

**DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING
R-21 UNDER GRADUATE (B.Tech) COURSE STRUCTURE**

I Year - I Semester						
S.No	Course Code	Course Title	L	T	P	C
1	P21HST01	Communicative English	3	0	0	3
2	P21BST01	Linear Algebra & Differential Equations	3	0	0	3
3	P21BST04	Applied Chemistry	3	0	0	3
4	P21EST01	Engineering Graphics	3	0	0	3
5	P21EST03	C-Programming for Problem Solving	3	0	0	3
6	P21HSL01	English Language Communication Skills Lab	0	0	3	1.5
7	P21BSL03	Applied Chemistry Lab	0	0	3	1.5
8	P21ESL02	C-Programming for Problem Solving Lab	0	0	3	1.5
9	P21MCT01	Induction program	2	0	0	0
Total Credits						19.5

I Year - II Semester						
S.No	Course Code	Course Title	L	T	P	C
1	P21BST02	Applied Physics	3	0	0	3
2	P21BST06	Numerical Methods & Vector calculus	3	0	0	3
3	P21EST06	Electrical Circuits Analysis-I	3	0	0	3
4	P21EST11	Electronic Devices and Circuits	3	0	0	3
5	P21EST13	Data Structures	3	0	0	3
6	P21BSL01	Applied Physics Lab	0	0	3	1.5
7	P21ESL05	Electronic Devices and Circuits Lab	0	0	3	1.5
8	P21ESL06	Data Structure Lab	0	0	3	1.5
9	P21MCT02	Biology for Engineering	2	0	0	0
Total Credits						19.5

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II Year - I Semester						
S.No	Course Code	Course Title	L	T	P	C
1	P21BST07	Transformation Techniques and Differential Equations	3	0	0	3
2	P21EET01	Electrical Circuit Analysis – II	3	0	0	3
3	P21EET02	Electro Magnetic Fields	3	0	0	3
4	P21EET03	Electrical Machines - I	3	0	0	3
5	P21EET04	Power Systems –I	3	0	0	3
6	P21EEL01	Electrical Circuits Lab	0	0	3	1.5
7	P21EEL02	Electrical Machines – I Lab	0	0	3	1.5
8	P21EEL03	Electrical workshop	0	0	3	1.5
9	P21EES01	Skill Oriented Course - I	1	0	2	2
10	P21MCT03	Environmental Studies	2	0	0	0
Total Credits						21.5

II Year - II Semester						
S.No	Course Code	Course Title	L	T	P	C
1	P21CST01	Python Programming	3	0	0	3
2	P21EET05	Electrical Machines - II	3	0	0	3
3	P21EET06	Power Systems - II	3	0	0	3
4	P21EET07	Electrical Measurements	3	0	0	3
5	P21ECT02	Switching Theory and Logic Design	3	0	0	3
6	P21CSL01	Python Programming Lab	0	0	3	1.5
7	P21EEL04	Electrical Machines – II Lab	0	0	3	1.5
8	P21EEL05	Electrical Measurements Lab	0	0	3	1.5
9	P21EES02	Skill Oriented Course - II	1	0	2	2
Total Credits						21.5
Internship 2 Months (Mandatory) during summer vacation						

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III Year - I Semester						
S.No	Course Code	Course Title	L	T	P	C
1	P21EET08	Power Electronics	3	0	0	3
2	P21EET09	Control Systems	3	0	0	3
3	P21ECT10	Pulse and Digital Circuits	3	0	0	3
4	P21EETXX	Professional Elective-I	3	0	0	3
5	P21XXXXX	Open Elective-I	3	0	0	3
6	P21EEL06	Power Electronics Lab	0	0	3	1.5
7	P21EEL07	Control Systems Lab	0	0	3	1.5
8	P21EESO3	Certificate course being offered by industries/ professional bodies/ APSSDC or any other accredited bodies.	1	0	2	2
9	P21XXXXX	Professional Ethics and Human values	2	0	0	0
10	P21XXXX	Summer Internship 2 Months (Mandatory) after II Year (to be evaluated during III Year I Semester)	0	0	0	1.5
Total Credits						21.5

Professional Elective - I		
S.No	Course Code	Course Title
1	P21EEP01	Renewable Energy Sources
2	P21EEP02	Energy Audit and Conservation Management
3	P21EEP03	Electrical Machine Modelling
4	P21EEP04	Fundamentals of Electrical Vehicles

Open Elective - I		
S.No	Course Code	Course Title
NPTEL COURSE		

**DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING
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III Year - II Semester						
S.No	Course Code	Course Title	L	T	P	C
1	P21EET11	Power System Analysis	3	0	0	3
2	P21EET12	Switchgear and Protection	3	0	0	3
3	P21ECT05	Linear and Digital IC Applications	3	0	0	3
4	P21EEXXX	Professional Elective-II	3	0	0	3
5	P21XXXXX	Open Elective-II	3	0	0	3
6	P21EEL08	Electrical Simulation Lab	0	0	3	1.5
7	P21EEL09	Power Systems Lab	0	0	3	1.5
8	P21EEL10	PDC Lab/LDIC Lab	0	0	3	1.5
9	P21EES04	Soft Skill/MATLAB	1	0	2	2
10	P21XXXXX	Design Thinking for Innovation	2	0	0	0
Total Credits						21.5
Industrial/Research Internship (Mandatory) 2 Months during summer vacation						

Professional Elective - II		
S.No	Course Code	Course Title
1	P21EEP05	Power Semiconductor Drives
2	P21EEP06	Utilization of Electrical Energy
3	P21EEP07	Control and Integration of RES
4	P21EEP08	IOT Applications in Electrical Engineering

Open Elective - II		
S.No	Course Code	Course Title
NPTEL COURSE		

**DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING
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IV Year - I Semester						
S.No	Course Code	Course Title	L	T	P	C
1	P21EETXX	Professional Elective-III	3	1	0	3
2	P21EETXX	Professional Elective-IV	3	0	0	3
3	P21EETXX	Professional Elective-V	3	0	0	3
4	P21XXXXX	Open Elective-III	3	0	0	3
5	P21XXXXX	Open Elective-IV	3	0	0	3
6	P21XXXXX	Universal Human Values-II	3	0	0	3
7	P21XXXXX	Employability Skills	1	0	2	2
8	P21XXXXX	Industrial/Research Internship 2 Months (Mandatory) after III Year (to be evaluated during IV Year I Semester)	0	0	0	3
Total Credits						23

Professional Elective - III		
S.No	Course Code	Course Title
1	P21EEP09	Power System Operation and Control
2	P21EEP10	Electrical Distribution Systems
3	P21EEP11	Special Electrical Machines
4	P21EEP12	Smart Grid Technologies
5	P21EEP13	Extra High Voltage AC Transmission

