**Transforms and Numerical Methods**	3	0	0	3

Course Objectives:

- To develop a solid understanding of fundamental mathematical concepts essential for engineering, including Numerical methods, Optimization methods and transform techniques.
- To provide students sufficient knowledge and skills enabling them to undertake further studies in engineering and its allied areas on multiple disciplines concerned with mathematics.
- To foster critical thinking and logical reasoning skills to approach and solve engineering challenges methodically.
- To develop teamwork skills by engaging in collaborative projects and group problem-solving activities, simulating real-world engineering environments.
- To encourage a mindset of continuous learning and adaptation, preparing students to stay current with evolving mathematical methods and engineering practices.
- To improve the ability to communicate mathematical ideas and solutions effectively in written and oral forms within the context of engineering.
- To enhance analytical and problem-solving abilities by applying mathematical methods to solve engineering problems.

Course Outcomes:

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

1. Apply Laplace transforms to solve the real world problems when modeled into differential equations.
2. Apply Z- transforms to solve the real world problems when modeled into difference equations.
3. Apply suitable numerical methods to find the roots for given equation, interpolating formula for given data and solve real world problems when modeled into differential equations.
4. Analyze the data by fitting into regression lines using least square methods.
5. Apply suitable optimization techniques to solve the real world problems when modeled into linear and nonlinear optimization problems.

Unit I (10 hours)

Laplace transforms Definition, existence conditions, properties, Laplace transforms of derivatives and integrals, multiplication by t^n, division by t, periodic functions, unit step function and impulse function. Inverse Laplace transforms and convolution theorem.

Applications: improper integrals, ordinary differential equations.

Unit II (10 hours)

Z-transforms: Definition of Z-transform, elementary properties, linearity property, damping rule, shifting u_n to the right and left, multiplication by n, initial value theorem, final value theorem, inverse Z-transform, convolution theorem.

Applications: Solution of difference equations using Z-transforms.

Unit III (10 Hours)

Solution of Algebraic and Transcendental Equations: Numerical solutions of linear and non-linear algebraic equations: Intermediate value theorem (Statement only). Geometrical representation of root of an equation. Bisection Method**,** Regula - Falsi method, Iterative Method, Newton- Raphson method for one variable.

Interpolation: Finite differences. Relations between∇, Δ, E, D, δ and μ. Missing terms using forward difference operator. Newton's forward interpolation formula, Newton Backward interpolation formula, Lagrange's difference formula, Gauss Forward difference formula.

UNIT IV (10 Hours)

Numerical Integration: Trapezoidal and Simpson's rules($1/3^{rd}$ &$3/8^{th}$)

Solutions of Ordinary differential equations: Taylor series method, Picard's method, Euler's method. Modified Euler's methods and Runge-Kutta method of fourth order, Milne's Predictor and Corrector Method.

Unit V (8 hours)

Curve Fitting: Method of Least square Method- Linear curve fitting: Straight line fit. Nonlinear curve fitting: Parabolic fit.

Correlation and Regression: Correlation, correlation coefficient, rank correlation. Linear regression coefficients, regression lines.

Student Activity: Analyze the data using correlation and Regression with any software tools such as R, Python, or Excel.

Text Books

1. B. S. Grewal, Higher Engineering Mathematics, 45^{th} edition, Khanna publishers, 2023.
2. S.D.Sharma, Operations Research (Theory Methods & Applications), Kedar Nath Ram Nath & Co. Meerut, 20^{th} Edition,2014

References

1. B.S. Grewal, Numerical Methods in Engineering & Science, Khanna Publishers, 2014.
2. S.S.Sastry, Introductory Methods of Numerical Analysis, 5^{th} Edition, 2012
3. Erwin Kreyszig, Advanced Engineering Mathematics, 10/e, John Wiley & Sons, 2011.
4. Dennis G. Zill and Warren S. Wright, Advanced Engineering Mathematics, Jones and Bartlett, 2011.
5. Michael Greenberg, Advanced Engineering Mathematics, 2/e, Pearson, 2018.

Course code	Course Title	L	T	P	Credits
R23BSH-HM2101	Universal Human Values: Understanding Harmony and Ethical Human Conduct	2	1	0	3

Course Objectives:

- Development of a holistic perspective based on value education and right understanding.
- Build harmony in the human being, Outline and strengthening of self-reflection.
- Develop Harmony in the family and society and interconnectedness with universal human order.
- Make use of mutual fulfilment relate to orders of nature and holistic perception of societal aspects.
- Integrate the humanistic constitution and humanistic universal order.

Course Outcomes:

1. Implement elements and process of value education.
2. Recognize thoughts, emotions and physical sensations of the self and the body and harmonizing their relationship.
3. Analyze human relations and their role in ensuring harmonious society.
4. Develop interconnected nature of existence encourages actions that contribute to global peace, justice and sustainability.
5. Make use of humanistic constitution, mutual respect and universal human order with holistic technologies.

UNIT-I

Introduction to Value Education: Understanding Value Education- Self-exploration as the Process for Value Education- Continuous Happiness and Prosperity – Basic Human Aspirations - Right Understanding, Relationship and Physical Facility - Happiness and Prosperity – Current Scenario.

UNIT-II

Harmony in the Human Being : Understanding Human being as the Co-existence of the Self and the Body- Distinguishing between the Needs of the Self and the Body-The Body as an Instrument of the Self -Understanding Harmony in the Self - Harmony of the Self with the Body.

UNIT-III

Harmony in the Family and Society: Harmony in the Family – Basic Unit of Human Interaction - Values in Human-to-Human Relationship - 'Trust' – Foundational Value in Relationship - 'Respect' – Right Evaluation -Understanding Harmony in the Society -Vision for the Universal Human Order.

UNIT-IV

Harmony in the Nature/Existence: Understanding Harmony in the Nature - Interconnectedness, self-regulation and Mutual Fulfilment among theFour Orders of Nature - Realizing Existence as Co-existence at All Levels - The Holistic Perception of Harmony in Existence.

UNIT-V

Implications of the Holistic Understanding – a Look at Professional Ethics: Natural Acceptance of Human Values - Definitiveness of (Ethical) Human Conduct - A Basis for Humanistic Education, Humanistic Constitution andUniversal Human Order - Competence in Professional Ethics - Holistic Technologies, Production Systems and Management Models.

Text Books

1. A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana,

2. G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034- 47-1

Reference Books

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi, Publisher : Prabhat Prakashan; 1st edition (1 January 2018); Prabhat Prakashan Pvt. Ltd, New Delhi-110002
4. Small is Beautiful - E. F Schumacher. Blond & Briggs (1973–2010), HarperCollins (2010)
5. Slow is Beautiful - Cecile Andrews, New Society Publishers (1 October 2006)
6. Economy of Permanence - J C Kumarappa, Publisher : Sarva Seva Sangh Prakashan (1 January 2017)
7. India Wins Freedom - Maulana Abdul Kalam Azad, Publisher : Orient BlackSwan; 1st Edition (1 January 1988)
8. Vivekananda - Romain Rolland (English), Publisher : Advaita Ashrama, India; Fourth Impression edition (30 March 2010)

Course code	Course Title	L	T	P	Credits
R23EEE-ES2101	Electromagnetic Field Theory	3	0	0	3

Course Objectives:

- To study the concepts of electrostatics like electric field intensity and potentials due to different configurations of static charges.
- To study the properties of conductors and dielectrics, calculate the capacitance of different configurations, electric potential and electric dipole using appropriate mathematical techniques.
- To study the magnetic fields produced by currents in different configurations using Biot-Savart's law, Ampere's circuital law, Maxwell's second and third equations.
- To study Lorentz force equation , magnetic forces on different configurations of conductors, current loops, magnetic dipole and torque due to dipole moment, concept of self and mutual inductances and energy stored
- To study statically, dynamically induced electromotive forces, Maxwell's equations in different forms of static and time varying fields, Modified Maxwell's equation, Maxwell's fourth equation.

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

1. Analyze the behavior of charges for different charge distributions using Coulombs Law and Gauss law.
2. Analyze the behavior of conductors and capacitance calculations for different configurations.
3. Analyze the magnetic fields by using Biot-Savart's law and Ampere's circuital law.
4. Analyze the effect of magnetic forces, inductances for different configurations in the transmission lines.
5. Understand Faraday's laws of electromagnetic induction, Maxwell's equations with static and time varying fields.

UNIT-I

Electrostatics: Introduction to vector algebra - Coordinate systems - Coulomb's law - Electric field intensity due to line, surface and volume charges - Electric potential due to point charges, line charges and volume charges – Divergence - Gauss's law (Maxwell's first equation) and its applications - Laplace's equation and Poisson's equations - Numerical problems

UNIT- II

Conductors, Capacitance and Dielectrics: Electric dipole , dipole moment and its potential, electric field intensity- Torque due to electric dipole - Capacitance and its calculation in parallel plate, spherical, co-axial capacitors, boundary conditions - Energy stored– Numerical problems.

UNIT-III

Magneto Statics: Static magnetic fields – Biot Savart's law, Magnetic field intensity due to a straight, circular, solenoid current carrying wire, Magnetic field intensity due to an infinite sheet of current, long current carrying filament – Ampere's circuital law and its applications, Point form of Ampere's circuital law – Maxwell's second equation, Maxwell's third equation - Numerical problems.

UNIT-IV

Force in Magnetic fields: Lorentz force equation - Force on current element - Straight and long current carrying conductor in a magnetic field - Force between two straight and parallel current carrying conductors - Magnetic dipole, magnetic moment and its torque –Numerical problems.