Professional Elective - IV		
S.No	Course Code	Course Title
1	P21EEP14	HVDC Transmission
2	P21EEP15	Flexible AC Transmission Systems
3	P21EEP16	Machine Learning Applications in Electrical Engineering
4	P21EEP17	Industrial Automation
5	P21EEP18	Power Electronics for Renewable Energy Sources

Professional Elective - V		
S.No	Course Code	Course Title
1	P21EEP17	Programmable Logic Controller
2	P21EEP18	Instrumentation
3	P21EEP19	Electric and Hybrid Vehicles
4	P21EEP20	AI Techniques in Electrical Engineering

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IV Year - II Semester						
S.No	Course Code	Course Title	L	T	P	C
1	P21EEXXX	Project Work, Seminar and Internship in Industry	0	0	0	12
Internship (6 Months)						
Total Credits						12



Course Code	Course Name	Course Structure			
		L	T	P	C
P21HST01	Communicative English	3	0	0	3

Internal Marks: 30

External Marks: 70

Course Prerequisite: The students should have basic knowledge of English grammar and LSRW skills.

Course Objectives: The student will be able

1. To enable the engineering students to develop their basic communication skills in English for academic and social purposes.
2. To equip the students with appropriate oral and written communication skills.
3. To inculcate the skills of listening, reading and critical thinking.
4. To integrate English Language learning with employability skills and training.
5. To enhance the students' proficiency in reading skills enabling them to meet the academic demands of their course.

Course Outcomes: After going through this course the student will be able to

1. Use English Language effectively in spoken and written forms
2. Interpret the contextual meaning of words
3. Comprehend the given texts and respond appropriately
4. Recall and reproduce the theme in a given context
5. Communicate confidently in formal and informal contexts

UNIT-I

(9 Lectures)

- a. Reading Skills: Leela's Friend – R.K. Narayan
- b. Vocabulary: Synonyms, Antonyms and Word formation, Root Words
- c. Grammar: Parts of Speech, Sentence structure and Types of sentences
- d. Writing: Letter Writing, Note Making and Note Taking

UNIT-II

(9 Lectures)

- a. Reading Skills: Dr. A.P.J. Abdul Kalam's Biography
- b. Vocabulary: Prefixes, Suffixes and Affixes
- c. Grammar: Prepositions and Articles
- d. Writing: Paragraph Writing and Precis Writing

UNIT-III

(9 Lectures)

- a. Reading Skills: Three Days to See – Helen Keller
- b. Vocabulary: Collocations, One word substitutes & Idioms
- c. Grammar: Tenses, Active voice & Passive voice
- d. Writing: Technical Report Writing

UNIT-IV**(9 Lectures)**

- a. Reading Skills: Satya Nadella's Email to His Employees on His First Day as CEO of Microsoft
- b. Vocabulary: Phrasal verbs and Commonly confused words
- c. Grammar: Subject-Verb Agreement (Concord) and Question tags
- d. Writing: Curriculum vitae, Cover Letter and Resume Writing. (Functional, Chronological and standard Resumes)

UNIT-V**(9 Lectures)**

- a. Reading Skills: Mokshagundam Visveswaraya
- b. Vocabulary: Homonyms, Homophones and Homographs
- c. Grammar: Modal Auxiliaries, Degrees of Comparison and Direct speech & Indirect Speech
- d. Writing: E- mail Writing and Essay Writing

Text Books:

1. New Horizons – Pearson Publishers
2. Fluency in English”, A Course Book for Engg. Students, Published by Orient Black Swan, Hyderabad, 2016 print.
3. “Technical Communication- Principles and Practice”, Third Edition. New Delhi: Oxford University press.
4. Epitome of Wisdom – Maruthi Publications

Reference Books:

1. Meenakshi raman, Sangeetha, Sharma Fundamentals of technical communication, Pg: 119-153 Oxford University press, 2015
2. Rutherford, Andhrea. J, Communication skills for technology. Pearson, New Delhi.2001
3. Raymond Murphy, Murphy's English Grammar, Cambridge University Press 2004
4. Meenakshi raman, Sangeetha, Sharma, Technical communication: English Skills for Engineers, Oxford University press, 2009
5. Michael Swan, Practical English Usage, Oxford University press, 1996

Web Resources:

1. www.englishhints.com
2. www.enchantedlearning.com
3. www.learnenglish.de/grammar/prefixtext.html

4. <http://www.magickeys.com/books/riddles/words.html>
5. http://www.pinnacle.edu.in/campusfiles/1826_campusFile_1.pdf
6. <http://www.yourdictionary.com>
7. <http://www.learnenglish.com>
8. <http://www.cambridge.org>
9. <http://www.eslcafe.com>
10. <http://www.eslgames.com>
11. <http://www.penguin.co.uk>
12. <http://www.edufind.com/english/practice>
13. www.englishhints.com, www.enchantedlearning.com,
14. www.learnenglish.de/grammar/prefixtext.html
15. <http://www.magickeys.com/books/riddles/words.html>



Course Code	Course Name	Course Structure			
		L	T	P	C
P21BST01	Linear Algebra & Differential Equations	3	0	0	3

Internal Marks: 30

External Marks: 70

Course Prerequisite: Basics of Matrix Algebra, Differentiation, Integration

Course Objectives: The student will be able to

1. The concept of rank of a matrix which is used to know the consistency of system of linear equations and find the solution by using various analytical and numerical methods.
2. Eigen values and eigenvectors of a given matrix. Cayley-Hamilton theorem to find the inverse and power of a matrix and determine the nature of the quadratic form,
3. Recognize and model differential equations, apply analytical techniques to compute solutions for engineering problems.
4. The general solution to the higher order linear differential equations and applies to calculate the current in electrical circuits.
5. Explore the use of Laplace transform method to solve with initial value problems of ordinary differential equations.

Course Outcomes: After going through this course the student will be able to

1. Demonstrate the understanding of rank of a matrix. Analyze the solution of the system of linear equations.
2. Find the Eigen values and Eigenvectors of a matrix, apply Cayley-Hamilton theorem to determine inverse and power of a matrix and identify the nature of the quadratic form.
3. Solve the differential equations of first order and first degree related to various engineering fields.
4. Find the complete solution to the higher order linear differential equations and apply these methods to find the current in complex electrical circuits.
5. Apply the technique of Laplace transform and solve differential equations for analytical solutions with the initial conditions.

UNIT-I: Solving System of Linear Equations (8 Lectures)

Rank of a matrix by Echelon form-Normal form- Normal form through PAQ method – Solving system of homogeneous and non-homogeneous linear equations – Gauss elimination – Gauss Jordan methods.

UNIT-II: Eigen values – Eigenvectors, Cayley-Hamilton Theorem and Quadratic forms (10 Lectures)

Eigen values - Eigenvectors– Properties – Cayley-Hamilton theorem (without proof)- Finding inverse and power of a matrix by Cayley-Hamilton theorem–Reduction to Diagonal form. Quadratic forms: Rank, index, signature and nature of the

quadratic forms–Reduction of quadratic form to canonical forms by orthogonal transformation.

UNIT-III: Differential Equations of First Order and First Degree (10 Lectures)

Linear differential equation - Bernoulli's differential equation–Exact equations and equations reducible to exact form.

Applications: Newton's Law of cooling-Law of natural growth and decay-Orthogonal trajectories-Electrical circuits.

UNIT-IV: Linear Differential Equations of Higher order (8 Lectures)

Non-homogeneous equations of higher order with constant coefficients-with RHS term of the type e^{ax} , $\sin ax$, $\cos ax$, polynomials in x , $e^{ax}V(x)$, $x^n V(x)$ and general method - Method of Variation of parameters.

Applications: LCR circuit

UNIT-V: Laplace Transforms (9 Lectures)

Laplace transforms of standard functions– First shifting Theorem-Change of scale property multiplication by t^n –division by t , transforms of derivatives and integrals – Second shifting theorem– Laplace transform of Periodic functions.

Inverse Laplace transforms – Convolution theorem (without proof)

Applications: Evaluation of integrals using Laplace transforms - Solving ordinary differential equations (Initial value problems) using Laplace transforms.

Text Books:

1. B. S. Grewal, Higher Engineering Mathematics, 44th Edition, Khanna Publishers
2. B.V. Ramana, Higher Engineering Mathematics, 2007 Edition, Tata Mc. Graw Hill Education.

Reference Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, Wiley-India.
2. H. K. Das, Advanced Engineering Mathematics, 22nd Edition, S. Chand & Company Ltd.
3. David Poole, Linear Algebra- A modern introduction, 4th edition, Cengage.
4. Peter O' Neil, Advanced Engineering Mathematics, Cengage
5. Srimantha Pal, S C Bhunia, Engineering Mathematics, Oxford University Press.

Web Resources:

1. <http://tutorial.math.lamar.edu/Classes/DE/DE.aspx>
2. <http://mathworld.wolfram.com/topics>
3. <http://www.nptel.ac.in/course.php>

Course Code	Course Name	Course Structure			
		L	T	P	C
P21BST04	Applied Chemistry	3	0	0	3

Internal Marks: 30

External Marks: 70

Course Prerequisite: Basic Chemistry at Intermediate or equivalent level.

Course Objectives: The student will be able

1. To analyze the different types of composite plastic materials and interpret the mechanism of conduction in conducting polymers.
2. To utilize the theory of construction of electrodes, batteries and fuel cells in redesigning new engineering products and categorize the reasons for corrosion and study methods to control corrosion.
3. To understand various synthetic methods of nonmaterials for modern advances of engineering technology. Summarize the preparation of semiconductors; analyze the applications of liquid crystals and superconductors
4. To analyze the principles of different analytical instruments and their applications.
5. To Design models for energy by different natural sources.

Course Outcomes: After going through this course the student will be able to

1. Analyze the different types of composite plastic materials and interpret the mechanism of conduction in conducting polymers.
2. Utilize the theory of construction of electrodes, batteries and fuel cells in redesigning new engineering products and categorize the reasons for corrosion and study methods to control corrosion.
3. Understand various synthetic methods of nonmaterials for modern advances of engineering technology. Summarize the preparation of semiconductors; analyze the applications of liquid crystals and superconductors
4. Analyze the principles of different analytical instruments and their applications.
5. Design models for energy by different natural sources.

UNIT-I: Polymer Technology

(9 Lectures)

Polymerization: Introduction, classification, methods of polymerization (Emulsion and Suspension), mechanical properties.

Plastics: Compounding, fabrication (compression, injection, blown film and extrusion), preparation, properties and applications (Poly ethylene, PVC, Polycarbonates and Bakelite).

Elastomers: Introduction, preparation, properties and applications (Buna S, Thiokol and Polyurethanes).

Composite materials: Fiber reinforced plastics, conducting polymers, biodegradable polymers,

UNIT-II: Electrochemical Cells and Corrosion (10 Lectures)

Galvanic Cells, Single electrode potential, electrochemical series and uses of series, standard hydrogen electrode, calomel electrode, construction of glass electrode, batteries (Dry cell, Li ion battery, Lead Acid battery and Ni-Cd cells).

Corrosion: Definition, theories of corrosion (Chemical and Electrochemical), galvanic corrosion, differential aeration corrosion, stress corrosion, galvanic series, corrosion control (Proper designing and cathodic protection), protective coatings (Surface preparation, Cathodic coatings, Anodic coatings, Electroplating and Electroless plating).

UNIT-III: Chemistry of Advanced Materials (10 Lectures)

Nano materials: Introduction, sol-gel method, characterization by (Brunauer Emmet Teller (BET), and transmission electron microscopy (TEM) with example (TiO₂), applications of fullerenes, carbon nanotubes (types, preparation and applications).

Liquid crystals: Introduction-types-applications.

Super conductors: Type -I, Type II-characteristics and applications

Non-elemental semiconducting materials: Stoichiometric, controlled valency & chalcogen photo/ semiconductors preparation of semiconductors (zone refining, Czochralski crystal pulling, epitaxy, diffusion, ion implantation)- semiconductor devices (p-n junction diode as rectifier, junction transistor).

UNIT-IV: Spectroscopic Techniques & Synthesis Of Essential Drug Molecules (9 Lectures)

Spectroscopic Techniques: Electromagnetic spectrum-types of molecular spectra and their absorption criteria ,UV-visible spectroscopy (electronic spectroscopy), Beer-Lambert's law and its limitations ,– applications of UV visible spectroscopy ,IR spectroscopy principle, Molecular vibrations – stretching and bending vibrations – applications of IR, NMR (Nuclear magnetic resonance)-working principle and instrumentation of NMR, chemical shift(δ) – applications of NMR

Synthesis of essential drug molecules: Preparation, properties and uses of Paracetamol , Aspirin, Ibuprofen

UNIT-V: Non-Conventional Energy Sources (7 Lectures)

Design, working, schematic diagram, advantages and disadvantages of photovoltaic cell, hydropower, geothermal power, tidal and wave power, ocean thermal energy conversion.