Self and Mutual Inductances: Self-inductance of a Solenoid, Toroid and mutual inductance between a straight long wire anda square loop wire in the same plane – Energy stored and energy density in a magnetic field – Numerical problems.

UNIT-V

Time varying fields: Faraday's laws of electromagnetic induction, statically and dynamically induced EMF , Maxwell's fourth equation, Maxwell's equations in integral form and derivative form, Modified Maxwell's equations for time varying fields - Displacement current, displacement current density, Poynting Theorem , poynting vector- Numerical problems

Text books:

1. "Elements of Electromagnetics" by Matthew N O Sadiku, Oxford Publications, 7th edition, 2018.
2. "Engineering Electromagnetics" by William H. Hayt & John. A. Buck Mc. Graw-Hill, 9th Editon.2020.

Reference Books:

1. Introduction to Electro Dynamics" by D J Griffiths, Prentice-Hall of India Pvt. Ltd,4th edition,2020
2. "Electromagnetic Field Theory" by Yaduvir Singh, Pearson India, 1st edition, 2011.
3. "Fundamentals of Engineering Electromagnetics" by Sunil Bhooshan, Oxford University Press, 2012.
4. Schaum's Outline of Electromagnetics by Joseph A. Edminister, Mahamood Navi,4th Edition,2014.

Online Learning Resources:

1. https://archive.nptel.ac.in/courses/108/106/108106073/
2. https://nptel.ac.in/courses/117103065

Course code	Course Title	L	T	P	Credits
R23EEE-PC2101	Electrical Circuit Analysis-II	3	0	0	3

Course Objectives:

- To understand three phase circuits
- To analyse transients in electrical systems
- To evaluate network parameters of given electrical network
- To apply Fourier analysis to electrical systems
- To understand the behaviour of filters

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

1. Analyse the balanced and unbalanced 3 phase circuits for power calculations.
2. Estimate various Network parameters.
3. Analyse the transient behaviour of electrical networks in different domains.
4. Apply the concept of Fourier series to electrical systems.
5. Describe the filter circuit for electrical circuits.

UNIT - I

Analysis of three phase balanced circuits: Phase sequence, star and delta connection of sources and loads, relationship between line and phase quantities, analysis of balanced three phase circuits and measurement of active and reactive power.

Analysis of three phase unbalanced circuits: Loop method, Star-Delta transformation technique, measurement of active and reactive power. Measurement of power by using Wattmeters.

UNIT - II

Network Parameters: Impedance parameters, Admittance parameters, Hybrid parameters, Transmission (ABCD) parameters, conversion of Parameters from one form to other, Conditions for Reciprocity and Symmetry, Interconnection of Two Port networks in Series, Parallel and Cascaded configurations- problems.

UNIT – III

Transient Analysis of DC and AC Circuits: Behavior of circuit elements under switching condition and initial and final conditions, transient response of R-L, R-C and R-L-C circuits and solution of differential equation for D.C-excitation. Transient response of series R-L, R-C and R-L-C circuits for A.C-excitation, analysis of electrical circuits using Laplace transform approach for standard inputs.

UNIT - IV

Fourier Analysis: Trigonometric and exponential form of Fourier series, evaluation of Fourier coefficients, Symmetry in Fourier Series – Even Symmetry, Odd Symmetry, Half Wave Symmetry, Quarter Wave Symmetry, Average & RMS values of periodic waveforms, Analysis of Electric Circuits with Periodic Excitation.

UNIT - V

Filters: Classification of filters-Low pass, High pass, Band pass and Band Elimination filters, Constant-k filters -Low pass and High Pass, Design of Filters - Low pass and High pass.

Textbooks:

1. Engineering Circuit Analysis, William Hayt and Jack E. Kemmerly, 9th Edition McGraw-Hill, 2020
2. Fundamentals of Electric Circuits, Charles K. Alexander, Mathew N. O. Sadiku, 7th Edition, Tata McGraw-Hill, 2022

Reference Books:

1. Network Analysis, M. E. Van Valkenburg, 3rd Edition, PHI, 2019.
2. Network Theory, N. C. Jagan and C. Lakshminarayana, 3rd Edition, B. S. Publications, 2015.
3. Circuits and Networks Analysis and Synthesis, A. Sudhakar, Shyam Mohan S. Palli, 5th Edition, Tata McGraw-Hill, 2017.
4. Engineering Network Analysis and Filter Design (Including Synthesis of One Port Networks)- Durgesh C. Kulshreshtha Gopal G. Bhise, Prem R. Chadha ,Umesh Publications 2012.
5. Circuit Theory: Analysis and Synthesis, A. Chakrabarti, Dhanpat Rai & Co., 2018, 7th Revised Edition.

Online Learning Resources:

1. https://archive.nptel.ac.in/courses/117/106/117106108/
2. https://archive.nptel.ac.in/courses/108/105/108105159/

Course code	Course Title	L	T	P	Credits
R23EEE-PC2102	DC Machines & Transformers	3	0	0	3

Course Objectives:

- To discuss the unifying principles of electromagnetic energy conversion.
- To understand the construction, principle of operation and performance of DC machines.
- To learn the characteristics, performance, methods of speed control and testing methods.
- To predetermine the performance of single-phase transformers with its equivalent circuit.
- To analyze the three phase transformers and achieve three phase to two phase conversion.

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

1. Understand the unifying principles of electromagnetic energy conversion
2. Analyze the operation & performance of DC Generators and Parallel Operation of DC Generators
3. Recognize the operation, performance of DC Motors, starting and speed control Techniques
4. Understand the operation & performance of single phase Transformers
5. Analyze the construction, classification of Three Phase Transformers & Auto-transformers.

UNIT-I

Electromechanical energy conversion: Principle of electromechanical energy conversion forces and torque in magnetic field systems, lenz law, and energy balance in magnetic circuits, magnetic force, and co-energy in singly excited and multi excited magnetic field system.

UNIT-II

DC Generators: Constructional details, types of armature windings, EMF equation, armature reaction its remedy methods, commutation and methods of improving commutation, Types of DC Generators, VI relations ,residual magnetism, OCC, internal and external characteristics of DC Generators, applications of DC Generators.

UNIT-III

DC Motors: Significance of back emf, torque equations, speed control of DC motors, 2 point starter, 3-point starter & 4 point Starter, Types of DC Motors, losses and efficiency, condition for maximum efficiency. Brake and pulley test, Swinburne's test, Hopkinson's test, Field's test, Retardation test & Separation of losses, applications of DC Motors.

UNIT-IV

Single Phase Transformer: Construction, equivalent circuit, phasor diagrams, losses, open circuit and short circuit tests, voltage regulation- efficiency, Sumpner.s test, separation of core losses, parallel operation of single-phase transformers, All day Efficiency, applications of single phase transformers.

UNIT-V

Autotransformer & Three Phase Transformers:

Autotransformer: Construction and working of auto transformer, volt ampere relations, comparison with two Winding transformers, applications of autotransformer.

Three-Phase Transformer: Construction, factors affecting the choice of connection, types of connections and their comparative features, parallel operation, working of Phase shifting transformer, Scott connection.

Textbooks:

1. Electrical Machinery by Dr. P S Bimbhra, Fully Revised edition, Khanna Publishers, New Delhi, 2021.
2. Performance and analysis of AC machines by M.G. Say, CBS, 2002.

Reference Books:

1. Electrical Machines by D. P.Kothari, I .J .Nagarth, McGraw Hill Publications, 5th edition, 2017.
2. Electrical Machinery Fundamentals by Stephen J Chapman McGraw Hill education 2017
3. Generalized Theory of Electrical Machines by Dr. P S Bimbhra, 7th Edition, Khanna Publishers, 2021.
4. Theory & Performance of Electrical Machines by J.B.Gupta, S.K.Kataria& Sons,2013.
5. Electric Machinery by Fitzgerald, A.E.,Kingsley, Jr.,C.,& Umans, S. D, 7th edition, McGraw-Hill Education, 2014.

Online Learning Resources:

1. nptel.ac.in/courses/108/105/108105112
2. nptel.ac.in/courses/108/105/108105155

Course code	Course Title	L	T	P	Credits
R23EEE-PC2103	Electrical Circuit Analysis-II and Simulation Lab	0	0	3	1.5

Course Objectives:

- To measure three phase Active and Reactive power
- To analyse transient behaviour of circuits
- To determine two-port network parameters
- To analyse electrical circuits using simulation tools

Course Outcomes:

At the end of this course, students will be able to

1. Evaluate the powers in three phase networks
2. Analyze the concepts of Transient response and time constants for the given circuits
3. Determine two port networks parameters for various combination of circuits
4. Construct the experimental network with suitable values of meters
5. Simulate and analyze electrical circuits using MATLAB/PSPICE tools

Any 10 of the following Experiments are to be conducted:

1. Measurement of Active Power and Reactive Power for balanced loads.
2. Measurement of Active Power and Reactive Power for unbalanced loads.
3. Verify that the current flowing through the neutral wire is zero for balanced load
4. Determination of the current flowing through the neutral wire for unbalanced load
5. Determination of Z and Y parameters.
6. Determination of ABCD and hybrid parameters
7. Verification of Kirchhoff's current law and voltage law using simulation tools.
8. Verification of mesh and nodal analysis using simulation tools.
9. Verification of super position and maximum power transfer theorems using simulation tools.
10. Verification of Reciprocity and Compensation theorems using simulation tools.
11. Verification of Thevenin's and Norton's theorems using simulation tools.
12. Verification of series and parallel resonance using simulation tools.
13. Simulation and analysis of transient response of RL, RC and RLC circuits.
14. Determination of self-inductance, mutual inductance and coefficient of coupling

Course code	Course Title	L	T	P	Credits
R23EEE-PC2104	DC Machines & Transformers Lab	0	0	3	1.5

Course Objectives:

- To plot the OCC characteristics of DC Shunt Generator and understand the mechanism of Self-Excitation.
- To control the speed of the DC Motors.
- To determine and pre-determine the Efficiency of DC Machines.
- To Predetermine the Efficiency, Regulation of Single Phase Transformer and assess their performance.
- To study the internal & external characteristics of a D.C Generators.