Text Books:

1. P.C. Jain and M. Jain "Engineering Chemistry", 15/e, Dhanpat Rai & Sons, Delhi, (Latest edition).
2. Shikha Agarwal, "Engineering Chemistry", Cambridge University Press, New Delhi, (2019).
3. S.S. Dara, "A Textbook of Engineering Chemistry", S.Chand & Co, (2010).
4. Shashi Chawla, "Engineering Chemistry", Dhanpat Rai Publishing Co. (Latest edition).

Reference Books:

1. K. Seshamaheshwaramma and Mridula Chugh, "Engineering Chemistry", Pearson India Edition.
2. O.G. Palana, "Engineering Chemistry", Tata McGraw Hill Education Private Limited, (2009).
3. CNR Rao and JM Honig (Eds) "Preparation and characterization of materials" Academic press, New York (latest edition).
4. B. S. Murthy, P. Shankar, "Textbook of Nanoscience and Nanotechnology", University press (latest edition).

Web Resources:

1. <http://jntuk-coeerd.in/>
2. <http://en.wikipedia.org/wiki/title>
3. <http://nptel.ac.in/coures/105106/.com>
4. <https://en.wikipedia.org/wiki/Electrochemistry>
5. <https://www.youtube.com/watch?v=WLYaZbT97EI&list=PLzW3118TEXrpqo3jRarGr9ao-61tB2184>
6. <https://encyclopedia.che.engin.umich.edu/>
7. <http://encyclopedia.che.engin.umich.edu/Pages/ProcessParameters/Spectrometers/Spectrometers.html>

Course Code	Course Name	Course Structure			
		L	T	P	C
P21EST01	Engineering Graphics	1	0	4	3

Internal Marks: 30

External Marks: 70

Course Prerequisite: Nill

Course Objectives: The student will be able

1. To introduce the students to use drawing instruments and to draw polygons, Engineering Curves and Scales, orthographic projections, projections of points.
2. To introduce the students to use projections of lines.
3. To make the students draw the projections of the planes and the various types of solids.
4. To enable the students to gain the ability to convert the Isometric views in to Orthographic views vice versa and development of surfaces of regular solids.
5. To introduce the students to use the Fusion 360 for creating basic geometric figures.

Course Outcomes: After going through this course the student will be able to

1. Construct polygons, scales and engineering curves and Identify the position of points with use of orthographic projections.
2. Identify the position of points and lines with use of orthographic projections.
3. Analyze the location and position of plane figures and solids through orthographic projections.
4. Develop 2D and 3D objects by converting their view.
5. Construct basic geometric figures using Fusion 360.

UNIT-I

(9 Lectures)

Introduction To Engineering Graphics: Introduction to Drawing instruments and their uses, construction of regular polygons, Conic sections- ellipse, parabola, hyperbola using general method, Scales- Diagonal scale, Vernier scale.

Projections of Points: Principle of orthographic projection-Method of Projection – First and third angle projection methods- Projections of Points.

UNIT-II

(9 Lectures)

Projections Of Lines: projection of straight lines- parallel to one plane and inclined to the other plane, projections of straight lines inclined to both the planes, determination of true lengths, angle of inclinations and traces.

UNIT-III

(9 Lectures)

Projections Of Planes: projections of plane figures- triangle, square, rectangle, pentagon and hexagon, circle with surfaces inclined to both the reference planes.

Projections Of Solids: projections of solids: projections of regular solids with the axis inclined to only one reference plane.

UNIT-IV**(9 Lectures)**

Surface Development: development of surfaces for basic solids- prisms, pyramids, cylinder and cone.

Projections of Pictorial Views: Conversion of isometric views into orthographic views and conversion of orthographic views in to isometric views.

UNIT-V**(9 Lectures)**

Introduction To Autodesk Fusion 360: fusion 360 fundamentals-Getting Started -The Fusion 360 Interface Design Navigation & Display-Design Units and Origin -Quick Shape Creation.

Creating Sketched Geometry: Introduction to the sketching workflow - sketch entities -dimensioning sketch constraint.

Text Books:

1. Engineering Drawing by N.D. Bhatt & V.M. Panchal, Charotar Publications, 2014.
2. Engineering Drawing by Basant Agrawal and C.M. Agrawal, McGraw Hill Education Pvt. Limited, 2013.
3. Engineering Drawing by Prof. K.L. Narayana & Prof. R.K.Kannaiah, Scitech Publications, 2010.
4. Parametric Modeling with Autodesk Fusion 360 By Randy H. Shih SDC publications April 23, 2021

Reference Books:

1. Engineering Graphics with AutoCAD 2002 by James D. Bethune, PHI, 2011.
2. Engineering Graphics. P I Varghese Tata McGraw Hill Education Pvt. Ltd, 2010.
3. Engineering drawing – P.J. Shah .S.Chand Publishers,2010.
4. Engineering Drawing- Johle/Tata Macgraw Hill Book Publishers, 2010.
5. Autodesk Fusion 360: A Tutorial Approach Kindle Edition by Prof. Sham Tickoo Purdue Univ. and CAD/CIM Technologies.

Web Resources:

1. <https://lecturenotes.in/subject/436/engineering-drawing-ed>.
2. web.iitd.ac.in/~achawla/public_html/201/lectures/sp46.pdf.
3. <https://www.smartzworld.com/notes/engineering-drawing-pdf-1st-year-notes-ppts>
4. https://www.researchgate.net/305754529_A_Textbook_of_Engineering_Drawing
5. www.academia.edu/32510080/N_d_bhatt_engineering_drawing_pdf

Course Code	Course Name	Course Structure			
		L	T	P	C
P21EST03	C - Programming for Problem Solving	3	0	0	3

Internal Marks: 30

External Marks: 70

Course Prerequisite: Nil

Course Objectives: The student will be able

1. To impart adequate knowledge on the need of programming languages and problem solving techniques.
2. To impart problem solving skills.
3. To enable student to write programs in C and to solve the problems.

Course Outcomes: After going through this course the student will be able to

1. Design algorithms and flowchart / Pseudo code for a given problem.
2. Design programs involving decision structures and loops.
3. Implement different operations on arrays and solve problems using functions.
4. Understand pointers and strings.
5. Implement structures, unions and file operations in C programming for a given application problem.

UNIT-I

(8 Lectures)

Introduction to Programming: Computer hardware, Bits and Bytes, programming languages, application and system software, the software development process.

Idea of algorithm: steps to solve logical and numerical problems. Representation of algorithm: flowchart/pseudo code with examples, from algorithms to programs.

UNIT-II

(9 Lectures)

Introduction to C: Overview of C, Constants, Variables and Data Types, Operators and Expressions, Managing Input and Output. Decision Making - Branching and Looping. Enumerated Data type, Renaming Data type with type def, Type Casting.

UNIT-III

(10 Lectures)

Arrays: Definition, Declaration, Initialization, Assignment, Processing array, Passing array to a function, Two and multi dimensional array. **Functions:** Defining a function, Accessing a function, Passing argument to functions, Function prototypes, Nested function call, Storage classes.

UNIT-IV

(9 Lectures)

Pointers: Definition, initialization, operations on pointers, functions and pointers, arrays and pointers, pointers to pointers, dynamic memory allocation.

Strings: C Strings, String Input / Output functions, arrays of strings, string manipulation functions.

UNIT-V

(9 Lectures)

Structures: Definition, declaration, initialization, accessing members, array of structures, arrays within structure, functions and structures, pointers to structures, nested structures, unions.

File Handling: Types, operations on files, modes, file I/O functions, Random Access Functions.

Text Books:

1. Byron S Gottfried, —Programming with C, Schaums Outlines, Second Edition, Tata McGraw-Hill, 2006.
2. Problem Solving and Program Design in C, 4th edition, by jeri R. Hanly and Elli B.Koffman.
3. Balagurusamy. 2011. C Programming. Tata Mc Graw Hills, New Delhi, India.

Reference Books:

1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India.
2. Yashavant P. Kanetkar. —Let Us C, BPB Publications, 2011.

Web Resources:

1. <https://www.studytonight.com/c/>
2. <https://www.cprogramming.com/tutorial/c-tutorial.html>
3. <https://www.javatpoint.com/c-programming-language-tutorial>
4. <https://www.tutorialspoint.com/cprogramming/>

Course Code	Course Name	Course Structure			
		L	T	P	C
P21HSL01	English Language Communication Skills Lab	0	0	3	1.5

Internal Marks: 15

External Marks: 35

Course Prerequisite: Basic knowledge of English grammar, Basic understanding of English vocabulary, Ability to speak simple sentences, Have interest to learn the language.

Course Objectives: The student will be able

1. To facilitate computer assisted multimedia instructions enabling individualized and independent language learning.
2. To sensitize the students to the nuances of English speech sounds, word accent, intonation and rhythm.
3. To bring about a consistence accent and intelligibility in students' pronunciation of English by providing an opportunity for practice in speaking.
4. To improve the fluency of students in spoken English and neutralize their mother tongue influence.
5. To train students to use language appropriately for public speaking, group discussion and interviews.

Course Outcomes: After going through this course the student will be able to

1. Better understanding of nuances of English language through audio visual experience and group activities.
2. Neutralization of accent for intelligibility.
3. Speaking skills with clarity and confidence which in turn enhances their employability skills.
4. Better understanding of the production of sounds of language.
5. Suitable body language for employability.

EXERCISE-I

- A. Introduction to Phonetics
Consonant sounds
Vowel sounds – Pure Vowels & Diphthongs
- B. Greeting, Introducing & taking leave and Ice – Breaking Activity

EXERCISE-II

- A. Structure of Syllables - Plural markers & Past tense Markers
- B. JAM Session & Situational Dialogues

EXERCISE-III

- A. Word Stress & Rules of 'r' pronunciation

B. Role play, Giving Directions & Story Narration

EXERCISE-IV

- A. Consonant Cluster, Neutralization of Mother Tongue Influence and Listening Comprehension – Listening for General Details
- B. Describing objects, events, places etc. & Presentation Skills – Extempore, Public Speaking.

EXERCISE-V

- A. Intonation & Listening Comprehension – Listening for Specific Details
- B. Interview Skills & Group Discussion

Text Books:

1. Strengthen your Communication Skills - Maruthi Publication, Hyderabad 2013
2. A textbook of English Phonetics for Indian Students by T. Balasubramanian (Macmillan)

Reference Books:

1. INFOTECH English (Maruthi Publications).
2. Personality Development and Soft Skills (Oxford University Press, New Delhi)
3. Suresh Kumar, E. & Sreehari, P. 2009. A Handbook for English Language Laboratories. New Delhi: Foundation
4. Speaking English Effectively 2nd Edition by Krishna Mohan and N. P. Singh, 2011. Macmillan Publishers India Ltd. Delhi.
5. Sasi Kumar, V & Dhamija, P.V. How to Prepare for Group Discussion and Interviews. Tata McGraw Hill
6. Hancock, M. 2009. English Pronunciation in Use. Intermediate. Cambridge: CUP
7. Spoken English: A Manual of Speech and Phonetics by R. K. Bansal & J. B. Harrison. 2013. Orient Blackswan. Hyderabad
8. Hewings, M. 2009. English Pronunciation in Use. Advanced. Cambridge: CUP
9. Marks, J. 2009. English Pronunciation in Use. Elementary. Cambridge: CUP
10. Nambiar, K.C. 2011. Speaking Accurately. A Course in International Communication. New Delhi : Foundation

11. Soundararaj, Francis. 2012. Basics of Communication in English. New Delhi: Macmillan
12. Spoken English (CIEFL) in 3 volumes with 6 cassettes, OUP.
13. English Pronouncing Dictionary Daniel Jones Current Edition with CD.

Web Resources:

1. <http://www.cambridge.org>
2. <http://www.edufind.com/english/practice>
3. <http://www.learnenglish.com>
4. <http://www.penguin.co.uk>



Course Code	Course Name	Course Structure			
		L	T	P	C
P21BSL03	Applied Chemistry Lab	0	0	3	1.5

Internal Marks: 15

External Marks: 35

Course Prerequisite: Basic Chemistry at Intermediate or equivalent level.

Course Objectives: The purpose of this course to provide students with practical knowledge of quantitative analysis of materials by classical and instrumental methods for developing experimental skills in building technical competence.

Course Outcomes: After going through this course the student will be able to

1. Carrying out different types of titrations for estimation of concerned in materials using comparatively more quantities of materials involved for good results.
2. Handling different types of instruments for analysis of materials using small quantities of materials involved for quick and accurate results.

LIST OF EXPERIMENTS: Introduction to Chemistry laboratory – Molarity, normality, primary, secondary standard solutions, volumetric titrations, quantitative analysis.

1. Determination of HCl using standard Na_2CO_3 solution.
2. Determination of alkalinity of water sample containing Na_2CO_3 and NaOH.
3. Determination of Mn^{+2} using standard oxalic acid solution.
4. Determination of ferrous iron using standard $K_2Cr_2O_7$ solution.
5. Determination of Cu^{+2} using standard hypo solution.
6. Determination of temporary and permanent hardness of water using standard EDTA solution.
7. Determination of Fe^{+3} by a colorimetric method.
8. Determination of the concentration of acetic acid using sodium hydroxide (p^H metry method).
9. Determination of isoelectric point of amino acids using p^H metry method (or) conductometric method.
10. Determination of the concentration of strong acid vs strong base (by conductometric method).
11. Determination of strong acid vs strong base (by potentiometric method).
12. Estimation of Vitamin C.
13. Preparation of Nylon-6, 6 and Bakelite (demonstration only).