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

1. Understand the principles and operational characteristics of DC Generators
2. Analyze the performance of DC Motors with direct and indirect loading
3. Understand the Speed Control Techniques of DC Shunt Motors
4. Evaluate the performance of single-phase Transformers
5. Achieve Three Phase to Two Phase Transformation

List of experiments are to be conducted

1. Magnetization characteristics of self-excited DC Shunt Generator, determination of Critical Field Resistance and Critical Speed.
2. Brake test on DC shunt motor
3. Hopkinson's Test on DC Shunt Machines.
4. Swinburne's Test and Predetermination of Efficiencies of DC Generator and DC Motor.
5. Speed Control of DC shunt motor by Field and armature Control methods.
6. Retardation Test on DC Shunt Motor.
7. Load test on DC compound generator
8. OC & SC Test on Single Phase Transformer.
9. Sumpner's Test on Single Phase Transformer.
10. Scott Connection of Transformers.

Any 03 of the following experiments are to be conducted

11. Separation of Losses in DC Shunt Motor.
12. Separation of Core Losses of a Single Phase Transformer.
13. Parallel Operation of Single Phase Transformers.
14. Brake test on DC compound motor, determination of performance curves.
15. Fields test on two identical DC Series machines, determination of Efficiency.
16. Load test on DC series generator

Course code	Course Title	L	T	P	Credits
R23CSE-SC2101	Data Structures using C Lab (Skill Oriented Course)	1	0	2	2

Course Objectives:

- To provide the knowledge of basic data structures and their implementations.
- Provide the importance of data structures in context of writing efficient programs.
- To develop skills to apply appropriate data structures in problem solving.

Course Outcomes: At the end of the course, Student will be able to

1. Identify the role of data structures in organizing and accessing data.
2. Design, implement, and apply linked lists for dynamic data storage.
3. Develop applications using stacks and queues.
4. Design and implement algorithms for operations on binary trees and binary Search trees.
5. Devise novel solutions to small scale programming challenges involving data structures such as stacks, queues, Trees.

UNIT I

Introduction to Data Structures: Definition and importance of Data structures, Abstract data types (ADTs) and its specifications,
Searching Techniques: Linear & Binary Search,
Sorting Techniques: Bubble sort, Selection sort, Insertion sort, Quick sort.
Sample experiments:

1. Program to find min & max element in an array.
2. Find an element in given list in an array using Linear search.
3. Find an element in given list of sorted elements in an array using Binary search.
4. Implement Selection and Quick sort techniques
5. Implement Bubble and Insertion sort techniques

UNIT II

Linked Lists: Singly linked lists : representation and operations, doubly linked lists and circular linked lists, Comparing arrays and linked lists, Applications of linked lists.
Sample experiments:

1. Write a program to implement the following operations using singly linked list.
   a. Insert b.Deletion c.Searching
2. Write a program to implement the following operations using double linked list.
   a. Insert b.Deletion c.display
3. Write a program to implement the following operations using circular linked list.
   a. Insert b.Deletion c.display
4. Write a program to perform addition of given two polynomial expressions using linked list.

UNIT III

Stacks: Introduction to stacks : properties and operations , implementing stacks using arrays and linked lists, Applications of stacks in expression evaluation, reversing list, factorial calculation etc.
Sample experiments:

1. Implement stack operations using
   a. Arrays b.Linkedlist
2. Convert given infix expression into postfix expression using stacks.
3. Evaluate given postfix expression using stack.
4. Write a program to calculate factorial of a number using stack.

UNIT IV

Queues: Introduction to queues: properties and operations, Circular queues, implementing queues using arrays and linked lists, Applications of queues scheduling, etc.

1. Implement Queue operations using
   a. Arrays b. Linked list
2. Implement Circular Queue using
   a. Arrays b. Linkedlist

UNIT V

Trees: Introduction to Trees, Binary trees and traversals, Binary Search Tree – Insertion, Deletion & Traversal

Sample experiments:

1. Implement binary tree traversals using linked list.
2. Write program to create binary search tree for given list of integers. Perform in-order traversal of the tree. Implement insertion and deletion operations.

Textbooks:

1. Data Structures and algorithm analysis in C, Mark Allen Weiss, Pearson,2nd Edition.
2. Fundamentals of data structures in C, Ellis Horowitz, Sartaj Sahni ,Susan Anderson-Freed, Silicon Press, 2008

Reference Books:

1. Algorithms and Data Structures: The Basic Tool box by Kurt Mehlhorn and Peter Sanders.
2. C DataStructures and Algorithms by AlfredV.Aho,JeffreyD.Ullman, and JohnE. Hopcroft.
3. Problem Solving with Algorithms and Data Structures by Brad Miller and David Ranum.
4. Introduction to Algorithms by Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivest, and Clifford Stein.
5. Algorithms in C, Parts1-5(Bundle):Fundamentals, Data Structures, Sorting, Searching, and Graph Algorithms" by Robert Sedgewick.

Course Code	Course Name	L	T	P	Credits
R23BSH-MC2101	Environmental Science (Mandatory Course)	2	0	0	0

Course Objectives:

- To make the students to get awareness on environment.
- To understand the importance of protecting natural resources, ecosystems for futuregenerations and pollution causes due to the day-to-day activities of human life
- To save earth from the inventions by the engineers.

Course Outcomes:

1. Understand the significance of various natural resources, including renewable, non renewable water, minerals, forests and soil, in the environment and the problems associated with it in maintaining ecological balance and supporting human activities.
2. Apply strategies for mitigating different types of environmental pollution, managing solid waste effectively and adopt individual actions that contribute to pollution prevention and waste reduction.
3. Understand the structure, function, characteristic features of different kind of eco systems, value of biodiversity, threats to bio diversity and India's role and strategies in the conservation of biodiversity for sustainable development.
4. Apply the Air (Prevention and Control of Pollution) Act, Water (Prevention and Control of Pollution) Act, Wildlife Protection Act, and Forest Conservation Act to promote sustainable environmental development; Address related social issues and propose effective solutions, delving into the intersection of environmental policies and community welfare to achieve ultimate sustainability goals.
5. Identify the role of information technology in addressing population-related problems**,** focusing on resource management, environmental monitoring, urban planning, healthcare improvement, education to enhance sustainability and quality of life.

UNIT I

Multidisciplinary Nature of Environmental Studies: Definition, Scope and Importance – Need for Public Awareness.

Natural Resources: Renewable and non-renewable resources – Natural resources and associated problems – Forest resources – Use and over – exploitation, deforestation, case studies – Timber extraction – Mining, dams and other effects on forest and tribal people – Water resources – Use and over utilization of surface and ground water – Floods, drought, conflicts over water, dams – benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. – Energy resources:

UNIT II

Environmental Pollution: Definition, Cause, effects and control measures of:

a. Air Pollution.
b. Water pollution
c. Soil pollution
d. Marine pollution
e. Noise pollution
f. Thermal pollution

Solid Waste Management: Causes, effects and control measures of urban and industrial wastes – Role of an individual in prevention of pollution – Pollution case studies – Disaster management: floods, earthquake, cyclone, landslides and e-waste management.

UNIT III

Ecosystems: Concept of an ecosystem. – Structure and function of an ecosystem – Producers, consumers and decomposers – Energy flow in the ecosystem – Ecological succession – Food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the following ecosystem:

a. Forest ecosystem.
b. Grassland ecosystem
c. Desert ecosystem.
d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Biodiversity and its Conservation : Introduction: Definition: genetic, species and ecosystem diversity – Bio-geographical classification of India – Value of biodiversity: consumptive use, Productive use, social, ethical, aesthetic and option values – Biodiversity at global, National and local levels – India as a mega-diversity nation – Hot-spots of biodiversity – Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – Endangered and endemic species of India – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

UNIT IV

Social Issues and the Environment: From Unsustainable to Sustainable development – Urban problems related to energy – Water conservation, rain water harvesting, watershed management Resettlement and rehabilitation of people; its problems and concerns. Case studies – **Environmental ethics:** Issues and possible solutions – Climate change- global warming, acid rain and ozone layer depletion. Case Studies – Wasteland reclamation. – Consumerism and waste products. – Environment Protection Act. – Air (Prevention and Control of Pollution) Act. – Water (Prevention and control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act – Issues involved in enforcement of environmental legislation – Public awareness.

UNIT V

Human Population and the Environment: Population growth, variation among nations. Population explosion – Family Welfare Programmes – Environment and human health – Human Rights – Value Education – HIV/AIDS – Women and Child Welfare – Role of information Technology in Environment and human health – Case studies.

Field Work: Visit to a local area to document environmental assets River/forest grassland/hill/mountain – Visit to a local polluted site-Urban/Rural/Industrial/Agricultural Study of common plants, insects, and birds – river, hill slopes, etc.

Textbooks:

1. Textbook of Environmental Studies for Undergraduate Courses Erach Bharucha forUniversity Grants Commission, Universities Press
2. Palaniswamy, “Environmental Studies”, Pearson education.
3. S. Azeem Unnisa, “Environmental Studies” Academic Publishing Company.
4. K. Raghavan Nambiar, “Text book of Environmental Studies for Undergraduate Coursesas per UGC model syllabus”, Scitech Publications (India), Pvt. Ltd.

References:

1. Deeksha Dave and E.Sai Baba Reddy, “Textbook of Environmental Science”, CengagePublications
2. M. Anji Reddy, “Text book of Environmental Sciences and Technology”, B S Publication.
3. J. P. Sharma, Comprehensive Environmental studies, Laxmi publications.
4. J. Glynn Henry and Gary W. Heinke, “Environmental Sciences and Engineering”,Prentice Hall of India Private limited
5. G. R. Chatwal, “A Text Book of Environmental Studies” Himalaya Publishing House
6. Gilbert M. Masters and Wendell P. Ela, “Introduction to Environmental Engineering andScience, Prentice Hall of India Private limited.

B.Tech II Year - II Semester

Course Code	Course Name	L	T	P	Credits
R23BSH-HM2201	Managerial Economics & Financial Analysis	2	0	0	2

Course Objectives:

- Inculcate the basic knowledge with the concepts of Business, Economics and Finance.
- Analyze various factors of production with proposed theories in relation to cost - volume profit analysis.
- Identify micro environment in which markets operate, how price determination is done under different kinds of competitions and know the different forms of Business organization.
- Asess the best investment decisions by means of time value of money.
- Provide fundamental skills about accounting and explain the process of preparing accounting statements and analysis of financial statements.

Course Outcomes:

1. Equipped with the knowledge of fundamentals of economics, estimating the Demandfor a product, Capable of analyzing Elasticity & Forecasting methods.
2. Apply production concepts, assess the costs and Determine Break Even Point (BEP)of an enterprise for managerial decision making.
3. Identify the influence and price determination of various markets structures and knowledge of the forms of business organization and Business cycles.
4. Analyze how to invest adequate amount of capital in order to get maximum returnfrom selected business activity.
5. Analyze and interpret the process & principles of accounting & apply financial statements for appropriate decisions to run the business profitably.

Unit-I

Introduction to Managerial Economics and demand Analysis: Introduction to Managerial Economics: Definition, Nature and Scope of Managerial Economics– Demand Analysis: Demand Determinants, Law of Demand and its exceptions- Elasticity of Demand: Definition, Types, Measurement and Significance of Elasticity of Demand. Demand Forecasting, Factors governing demand forecasting, methods of demand forecasting- Law of Supply.

Application: Analyze the demand of a product by applying methods of the elasticity of demand.

Unit – II

Theories of Production and Cost Analysis: Production Function – Isoquants and Isocosts, Laws of Returns, Laws of return to Scale, Internal and External Economies of Scale. Cost Analysis: Cost concepts, Opportunity cost, Fixed vs. Variable costs, Explicit costs Vs. Implicit costs, Out of pocket costs vs. Imputed costs, Sunk costs, Historical cost. CVP analysis-Break-even Analysis (BEA) Significance and limitations -Determination of Break Even Point (simple Problems).

Application: Compute contribution, revenue, Cost comparison, Margin of safety for making accuratedecisions related to profitability of particular Enterprise

Unit – III

Introduction to Markets, Pricing & Types of Business Organizations: Types of competition, Features of Perfect competition, Monopoly and Monopolistic Competition. Objectives of Pricing- Methods of Pricing: Cost Plus Pricing, Limit Pricing, Market Skimming Pricing, Penetration Pricing, Internet pricing.

Types of Business Organizations: Features of Business, Features and evaluation of Sole Proprietorship, Partnership, Joint Stock Company

Application: Analyze the leaps and bounds faced by the service providers in estimation ofpricing in Telecom sector**.**

Unit –IV

Capital and Capital Budgeting: Capital and its significance, Types of Capital, Capital process, Methods and sources of raising finance. Capital budgeting-Meaning and Methods of Capital Budgeting: Payback Method, Accounting Rate of Return (ARR) and Net Present Value Method, Internal Rate of Return (IRR) (Simple problems)

Application: Assess long term investments and funds required in small scale organization**.**

Unit – V

Introduction to Accounting & Financial Analysis:

Accounting objectives, Accounting cycle, GAAP -Double-Entry Book Keeping, Journal, Ledger, Trial Balance-Final Accounts (Trading Account, Profit and Loss Account and Balance Sheet with simpleadjustments).

Application: Prepare the financial accounting statements like Trading account, Profit and Loss account,Balance sheet of any organization.

Text Books

1. A R Aryasri, "Managerial Economics and Financial Analysis",4th Edition, TMH Publication, 2012.
2. Varshney&Maheshwari, "Managerial Economic Text, problems & Cases", Sultan Chand& Sons Publishers, 2014.

Reference Books:

1. JL Pappas and EF Brigham, "Managerial Economics", Holt-Saunders Publishers, 4th Revised edition, 1st July, 1983.
2. N.P Srinivasn and M. SakthivelMurugan, "Accounting for Management", S. Chand & Publications, 2004.
3. Maheswari S.N., Suneel kK. Maheswari shared K Maheshwari, "An Introduction to Accountancy, Vikas Publishing House, 12th edition, 2018.
4. I.M Pandey, "Financial Management", Vikas Publishing House, 11th Edition, 2015.
5. V. Maheswari K. L. Varshney R.L, "Managerial Economics Text, Problems & Cases", S. Chand & Sons Publications, 2014.

Course code	Course Title	L	T	P	Credits
R23BSH-MA2202	Complex Variables and Statistical Methods	3	0	0	3

Course Objectives:

- To develop a solid understanding of fundamental mathematical concepts essential for engineering, including Complex variables and Statistical Methods.
- To provide students sufficient knowledge and skills enabling them to undertake further studies in engineering and its allied areas on multiple disciplines concerned with mathematics.
- To foster critical thinking and logical reasoning skills to approach and solve engineering challenges methodically.
- To develop teamwork skills by engaging in collaborative projects and group problem-solving activities, simulating real-world engineering environments.
- To encourage a mindset of continuous learning and adaptation, preparing students to stay current with evolving mathematical methods and engineering practices.
- To improve the ability to communicate mathematical ideas and solutions effectively in written and oral forms within the context of engineering.
- To enhance analytical and problem-solving abilities by applying mathematical methods to solve engineering problems.

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

1. Analyze various analytic functions using the Cauchy-Riemann equations
2. Apply various theorems of complex integration to solve engineering problems involving complex functions.
3. Analyze real-world engineering problems using the concepts of probability theory and statistical distributions in the process of assessment and decision-making under uncertainty.
4. Analyze data effectively to ensure accurate representation of populations in engineering studies and facilitate decision-making based on statistical inference using large sample tests.
5. Analyze data effectively to ensure accurate representation of populations in engineering studies and facilitate decision-making based on statistical inference using small sample tests.

UNIT I

Complex Variables and Analytic Functions: Functions of a complex variable, continuity, differentiation, analytic functions, Cauchy-Riemann equations (without proof), Milne- Thompson method, harmonic functions, harmonic conjugate.

Applications: Flow problems

UNIT-II

Complex Integration (All theorems without proofs): Contour integrals, Cauchy theorem, Cauchy integral formula, Taylor's series, Laurent's series, zeros of analytic functions, singularities, residues, and Cauchy residue theorem.

Applications: Evaluation of integrals of the type (a) Improper real integrals

$\int_0^{2\pi} f(\cos\theta, \sin\theta)\, d\theta$ (b) $\int_{-\infty}^{\infty} f(x)dx$ (c) $\int_{-\infty}^{\infty} e^{imx} f(x)dx$

UNIT III

Probability Theory: Probability: Introduction, probability axioms, addition law and multiplicative law of probability, conditional probability, Baye's theorem.

Probability Distribution: Random variable concept, distribution function, density function, Binomial distribution, Poisson distribution, Normal (Gaussian) distribution.

Unit IV

Estimation and Testing of Hypothesis: Introduction to Sampling, parameters, statistics, sampling distribution, point and interval estimation, formulation of null hypothesis, alternative hypothesis, the critical and acceptance regions, level of significance, two types of errors.

Large sample tests: Test for single proportion, difference of proportions, test for single mean and difference of means, confidence interval for parameters in one sample and two sample problems.

Unit V

Small Sample Tests: Student t-distribution (single mean, two means and paired t-test), testing of equality of variances (F-test), χ^2 - test for single variance, χ^2 - test for goodness of fit, ANOVA(1-way).

Text Books:

1. B. S. Grewal, Higher Engineering Mathematics, 45th edition, Khanna publishers, 2023.
2. Veerarajan T., Probability, Statistics and Random Processes, 3rd edition, Tata McGraw-Hill, New Delhi, 2008.

References:

1. Erwin kreyszig, Advanced Engineering Mathematics, 10/e, John Wiley & Sons, 2011.
2. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7/e, Mc-Graw Hill, 2004.
3. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, 2008.
4. Murray R. Spiegel,SeymourLipschutz, John J. Schiller , Dennis Spellman, Schaum's Outline of Complex Variables, 2ed (Schaum's Outlines) 2nd Edition.
5. Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers, Keying E. Ye, Probability and Statistics for Engineers and Scientists, 9th Edition, Pearson.
6. Miller and Freunds, Probability and Statistics for Engineers, 7/e, Pearson, 2008.
7. S. C. Guptha and V. K. Kapoor, Fundamentals of Mathematical Statistics, 11/e, SultanChand and Sons Publications, 2012.

Course code	Course Title	L	T	P	Credits
R23EEE-PC2201	Power Systems-I	3	0	0	3

Course Objectives:

- To study the principle of operation of different components of hydro and thermal power stations.
- To study principle of operation of different components of a nuclear power stations.
- To study construction and operation of different components of an Air and Gas insulated substations.
- To study different types of cables and distribution systems.
- To study different types of load curves and tariffs applicable to consumers.