Reference Books:

1. Dr. Jyotsna Cherukuris (2012) Laboratory Manual of engineering chemistry-II,
2. VGS Techno Series 3. Chemistry Practical Manual, Lorven Publications

Web Resources:

1. <https://vlab.amrita.edu/index.php?sub=2&brch=193>.



Course Code	Course Name	Course Structure			
		L	T	P	C
P21ESL02	C - Programming for Problem Solving Lab	0	0	3	1.5

Internal Marks: 15

External Marks: 35

Course Prerequisite: Nil

Course Objectives: The student will be able

1. To understand the various steps in program development.
2. To understand the basic concepts in C Programming Language.
3. To understand different modules that includes conditional and looping expressions.
4. To understand how to write modular and readable C Programs.
5. To write programs in C to solve problems using arrays, structures and files.

Experiment Wise Programs

EXERCISE-I

- a. Write a simple C program to Print "Hello World"
- b. Write a simple C Program to Calculate Area and Circumference of Circle
- c. Write a simple C program to implement basic arithmetic operations - sum, difference, product, quotient and remainder of given numbers.

EXERCISE-II: Write C programs to demonstrate the following operators

- a. Assignment Operator.
- b. Relational and Logical Operator.
- c. Increment and decrement operator.
- d. Bitwise operators.
- e. Ternary operator.

EXERCISE-III

- a. Write a C programs - to find the largest and smallest of 2 numbers(if – else), to find the largest and smallest of 3 numbers(Nested if – else), roots of quadratic equation(else – if ladder).
- b. The total distance travelled by vehicle in 't' seconds is given by $\text{distance} = ut + \frac{1}{2}at^2$ where 'u' and 'a' are the initial velocity and acceleration.

Write a c program to find the distance travelled at regular intervals of time given the Values of 'u' and 'a'. The program should provide the flexibility to the user to select his own time intervals and repeat the calculations for different values of 'u' and 'a'.

- c. Write a c program, which takes two integer operands and one operator from the user, performs the operation and the prints the result. (consider the operators +, -, *, /, % and use switch statement).

EXERCISE-IV

- a. Write a C program to find the sum of individual digits of a positive integer
- b. A Fibonacci Sequence is defined as follows: the first and second terms in the sequence are 0 and 1. Subsequent terms are found by adding the preceding two terms in the sequence .Write a c program to generate the first n terms of the sequence.
- c. Write a c program to generate all the prime numbers between 1 and n, where n is a value supplied by the user.

EXERCISE-V

- a. Write a C program to read in two numbers, x and n, and then compute the sum of this geometric progression: $1 + x + x^2 + x^3 + \dots + x^n$
- b. Write a C program to generate Pascal's triangle.
- c. Write a C program to construct a pyramid of numbers

EXERCISE-VI

- a. Write a c program to find both the largest and smallest number in a list of integers.
- b. Write a c program that uses functions to perform the following:
- Addition of Two Matrices.
 - Multiplication of Two Matrices.

EXERCISE-VII

- a. Write a programs that use both recursive and non-recursive functions
- b. To find the factorial of a given integer.
- c. To find the GCD of two given integers.

EXERCISE-VIII

- a. Write a c program that uses functions to perform the following operations:
- To insert a sub-string in given main string from a given position.
 - To delete n Characters from a given position in a given string.
- b. Write a C program to determine if the given string is a palindrome or not.

EXERCISE-IX

- a. Write a C program that displays the position or index in the string S Where the string T begins, or - 1 if S doesn't contain T.
- b. Write a C program to count the lines, words and characters in a given text .

EXERCISE-X

- a. Write a program to print the details of a student like(Name, Rollno, marks) using nested structures.
- b. Write a C Program to Calculate Difference Between Two Time Period.

EXERCISE-XI

- a. Write a C program that uses functions to perform the following operations:
 - i. Reading a complex number
 - ii. Writing a complex number
 - iii. Addition of two complex numbers
 - iv. Multiplication of two complex numbers(Note: represent complex number using a structure.)

EXERCISE-XII

- a. Write a C program which copies one file to another and display the contents of a file
- b. Write a C program to reverse the first n characters in a file.
- c. Write a C program to merge two files into a third file (i.e., the contents of the first file followed by those of the second are put in the third file)

Course Code	Course Name	Course Structure			
		L	T	P	C
P21BST02	Applied Physics	3	0	0	3

Internal Marks: 30

External Marks: 70

Course Prerequisite: The basics of analytical and conceptual understanding of physics

Course Objectives: The student will be able

1. To study the wave nature of light through Interference and diffraction.
2. To learn the basic principles of Lasers and fiber optics.
3. To express the physics of electrostatics and electromagnetic wave concepts through Maxwell's equations.
4. To study the basic concepts of Quantum mechanics.
5. Aware of limits of classical free electron theory and apply band theory of solids.
6. Acquire the knowledge of semiconductor physics.

Course Outcomes: After going through this course the student will be able to

1. Understanding the basic concepts of optics and how to apply them for engineering applications.
2. Acquire the knowledge of fundamentals of Lasers and fiber optics enables the students to develop Laser devices to apply them in various systems like communications, Industries and medicine.
3. Set students to be exposed to Electrostatics, Maxwell's equations, electromagnetic waves and fundamental concepts of quantum mechanics.
4. Enable to learn the fundamental concepts of free electron theory and band theory of solids.
5. Develop knowledge of band theory of solids for fundamentals of Semiconductor physics enables the students to apply the knowledge to various systems like communications, solar cell, photo cells and so on.

UNIT-I: Wave Optics

(9 Lectures)

Interference: Introduction, Principle of Superposition of waves, colors in thin films, interference in thin films, Newton's rings: Determination of wavelength and refractive index.

Diffraction: Introduction, differences between interference and diffraction, difference between Fraunhofer and Fresnel's diffraction, Fraunhofer diffraction at single slit, Fraunhofer diffraction due to double slit, Diffraction grating (N-slits qualitative), resolving power of grating.

UNIT-II: Lasers and Fiber Optics

(9 Lectures)

Lasers: Introduction, Characteristics of laser, absorption, spontaneous emission, stimulated emission, Einstein's coefficients, population inversion, pumping, pumping mechanisms, Types of Lasers: Ruby laser, He-Ne laser, diode laser, Applications of Lasers.

Fiber optics: Introduction, Total internal reflection-wave propagation in optical fiber, Acceptance angle, numerical aperture, applications of optical fiber.