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

1. Understand the different types of power plants, operation of hydroelectric and thermal power plants.
2. Understand the operation of nuclear power plants.
3. Describe the different components of air and gas insulated substations.
4. Discuss the construction of single core and three core cables and describe distribution system configurations.
5. Analyse different economic factors of power generation and tariffs.

UNIT I:

Hydroelectric Power Stations: Selection of site, general layout of a hydroelectric power plant with brief description of major components and principle of operation

Thermal Power Stations: Selection of site, general layout of a thermal power plant. Brief description of components: boilers, super heaters, economizers and electrostatic precipitators, steam turbines: impulse and reaction turbines, condensers, feed water circuit, cooling towers and chimney.

UNIT II:

Nuclear Power Stations: Location of nuclear power plant, working principle, nuclear fission, nuclear fuels, nuclear chain reaction, nuclear reactor components: moderators, control rods, reflectors and coolants, types of nuclear reactors and brief description of PWR, BWR and FBR. Radiation: radiation hazards and shielding, nuclear waste disposal.

UNIT III:

Substations:

Air Insulated Substations – indoor & outdoor substations, substations layouts of 33/11 kV showing the location of all the substation equipment. Bus bar arrangements in the sub-stations: simple arrangements like single bus bar, sectionalized single bus bar, double bus bar with one and two circuit breakers, main and transfer bus bar system with relevant diagrams.

Gas Insulated Substations (GIS) – advantages of gas insulated substations, constructional aspects of GIS, comparison of air insulated substations and gas insulated substations.

UNIT IV:

Underground Cables: Types of cables, construction, types of insulating materials, calculation of insulation resistance, stress in insulation and power factor of cable. Capacitance of single and 3-Core belted Cables. Grading of cables: capacitance grading and inters heath grading.

Distribution Systems: Classification of Distribution systems, A.C Distribution, overhead

versus Underground system, Connection schemes of Distribution system, Requirements of Distribution system, requirements of a Distribution system, Design considerations in Distribution system.

UNIT V:

Economic Aspects & Tariff:

Economic Aspects – load curve, load duration and integrated load duration curves, discussion on economic aspects: connected load, maximum demand, demand factor, load factor, diversity factor, plant capacity factor and plant use factor, base and peak load plants.

Tariff Methods– Costs of generation and their division into fixed, semi-fixed and running costs, desirable characteristics of a tariff method, tariff methods: simple rate, flat rate, block-rate, two-part, three–part, and power factor tariff methods.

Text Books:

1. I.J. Nagarath & D.P. Kothari, Power System Engineering, McGraw-Hill Education, 3rd Edition, 2019.
2. C.L.Wadhwa, Generation, Distribution and Utilization of Electrical Energy, New Age International Publishers, 6th Edition, 2018.

Reference Books:

1. S. N. Singh, Electric Power Generation, Transmission and Distribution, PHI Learning Pvt Ltd, New Delhi, 2nd Edition, 2010
2. J.B.Gupta, Transmission and Distribution of Electrical Power, S.K.Kataria and sons,10th Edition, 2012
3. V. K. Mehta and Rohit Mehta, Principles of Power System, S. Chand, 4th Edition, 2005.
4. Turan Gonen, Electric Power Distribution System Engineering, McGraw-Hill, 3rd edition 2014.
5. Handbook of Switchgear, BHEL, McGraw-Hill Education, 2007.

Online Learning Resources:

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

Course code	Course Title	L	T	P	Credits
R23EEE-PC2202	Induction and Synchronous Machines	3	0	0	3

Course Objectives:

- To understand the principle of operation and performance of three-phase induction motor.
- To analyze the relation between torque vs slip characteristics and performance of
- Induction motor.
- To discuss the principle of operation, voltage regulation of synchronous Generators.
- To understand the operation and performance of synchronous motor.
- To discuss the concept of double revolving field theory for single phase induction motor.

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

1. Describe the principle and operation of three phase induction motors
2. Identify the speed control, testing and performance characteristics of three phase induction motor
3. Test for Performance and synchronization of synchronous generator
4. Analyze the performance characteristics of synchronous motor
5. Describe the principle of operation of single-phase induction motors

UNIT-I

Three Phase Induction Motors: Constructional details, production of rotating magnetic field, slip, effect of rotor EMF, rotor frequency, rotor current and power factor at standstill and running conditions - rotor power input, rotor copper loss, mechanical power developed and their interrelationships, equivalent circuit, Phasor diagram.

UNIT-II

Characteristics, Starting and Testing Methods of Three Phase Induction Motors: Torque equation, expressions for maximum torque and starting torque, torque-slip characteristics, applications of three phase induction motor- harmonics, effects of crawling and cogging, speed control of induction motor with v/f method, no load and blocked rotor tests, methods of starting, starting torque and starting current calculations, induction generator operation (qualitative treatment only).

UNIT–III

Construction and Voltage Regulation of Synchronous Generator: Constructional features of Synchronous Generator, armature windings, distribution and pitch factors, EMF equation, voltage regulation by synchronous impedance method, MMF method and Potier triangle method, phasor diagrams, two reaction theory of salient pole machine. Determination of efficiency of three phase-alternator by loading with three phase induction motor.

Parallel operation of Synchronous Generators

Synchronization, synchronization methods, two bright and one dark lamp, synchroscope method, parallel operation-with single alternator and infinite bus.

UNIT–IV

Synchronous Motor – Performance and Starting methods: Variation of current and power factor with excitation, synchronous condenser, power equation, hunting and its suppression, methods of starting, applications of synchronous motor.

UNIT – V

Single Phase Induction Motors: Constructional features, Double revolving field theory, Cross field theory, equivalent circuit, starting methods, Speed Control of single-phase induction motor, Comparison of single-phase Induction motors, application of single-phase induction motor.

Textbooks:

1. P.S.Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
2. I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.

Reference Books:

1. Stephen J. Chapman, Electric Machinery and Power System Fundamentals, McGraw-Hill Education, 2001.
2. Bhag S. Guru, Huseyin R.Hiziroglu, Electric Machinery and Transformers, Oxford University Press, 2012.
3. J.B.Gupta "Theory and performance of Electrical machines" S.K.Kataria & Sons,2013.
4. M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
   A. S. Leinsdorf, "Alternating current machines", McGraw Hill Education, 1984.
5. P. C. Sen, "Principles of Electric Machines and Power Electronics", John Wiley & Sons, 2007.

Online Learning Resources:

1. nptel.ac.in/courses/108/105/108105131
2. https://nptel.ac.in/courses/108106072

Course code	Course Title	L	T	P	Credits
R23EEE-PC2203	Control Systems	3	0	0	3

Course Objectives:

- To obtain the mathematical models of physical systems and derive transfer function.
- To determine the time response of systems and analyse system stability.
- To analyse system stability using frequency response methods.
- To design compensators using Bode diagrams.
- To obtain the mathematical models of physical systems using state space approach and determine the response.

Course Outcomes:

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

1. Determine overall transfer function using block diagram algebra and signal flow graphs.
2. Obtain the time response of first and specifications of second order systems and analyze the absolute and relative stability of LTI systems using Routh's stability criterion and root locus method.
3. Analyze the stability of LTI systems using frequency response methods.
4. Design Lag, Lead, Lag-Lead compensators to improve system performance using Bode Diagrams.
5. Apply state space analysis concepts to represent physical systems as state models.

UNIT - I

Mathematical Modelling of Control Systems: Classification of control systems - open loop and closed loop control systems and their differences - Feedback characteristics - transfer function of linear system, differential equations of electrical networks- translational and rotational mechanical systems- block diagram reduction techniques – representation by signal flow graph – reduction using Mason's gain formula.

UNIT - II

Time Response Analysis: Standard test signals – time response of first and second order systems – time domain specifications - steady state errors and error constants - effects of proportional (P) - proportional integral (PI) - proportional derivative (PD) proportional integral derivative (PID) systems.

Stability and Root Locus Technique: The concept of stability – Routh's stability criterion – limitations of Routh's stability, root locus concept – construction of root loci (simple problems) - Effect of addition of Poles and Zeros to the transfer function.

UNIT – III:

Frequency Response Analysis: Introduction to frequency domain specifications – Bode diagrams – transfer function from the Bode diagram –Polar plots, Nyquist stability criterion-stability analysis using Bode plots (phase margin and gain margin).

UNIT – IV:

Classical Control Design Techniques: Lag, lead, lag-lead compensators - physical realization - design of compensators using Bode plots.

UNIT – V:

State Space Analysis of LTI Systems: Concepts of state - state variables and state model - state space representation of transfer function: Controllable Canonical Form - Observable Canonical Form - Diagonal Canonical Form, Diagonalization using linear transformation - solving the time invariant state equations State Transition Matrix and its properties- concepts of controllability and observability.

Text Books:

1. Modern Control Engineering by Kotsuhiko Ogata, Prentice Hall of India, 5th edition, 2015.
2. Automatic control systems by Benjamin C.Kuo, Prentice Hall of India, 9th Edition,2014.

Reference Books:

1. Control Systems principles and design by M.Gopal, Tata Mc Graw Hill education Pvt Ltd., 4th Edition.
2. Control Systems Engineering by Norman S. Nise, Wiley Publications, 7th edition
3. Control Systems by Manik Dhanesh N, Cengage publications.
4. Control Systems Engineering by I.J.Nagarath and M.Gopal, Newage International Publications, 5th Edition.
5. Control Systems Engineering by S.Palani, Tata Mc Graw Hill Publications.

Online Learning Resources:

1. https://archive.nptel.ac.in/courses/107/106/107106081/
2. https://archive.nptel.ac.in/courses/108/106/108106098/
3. https://nptelvideos.com/video.php?id=1423&c=14

Course code	Course Title	L	T	P	Credits
R23EEE-PC2204	Induction and Synchronous Machines Lab	3	0	0	3

Course Objectives:

- To Operate and test the 3-phase induction motor to find its characteristics and efficiency at the different loads.
- To understand the circle diagram of an induction motor by conducting a no load and blocked rotor test on 3-phse induction motor.
- To perform no-load and blocked–rotor test on single-phase Induction motor and to determine the parameters of equivalent circuit.
- To Understand the speed control of ac machines by V/F and rotor resistance control methods
- To Predetermine the Regulation and efficiency of Three–Phase Alternator by various Methods.
- To Study the effect of variation of field current upon the stator current and power factor of a synchronous motor at various load and draw V-curves and invert V-curves.

Course outcomes:

At the end of this Course, the Student will be able to

1. Analyze the performance characteristics of AC machines by Effective Collaboration in teams
2. Apply speed control techniques on various AC machines that are required for project designs
3. Estimate how much reactive power is reduced by capacitor banks in order to abide by environmental requirements
4. Determine the voltage regulation using specific methods are applied in industrial alternators
5. Estimate the reliable data by Conducting tests accurately for AC motor performance evaluation by Prioritizing safety protocols

Following any 10 Experiments are required to be conducted as compulsory:

1. Brake test on Three Phase Induction Motor.
2. No–load & Blocked Rotor Tests on Three Phase Induction Motor.
3. Speed Control of Induction Motor by V/f method.
4. Regulation of a Three –Phase Alternator by Synchronous Impedance method and MMF method.
5. Regulation of Three–Phase Alternator by Potier Triangle Method.
6. Determination of X_d, X_q and Regulation of a Salient Pole Synchronous Machine.
7. Synchronization of alternator by Dark Lamp method.
8. V and Inverted V Curves of a Three Phase Synchronous Motor.
9. Equivalent circuit parameters of Single-Phase Induction Motor
10. Power factor improvement of Single-Phase Induction motor by using Capacitor bank.
11. Determination of efficiency of three phase alternator by loading with three phase induction motor.
12. Star-delta starting of a three-phase induction motor.
13. Speed control of Three Phase Induction Motor by rotor resistance method
14. Load test on Single Phase Induction Motor

Course code	Course Title	L	T	P	Credits
R23EEE-PC2205	Control Systems Lab	0	0	3	1.5

Course Objectives:

- To impart hands on experience to understand the performance of basic control system components such as magnetic amplifiers, D.C. servo motors, A.C. Servo motors and Synchro's.
- To understand time and frequency responses of control system with and without controllers and compensators.

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

1. Analyse the time response of system (first order and second order system).
2. Design of PID controllers and compensators.
3. Determine the transfer function of D.C Motor
4. Judge the stability in time and frequency domain and Kalman's test for controllability and observability
5. Analyse the potentiometer and determine the state space analysis concepts to represent physical systems as state models in MATLAB

List of Experiments any 10 of the following experiments are to be conducted:

1. Analysis of First order system in time domain (For Step, Ramp Inputs)
2. Analysis of Second order system in time domain (For Step, Ramp Inputs)
3. Effect of P, PD, PI, PID Controller on a second order systems
4. Design of Lag Compensation - Magnitude and phase plot
5. Design of Lead Compensation - Magnitude and phase plot
6. Transfer function of DC Motor
7. Potentiometer as an error detector
8. Stability analysis of Linear Time Invariant system using Root Locus Technique (MATLAB)
9. Stability analysis of Linear Time Invariant system using Bode Plot Technique (MATLAB)
10. Stability analysis of Linear Time Invariant system using Nyquist Plot Technique (MATLAB)
11. Kalman's test of Controllability and Observability using MATLAB.
12. State space model for classical transfer function using MATLAB.

Course code	Course Title	L	T	P	Credits
R23CSE-PC2202	Python Programming Lab (Skill Oriented Course)	1	0	2	2

Course Objectives: The main objectives of the course are to

- Introduce core programming concepts of Python programming language.
- Demonstrate about Python data structures like Lists, Tuples, Sets and dictionaries
- Implement Functions, Modules and Regular Expressions in Python Programming and to Create practical and contemporary applications using these.

COURSE OUTCOMES: At the end of the course, students will be able to:

1. Implement and debug simple Python programs.
2. Implement Python programs with Conditionals and Loops and functions.
3. Implement Python Lists, Tuples and Dictionaries for representing compound data.
4. Interpret the concepts of Object-Oriented Programming as used in Python
5. 5.Appply the Module Concepts and Packages for Real Time Applications

UNIT-I

History of Python Programming Language, Thrust Areas of Python, Installing Anaconda Python Distribution, Installing and Using Jupyter Notebook.

Parts of Python Programming Language: Dynamic and Strongly Typed Language, Identifiers, Keywords, Statements and Expressions, Variables, How to Running Python scripts, Basic Data Types, Indentation, Comments, Reading Input, Print Output, Operators, Type Conversions.

Sample Experiments:

1. Demonstrate the python script by running in Interactive and Script Mode.
2. Write a python script to read using input () and display using print () functions.
3. Write a program to swap two numbers without using a temporary variable.
4. Write a Python Program to Convert Celsius To Fahrenheit
5. Write a Python program to compute area of triangle.
6. Write a program to calculate the circumference of the circle
7. Write a Python program to compute distance between two points in a 2-dimensional Coordinate system.
8. Write a Python program that calculates number of seconds in a day
9. Write a python script to make use of all conversion functions.
10. Demonstrate the following Operators in Python with suitable examples. i) Arithmetic
11. Operators ii) Relational Operators iii) Assignment Operators iv) Logical Operators v) Bit wise Operators vi) Membership Operators vii) Identity Operator.

UNIT-II

Control Flow Statements: if statement, if-else statement, if...elif…else, Nested if statement, while Loop, for Loop, continue and break Statements.

Functions : Built-In Functions, Function Definition and Calling the function, return Statement and void Function, Scope and Lifetime of Variables, Default Parameters, Keyword Arguments, *args and **kwargs, Command Line Arguments. Anonymous Functions, Lambda, map, reduce and filter.

Sample Experiments:

1. Write a program to find the largest element among three Numbers.
2. Write a program to find the factorial of a given number
3. Write a Python program to find the given year is leap year or not
4. Write a Program to display all prime numbers within an interval
5. Write a python program to check whether given letter is vowels or not
6. Write a python script to take five subject marks and print the grade for the student.
7. Program to check whether a person is eligible to vote or not
8. Write a Python program to calculate the sum of the first N natural numbers using a while loop. Take N as input from the user.
9. Write a program to take input as integer N and check whether N is Pronic Number or not. (Product of two consecutive numbers is pronic N(N+1): Eg 110 = 10*11)
10. Write a python script to take input as amount in rupees R and find out the least number of notes N that can be possible to store in a Wallet. (Hint Notes: 2000,500,200,100,50,20,10) Eg: R=2589, N=5
11. Write a python script to implement map(), reduce() and filter() functions

UNIT-III

Strings & Data Structures: Strings**,** Lists, String and List Slicing, Tuple, Sets, Frozen Sets, Dictionaries, Comprehensions, Built-in methods of all sequences, File Handling: Reading and writing files, File modes and file objects

Sample Experiments:

1. 1.Write a program to perform the given operations on a strings

   i) Creating the string ii) slicing the string iii) Delete character in the string
2. Write a program to perform the given operations on a list:

   i) Creating the list ii) slicing in the lists iii) Adding Elements in List iv) Deleting the list elements
3. Write a python script to take two string S1 and S2 and do the following:

i)Check S1 and S2 are anagrams or not. ii) Check S1 is Sub string of S2 or not. iii)S1 is palindrome or not

4. Write a program to check if a given key exists in a dictionary or not.
5. Write a program to add a new key-value pair to an existing dictionary.
6. Write a program to take input as String S and print frequency of each character in S using List data structure.
7. Write a program to take input as String S contains characters and special symbols, reverse the String S such that special symbols remains at same position. (Eg. S=”m@d#u” , Output=”u@d#m”).
8. Write a python script to take input as String sentence S and print each word count using dictionary.
8. Write a program to sort words in a file and put them in another file. The output file should have only lower-case words, so any upper-case words from source must be lowered.
9. Python program to compute the number of characters, words and lines in a file.

UNIT-IV

Object Oriented Programming OOP in Python: Classes, 'self- variable', Methods, Constructor, Inheritance, Polymorphism, and Data Abstraction.

Errors and Exceptions: Syntax Errors, Exceptions, Exception Handlers,

Sample Experiments:

1. Write program on create classes and objects.
2. Write a program on Default constructors, constructor with parameters
3. Write a program on class variables and instance variables.
4. Write a Python program to create a class that represents a shape. Include methods to calculate its area and perimeter. Implement subclasses for different shapes like circle, triangle, and square.
5. Write a Python program to create a person class. Include attributes like name, country and date of birth. Implement a method to determine the person's age.
6. Write a Python program to create a class representing a shopping cart. Include methods for adding and removing items, and calculating the total price.
7. Using Python OOPS, create a class, constructor, method, __str__ and __repr__ for Employee, Student
8. Write a python program to implement Exceptions hierarchy.
9. Write a program to Catching Specific Exceptions in Python Python program to try

with else clause.

UNIT-V

Modules: Creating modules, import statement, from import statement, random, Math, JSON, date, Request, RegEx. **Packages:** Introduction to PIP, Installing packages using PIP.