UNIT-III: Electrostatics, Maxwell's Equations and Electromagnetic Waves

(9 Lectures)

Electrostatics: Coulombs law, electric field, electric field intensity, electric flux density, electrostatic potential, divergence of electric field, Laplace's and Poisson's equations for electrostatic potential, Gauss theorem in electrostatics.

Maxwell's equations and electromagnetic waves: Gauss theorem in magneto statics, Faraday's law of electromagnetic induction, Ampere's law, displacement current, Maxwell's equations in vacuum, electromagnetic wave equation in dielectric medium, velocity of propagation of electromagnetic wave, poynting vector and poynting theorem.

UNIT-IV: Quantum Mechanics, Free Electron Theory and Band Theory

(10 Lectures)

Quantum Mechanics: Introduction to quantum physics, de-Broglie's hypothesis and properties of matter waves, Schrodinger's time independent wave equation, Schrodinger's time dependent wave equation, Particle in one dimensional box.

Free electron theory: classical free electron theory of metals- assumptions and failures, quantum free electron theory of metals-assumptions and failures, Fermi Dirac distribution function- Fermi level, Femi energy, density of states.

Band theory of solids: Introduction, Bloch's theorem, Kronig penny model (qualitative), E-K diagram, Brillouin's zones, classification of solids into metals, semiconductors and insulators, effective mass of electron and concept of hole.

UNIT-V: Semiconductor Physics

(8 Lectures)

Semiconductor physics: Introduction, intrinsic and extrinsic semiconductors, carrier concentration in intrinsic semiconductors, electrical conductivity of intrinsic semiconductor, Fermi energy, carrier concentration in N-type and P-type semiconductors, dependence of Fermi energy on carrier-concentration and temperature, drift and diffusion, Hall effect and its applications, mechanism in LED, solar cell and photo conductor.

Text Books:

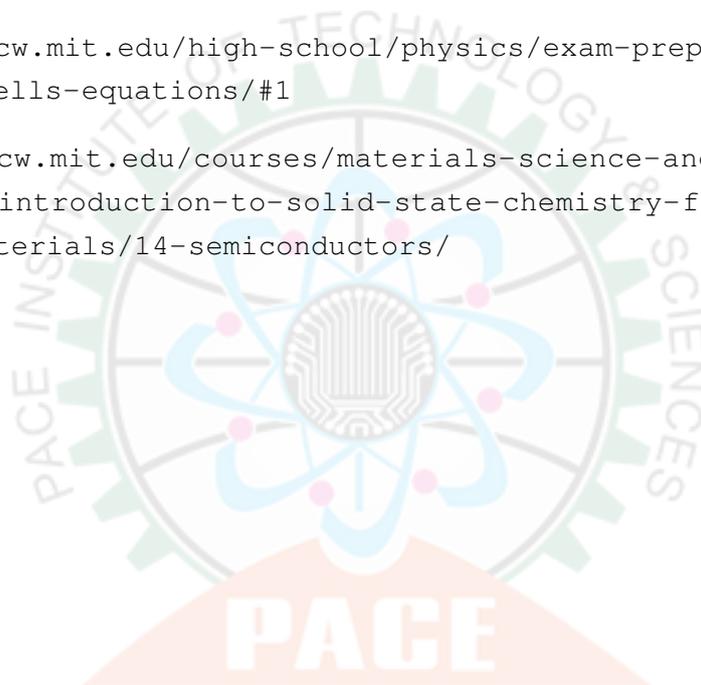
1. A Textbook of Engineering Physics by Dr. M. N. Avadhanulu, Dr. P.G. Kshirsagar - S. Chand.
2. Optics by Ajoy Ghatak, Tata McGraw-Hill Publishing company limited
3. Introduction to Electrodynamics by David Griffiths, Cambridge University Press
4. Introduction to Quantum physics by Eisberg and Resnick.

Reference Books:

1. Applied physics by Palanisamy (Scitech publications)
2. Optics by Eugene Hecht, Pearson Education.
3. Principle of Lasers by O. Svelto
4. Electricity, magnetism and light by W. Saslow
5. Semiconductor Optoelectronics by J. Singh, Physics and Technology, Mc Graw-Hill inc
6. Engineering Physics by B.K. Pandey, S. Chaturvedi - Cengage Learning.

Web Resources:

1. <https://nptel.ac.in/courses/115/106/115106066/>
2. <https://ocw.mit.edu/high-school/physics/exam-prep/electromagnetism/maxwells-equations/#1>
3. <https://ocw.mit.edu/courses/materials-science-and-engineering/3-091sc-introduction-to-solid-state-chemistry-fall-2010/electronic-materials/14-semiconductors/>



Course Code	Course Name	Course Structure			
		L	T	P	C
P21BST06	Numerical Methods & Vector Calculus	3	0	0	3

Internal Marks: 30

External Marks: 70

Course Prerequisite: Differentiation, Partial differentiation, Integration, Differential Equations

Course Objectives: The student will be able

1. The different numerical techniques to solve algebraic and transcendental equations and evaluate the polynomials from the numerical data.
2. The approximate solutions using numerical methods in the absence of analytical solutions of various systems of ordinary differential equations and integrations.
3. Enhance the knowledge level to visualize integrals in higher dimensional coordinate systems, possible representation and evaluation of geometrical and physical quantities in terms of multiple integrals.
4. Interpret concepts of vector functions, vector fields, differential calculus of vector functions in Cartesian coordinates and apply them for various engineering problems.
5. Evaluate line, surface and volume integrals and construct relation between line, surface and volume integrals using vector integral theorems.

Course Outcomes: After going through this course the student will be able to

1. Evaluate approximate roots of the polynomial and transcendental equations by different algorithms and apply Newton's forward, backward interpolation and Lagrange's formulae for equal and unequal intervals.
2. Apply different algorithms for approximating the integrals of numerical data and solutions of ordinary differential equations to its analytical computations.
3. Evaluate the multiple integrals by using change of variables and change of order of integration. Also apply double and triple integration techniques in evaluating areas and volumes bounded by regions and solids.
4. Interpret the physical meaning of different operators such as gradient, curl and divergence.
5. Determine line, surface and volume integrals. Apply Green's, Stoke's and Gauss divergence theorems to calculate line, surface and volume integrals.

UNIT-I: Iterative Methods, Finite differences and Interpolation (10 Lectures)

Introduction-Solution of algebraic and transcendental equations-Bisection method -Method of false position-Newton-Raphson method (Single variable only)

Interpolation: Introduction-Errors in polynomial interpolation-Finite differences – Forward differences-Backward differences-Relations between operators-Newton's forward and backward formulae for interpolation -Interpolation with unequal intervals -Lagrange's interpolation formula.