Introduction to Data Science: NumPy, Pandas,MatplotLib

1. Write a python script to take input as multi-line string and find the sum of all numbers in that string using re module. (Eg. S=”he11o they are 40students in97 room of 4th line” , Sum= 152)
2. Using RegEx object check whether given phone number, email address and password is valid or not.
3. Python program to check whether a JSON string contains complex object or not
4. Using date module, write a python script to take input as Date of birth (DOB) and current date(CD) and print age of the person.
5. Python Program to demonstrate NumPy arrays creation using array()function.
6. Python script to load data sets.
7. Write a python script to create a data frame.
8. Python program to demonstrate use of ndim, shape, size,dtype.
9. Using NumPy, implement different matrix operations in python.

Applications:

- Web Application Development and Scraping
- Designing Games
- Machine Learning and AI based applications
- Embedded Systems and IoT Applications
- Data Science and Visualization
- Embedded and CAD Applications

Reference Books:

1. Gowrishankar S,VeenaA., Introduction to Python Programming, CRC Press.
2. Python Programming, S Sridhar,J Indumathi,V M Hariharan,2nd Edition, Pearson, 2024
3. Introduction to Programming Using Python, Y . Daniel Liang, Pearson.

Online Learning Resources/ Virtual Labs:

1. https://www.coursera.org/learn/python-for-applied-data-science-aihttps://www.coursera.org/learn/python?specialization=python#syllabus

Course code	Course Title	L	T	P	Credits
R23EEE-ES2201	Design Thinking & Innovation	1	0	2	2

Course Objectives:

- To familiarize students with design thinking process as a tool for breakthrough innovation.
- To equip students with design thinking skills and ignite the minds to create innovative ideas, develop solutions for real-time problems.

Course Outcomes:

1. Explain the fundamentals of Design Thinking and innovation
2. Apply the design thinking techniques for solving problems in various sectors
3. Analyse to work in a multidisciplinary environment
4. Evaluate the value of creativity
5. Formulate specific problem statements of real time issues

UNIT I

Introduction to Design Thinking: Introduction to elements and principles of Design, basics of design-dot, line, shape, form as fundamental design components. Principles of design. Introduction to design thinking, history of Design Thinking, New materials in Industry.

UNIT II

Design Thinking Process: Design thinking process (empathize, analyze, idea & prototype), implementing the process in driving inventions, design thinking in social innovations. Tools of design thinking - person, costumer, journey map, brainstorming, product development

Activity: Every student presents their idea in three minutes, every student can present design process in the form of flow diagram or flow chart etc. Every student should explain about product development.

UNIT III

Innovation: Art of innovation, Difference between innovation and creativity, role of creativity and innovation in organizations- Creativity to Innovation- Teams for innovation- Measuring the impact and value of creativity.

Activity: Debate on innovation and creativity, Flow and planning from idea to innovation, Debate on value-based innovation.

UNIT IV

Product Design: Problem formation, introduction to product design, Product strategies, Product value, Product planning, product specifications- Innovation towards product design- Case studies

Activity: Importance of modelling, how to set specifications, Explaining their own product design.

UNIT V

Design Thinking in Business Processes: Design Thinking applied in Business & Strategic Innovation, Design Thinking principles that redefine business – Business challenges: Growth, Predictability, Change, Maintaining Relevance, Extreme competition, Standardization. Design thinking to meet corporate needs- Design thinking for Startups- Defining and testing Business Models and Business Cases- Developing & testing prototypes.

Activity: How to market our own product, about maintenance, Reliability and plan for startup.

Textbooks:

1. Tim Brown,Change by design, Harper Bollins (2009)
2. Idris Mootee, Design Thinking for Strategic Innovation, 2013, John Wiley & Sons.

Reference Books:

1. David Lee, Design Thinking in the Classroom, Ulysses press
2. Shrutin N Shetty, Design the Future, Norton Press
3. William Lidwell, Universal Principles of Design- Kritinaholden, Jill Butter.
4. Chesbrough. H, The Era of Open Innovation – 2013

Online Learning Resources:

1. https://nptel.ac.in/courses/110/106/110106124/
2. https://nptel.ac.in/courses/109/104/109104109/
3. https://swayam.gov.in/nd1_noc19_mg60/preview

Course code	Course Title	L	T	P	Credits
R23BSH-MC2201	English For Employability Skills	0	0	3	0

Course Objectives

- Aims to help learners develop their English language skills, particularly those planning to appear for Competitive Exams that test their English Language abilities.
- Gains the power of expression through rich Vocabulary.
- Imparts critical reading strategies for comprehension of complex texts
- Provides training and opportunities to develop fluency in English through participation in formal group discussions and Self Introductions.
- Demonstrates good writing skills for effective Paragraph Writing, Essay Writing and formal correspondence through Emails.
- Encourages use of a wide range of grammatical structures, Phrases, Clauses and Idioms in speech and writing.

Course Outcomes

1. Enable students to identify Parts of Speech and use them flawlessly, write Emails in formal correspondence effectively, participate confidently by introducing oneself in any formal discussion.
2. Attain Language Proficiency & Accuracy through Contextualized Vocabulary, Verb forms, Tense and subject verb agreement, produce coherent expressions for professional writing, introduce themselves unhesitatingly with Task-Based Activities.
3. Develop the fluency and accuracy to write Technical Reports and Emails for professional communication by using appropriate vocabulary and participate confidently in any formal discussion.
4. Assimilate lifelong reading habit to comprehend a passage for its gist. Avoid the errors in both Speech & Writing and write Letters and Emails for official communication.Realise the technical communicative competence and attainment of grammatically correct structures for formal communication.

Unit 1

Vocabulary: How to talk about actions. **Grammar:U**sing and Identifying Parts of Speech accurately **. Writing:** Paragraph Writing and formal correspondence through Emails**. Speaking:**Background to Group discussions & Self-introductions.

Unit 2

Vocabulary: How to talk about various speech habits.**Grammar**: Learning Verb forms, Tenses and Subject-verb agreement and using them accurately in both Speaking and Writing contexts. **Writing :**Essay Writing and formal correspondence through Emails. **Speaking:**Four major areas -Subject Knowledge, Oral Communication Skills, Leadership Skills and Team Management-of GD;Real time GDs for Evaluation.

Unit 3

Vocabulary: How to insult your enemies**. Grammar:** Sentence Analysis & Synthesis - Voice, Degrees of Comparison, Reported Speech and Types & Forms of sentences. **Writing:** Report writing and Emails for formal correspondence**. Speaking:** Roles in structured GDs; real time GDs for practicing the above roles.

Unit 4

Vocabulary: How to flatter your friends**. Grammar**: Common errors and Correction of Sentences **Reading:**Reading Comprehension passages through Skimming and Scanning and understanding the gist or the specific purpose of them.. **Writing:** Letter writing and Emails. **Speaking:**Advantages of GDs for hiring process ; real time GDs for evaluating.

Unit 5

Vocabulary & Grammar: High-frequency words for all competitive exams, Clause ,Phrase & Idioms**. Reading:** Reading for Comprehending **Writing:**Business Letters and Emails **Speaking:**Group Discussions for Evaluation

Reference Books

1. Bailey, Stephen. Academic writing: A handbook for international students. Routledge, 2014.
2. Chase, Becky Tarver. Pathways: Listening, Speaking and Critical Thinking. Heinley ELT; 2nd Edition, 2018.
3. Skilful Level 2 Reading & Writing Student's Book Pack (B1) Macmillan Educational.
4. Hewings, Martin. Cambridge Academic English (B2). CUP, 2012. (Student Book, Teacher Resource Book, CD & DVD)
5. Word Power Made Easy by Norman Lewis

ASSESSMENT

The learners will demonstrate their knowledge and abilities through completion of the following required assessments while or at the end of this course. —2 Quizzes, 1 Professional Certificate, 3 Activities on LSRW skills.

Quiz: Quiz is conducted on Grammar & Vocabulary. Each Quiz consists of 50 questions and will be scaled down to 5 Marks. Two quizzes are conducted. One after the 3rd unit, the other, after the last unit. Duration of any quiz is 1hr 30 Min only.These Quizzes are Computer Based Tests (CBT)

Professional Certificate: An International Language Assessment Certificate secured on B1 of Common European Framework for Reference (CEFR) scale.

Activities on LSRW skills:

Interviews: The candidate has to interview one celebrity of his/her own choice.

The recorded 5-7 min video of the candidate should be uploaded on the ELCS LABLendi Youtube Channel with the help of concerned English Teacher

The Evaluation Parameters:

- Quality of the Questionnaire(3M)
- Body Language & Confidence of the candidate(5M)
- Youtube likes & Comments(2M)

E-mails: Each student is required to submit 5 independently written Emails during the course. Specific requirements for each one are accessed on the following Link:
https://docs.google.com/document/d/1IXuzjjmfiOLI23t8xlbLwNefRzIIXi9aOi3XkSHIK_Q/edit?usp=sharing

Listen to Speak: Students are expected to watch and listen to any one of the 10 given educational video and audio clips to express their point of view. After watching, they will have the opportunity to share their points of view about some of the everyday issues that they can relate to. They have to explain and justify their reasoning to a team of three peers to explore their verbal expressions and their points of view before an External Examiner.

The following is the link to access those clippings:
https://docs.google.com/document/d/1tFuQ_43AVAHKJGVs9AeOODHJTnQMoydqcodSgENaZ3o/edit?usp=drivesdk

Details of Peer Evaluation & Assessment Parameters are available on the following Link: https://docs.google.com/document/d/16l_PUzaOONnjpvMYVzE3XAYUBNhqMK9PbdDOPGIef_8/edit?usp=sharing

Grading:

Assessment Model	Points
Quiz-1	**10**
Quiz-2	**10**
Professional Certificate with B1 or above or Activity of Interview	**10**
E-Mails	**10**
Listen to Speak Activity	**10**
Total	**50**

Pass Criterion:

1. Student has to Secure 30 Marks to pass this examination
2. Student who is having a certificate of any International standard of English he/she has to secure a Minimum 20 Marks in this examination (Certificate+20 Marks) to pass the summative exam.
3. Student who is not having a certificate has to clear the exam with 30 marks mandatorily.
4. Clearing all categories is mandatory. Need to get 60% each category.
   20M +Certificate=Successful or 30M+No certificate=Successful

Honors Elective-I Syllabus

Course code	Course Title	L	T	P	Credits
R23EEE-HN2201	Renewable Energy Systems & Sources Honors Course-1(Track-1)	3	0	0	3

Course Objectives:

- To study the solar radiation data, extraterrestrial radiation, radiation on earth's surface.
- To study solar thermal collections.
- To study maximum power point techniques in solar Photovoltaic Systems
- To study wind energy conversion systems, Betz coefficient, tip speed ratio and geothermal systems.
- To study basic principle and working of tidal, biomass and fuel cell

Course Outcomes: After completion of the course, the student will be able to

1. Understand the basic concepts of solar radiation, its data on earth's surface
2. Explain the different types of solar thermal energy collectors
3. Develop the maximum power point techniques in solar Photovoltaic Systems
4. Understand the Wind energy conversion systems and the various geothermal resources
5. Explain the methods of generation of electricity from tidal and chemical resources

UNIT–I

Fundamentals of Energy Systems and Solar energy: Energy conservation principle – Energy scenario (world and India) – various forms of renewable energy - Solar radiation: Outside earth's atmosphere – Earth surface – Analysis of solar radiation data – Geometry – Radiation on flat and tilted surfaces – Numerical problems.

UNIT–II

Solar Thermal Systems: Liquid flat plate collectors: Performance analysis –Transmissivity– Absorptivity, collector efficiency factor – Collector heat removal factor – Numerical problems, Introduction to solar air heaters – Concentrating collectors, solar pond and solar still – solar thermal plants.

UNIT–III

Solar Photovoltaic Systems: Solar photovoltaic cell, module, array – construction – Efficiency of solar cells – Developing technologies – Equivalent circuit of solar cell – Series resistance – Shunt resistance – Cell I-V characteristics and P-V characteristics. Applications and systems – Balance of system components – System design: storage sizing – PV system sizing – Maximum power point techniques: Perturb and observe (P&O) technique- Hill climbing technique, MPPT during partial shading condition.

UNIT–IV

Wind Energy and Geothermal Systems: Sources of wind energy - Wind patterns – Types of turbines –Horizontal axis and vertical axis machines - Kinetic energy of wind – Betz coefficient – Tip–speed ratio – Efficiency – Power output of wind turbine – Selection of generator (synchronous, induction) – Maximum power point tracking – wind farms – Power generation for utility grids.

Geothermal: Classification – Dry rock and hot acquifer – Energy analysis – Geothermal based electric power generation

UNIT–V

Tidal power systems, Biomass and fuel cells: Tidal power – Basics – Kinetic energy equation – Turbines for tidal power – Numerical problems – Wave power – Basics – Kinetic energy equation – Wave power devices – Linear generators.

Biomass Energy: Fuel classification – Pyrolysis – Direct combustion of heat – Different digesters and sizing.

Fuel cell: Classification of fuel for fuel cells – Fuel cell voltage– Efficiency – V-I characteristics- Applications of Fuel cell.

Text Books:

1. Solar Energy**:** Principles of Thermal Collection and Storage, S. P. Sukhatme and J. K. Nayak, TMH, New Delhi, 3rd Edition.
2. Renewable Energy Resources, John Twidell and Tony Weir, Taylor and Francis - second edition, 2013.

Reference Books:

1. Energy Science**:** Principles, Technologies and Impacts, John Andrews and Nick Jelly, Oxford University Press.
2. Renewable Energy- Edited by Godfrey Boyle-oxford university.press,3rd edition,2013.
3. Handbook of renewable technology Ahmed and Zobaa, Ramesh C Bansal, World scientific, Singapore.
4. Renewable energy technologies – A practical guide for beginners – Chetong Singh Solanki, PHI.
5. Non-conventional energy source –B.H.khan- TMH-2nd edition.

Online Learning Resources:

1. https://nptel.ac.in/courses/103103206

Course code	Course Title	L	T	P	Credits
R23EEE-HN2202	Electric Vehicle Technology and Mobility Honors Course-1(Track-2)	3	0	0	3

Course Objectives:

- To Understand the fundamental concepts and principles of Electric vehicles
- To Apply the concepts to implement battery technology
- To Apply the concepts to implement charging technology
- To Understand the future trends in EVs

Course Outcomes: After completion of the course, the student will be able to

1. Describe the fundamental concepts and principles of Electric vehicles
2. Apply the battery technology for EVs
3. Apply the charging, Vehicle to X(V2X), X2V technology in EVs
4. Describe future technology for EVs such as Wireless charging, On-road charging, battery swap and solar powered EVs
5. Analyse the different policy perspectives and innovation in future mobility

UNIT I

INTRODUCTION: Introduction to electric vehicles: EV verses gasoline vehicles, vehicle dynamics fundamentals, e-drive train, Electric motor, Power electronic in electric vehicles, Regenerative braking.

UNIT II

BATTERY TECHNOLOGY: Battery Technology for EVs: Storage technologies for EV, Battery working principles, Battery losses, Li-ion batteries, Battery pack and battery management system.

UNIT III

CHARGING TECHNOLOGY: Charging Technology of EVs: AC charging - Type 1,2,3, DC charging, Fast charging and its limitations, Smart charging and applications, Vehicle to X(V2X), X2V technology.

UNIT IV

FUTURE TRENDS IN EVs: Future trends in e-Vehicles: Wireless charging of EV, On-road charging of EV, Battery swap technology, Solar powered EVs, Charging EVs from renewable.

UNIT V

E-MOBILITY: E-mobility: electrification challenges, business, connected mobility and autonomous mobility case study in Indian Roadmap Perspective, Policy- EVs in infrastructure system, integration of EVs in smart grid, social dimensions of EVs.

Textbooks:

1. Iqbal Hussain, “Electric & Hybrid Vehicles – Design Fundamentals”, Second Edition, CRC Press, 2011.
2. James Larminie, “Electric Vehicle Technology Explained”, John Wiley & Sons, 2003.

Reference Books:

1. Mehrdad Ehsani, Yimin Gao, Ali Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals", CRC Press, 2010.
2. Sheldon S. Williamson, Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles, Springer, 2013.
3. Sandeep Dhameja, "Electric Vehicle Battery Systems", Newnes, 2000
4. Tariq Muneer and Irene Illescas García, "The automobile, In Electric Vehicles: Prospects and Challenges", Elsevier, 2017.

Online Learning Resources:

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

Course code	Course Title	L	T	P	Credits
R23EEE-HN2203	Embedded System Design Honors Course-1(Track-3)	3	0	0	3

Course Objectives:

- To introduce major components of an embedded system
- To explain different characteristics and quality attributes of embedded systems.
- To expose role of firmware, and device driver programming.
- To explain implementation of hardware and software co-design in embedded system
- To explain embedded software development tools and debugging techniques.

Course Outcomes:

1. Interpret embedded system and its hardware and software
2. Identify different characteristics and quality attributes of embedded systems
3. Explain role of firmware, and device driver programming
4. Illustrate different types of operating systems and Multitasking
5. Apply embedded Software development tools to design and develop the embedded system

UNIT-I

Introduction to Embedded Systems: What is embedded system, embedded systems vs. general computing systems, history of embedded systems, and classification of embedded systems, major application areas of embedded systems, purpose of embedded systems, Design process in embedded systems, skills required for an embedded system designer, Design process and Design examples of embedded systems.

UNIT-II

Typical Embedded System: A typical embedded system, Core of embedded system, Memory, Sensors & actuators, Communication Interface, Embedded firmware, other system components, Characteristics and Quality attributes of embedded system.

UNIT-III

Embedded Firmware Development: Programmed I/O, ISR concept, Interrupt service Mechanism, Period for context switching, Interrupt latency and deadline, DMA, device driver programming.

UNIT-IV

RTOS and Hardware& software Co-design: Operating system basics, Types of operating systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling, Threads, Processes and Scheduling, Task communication, Task synchronization, Device Drivers, Fundamental Issues in Hardware Software Co-Design, Hardware Software Tradeoffs.

UNIT-V

Embedded Software development tools and debugging techniques: Embedded Software development tools, Host and target systems, cross compilers, linkers, locators for embedded systems. Getting embedded software in to the target system. Debugging techniques. Testing on host machine, Instruction set emulators, logic analyzers. In-circuit emulators and monitors, Laboratory tools.

Text Books

1. Shibu K V, Introduction to Embedded Systems, 2nd edition, McGraw Hill Education,2017.
2. Raj Kamal, Embedded Systems: Architecture, Programming and Design, 3rd edition, McGraw Hill Education, 2017.

References

1. Embedding system building blocks, Labrosse, via CMP publishers.
2. Computers as Components-principles of Embedded computer system design, Wayne Wolf, Elseveir.
3. Ali Mazidi Gillispie, Mazide Janice, "The 8051 microcontroller and embedded system using assembly & C", 2nd edition, pearson education, 2009.
4. An Embedded Software Primer, David E. Simon, Pearson Education.
5. The 8051 Microcontroller, Third Edition, Kenneth J.Ayala, Thomson.