UNIT-II: Numerical integration, Solution of ordinary differential equations with initial **(9 Lectures)**

Trapezoidal rule – Simpson's 1/3rd and 3/8th rule– Solution of ordinary differential equations by Taylor's series – Picard's method of successive approximations – Euler's method – Modified Euler's method-Runge-Kutta method (second and fourth order).

UNIT-III:Multiple Integrals: **(9 Lectures)**

Double integrals (Cartesian and Polar) – Change of order of integration – Change of variables (Cartesian to Polar coordinates) –Triple integrals- Change of variables (Cartesian to Cylindrical and Spherical coordinates).

Applications: Areas by double integrals and Volumes by triple integrals.

UNIT-IV: Vector Differentiation: **(8 Lectures)**

Scalar and Vector point functions-Vector Differential operator- Gradient – Directional derivatives – Divergence – Curl – Laplacian second order operator- Vector identities- Applications: Scalar Potential function.

UNIT-V: Vector Integration: **(9 Lectures)**

Line integral – Work done – Circulation- Surface integral- Volume integral **Vector Integral Theorems (without proof):** Application of Green's theorem in a plane- Stoke's theorem- Gauss Divergence theorem.

Text Books:

1. B.S. Grewal, Higher Engineering Mathematics, 44th Edition, Khanna Publishers.
2. B.V. Ramana, Higher Engineering Mathematics, 2007 Edition, Tata Mc. Graw Hill Education.

Reference Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, Wiley-India.
2. H. K. Das, Advanced Engineering Mathematics, 22ndEdition,S. Chand & Company Ltd.
3. David Poole, Linear Algebra- A modern introduction, 4th edition, Cengage.
4. Peter O' Neil, Advanced Engineering Mathematics, Cengage
5. Srimantha Pal, S C Bhunia, Engineering Mathematics, Oxford University Press.

Web Resources:

1. <http://tutorial.math.lamar.edu/Classes/DE/DE.aspx>
2. <http://mathworld.wolfram.com/topics>
3. <http://www.nptel.ac.in/course.php>

Course Code	Course Name	Course Structure			
		L	T	P	C
P21EST06	Electrical Circuits Analysis -I	3	0	0	3

Internal Marks: 30

External Marks: 70

Course Prerequisite: Applied Physics

Course Objectives: The student will be able

1. To analyze the ohms law and network reduction techniques.
2. To determine voltage and current in electrical element.
3. To understand the concept of magnetic circuits.
4. To analyze the AC Circuits with R- L –C Parameters.
5. To analyze the network theorems

Course Outcomes: After going through this course the student will be able to

1. Analyze the ohms law and network reduction techniques.
2. Determine voltage and current in electrical element.
3. Understand the concept of magnetic circuits.
4. Analyze the AC Circuits with R- L –C Parameters.
5. Analyze the network theorems

UNIT-I: BASIC CIRCUIT CONCEPTS-I (9 Lectures)

Basic definitions – Types of network elements- Types of sources - Ohm's Law –Energy Sources – R – L – C Parameters –Network Reduction Techniques – Series, Parallel Circuits- Star-Delta and Delta-Star Transformations - Source transformation- Numerical Problems.

UNIT-II: BASIC CIRCUIT CONCEPTS-II (9 Lectures)

Kirchhoff's Laws – Voltage division and Current Division - Source Transformation Technique – Mesh and Node Analysis – Super Mesh and Super Node Analysis – Numerical Problems.

UNIT-III: MAGNETIC CIRCUITS (9 Lectures)

Basic definition of Magnetic Quantities - Faraday's laws of Electromagnetic Induction- Lenz's Law - Analogy between Electrical and Magnetic Circuits. Concept of Self and Mutual Inductance - Coefficient of Coupling – Coupled Circuits – Numerical Problems.

Applications: Areas by double integrals and Volumes by triple integrals.

UNIT-IV: AC CIRCUIT ANALYSIS (9 Lectures)

Representation of Sinusoidal Waveforms - Peak and RMS values -Phasor Representation, Real Power, Reactive Power, Apparent Power, Power factor – Significant of J Operator - Analysis of Single-Phase AC Circuits Consisting of R, L, C, RL, RC, RLC Combinations – Numerical Problems.

UNIT-V: Network Theorems -I (9 Lectures)

Network Theorems – Superposition Theorem - Reciprocity Theorem - Thevenin's Theorem - Norton's Theorem - Maximum Power Transfer Theorem - Numerical Problems.

Text Books:

1. Engineering Circuit Analysis by William Hayt and Jack E.Kemmerley, McGraw Hill Company, 6th edition, 2007.
2. Network Analysis by Van Valkenburg; Prentice-Hall of India Private Ltd, 2015.

Reference Books:

1. Fundamentals of Electrical Circuits by Charles K.Alexander and Mathew N.O.Sadiku, McGraw Hill Education (India), 2013.
2. Linear Circuit Analysis by De Carlo, Lin, Oxford publications, 2008.
3. Electric Circuits– (Schaum's outlines) by Mahmood Nahvi & Joseph Edminister, Adapted by Kuma Rao, McGraw Hill, 5th Edition-2012.
4. Electric Circuits by David A. Bell, Oxford publications, 2009.
5. Introductory Circuit Analysis by Robert L Boylestad, Pearson Publications, 2013.
6. Circuit Theory (Analysis and Synthesis) by A.Chakrabarthy, Dhanpat Rai & Co, 2009.

Web Resources:

1. www.allaboutcircuits.com
2. www.electronics-tutorials.ws

Course Code	Course Name	Course Structure			
		L	T	P	C
P21EST11	Electronic Devices and Circuits	3	0	0	3

Internal Marks: 30

External Marks: 70

Course Prerequisite: Applied Physics

Course Objectives: The student will be able

1. The basic concepts of semiconductor devices will be reviewed.
2. Study the physical phenomenon such as conduction, transport mechanism and electrical characteristics of P-N diode and Study the physical phenomena such as basic principle of operation of different diodes.
3. The application of diodes as rectifiers with their operation and characteristics with and without filters are discussed.
4. The principal of working and operation of Bipolar Junction Transistor and Field Effect Transistor and their characteristics are explained.
5. To learn and understand the purpose of transistor biasing and its significance.

Course Outcomes: After going through this course the student will be able to

1. Analyze the basic concepts of semiconductor physics.
2. Design and formation of p-n junction and how it can be used as a p-n junction as diode in different modes of operation and Analyze the basic concepts of special purpose diodes.
3. Know the construction, working principle of rectifiers with and without filters with relevant expressions and necessary comparisons.
4. Understand the construction, principle of operation of transistors, BJT and FET with their V-I characteristics in different configurations.
5. Know the need of transistor biasing, various biasing techniques for BJT and FET and stabilization concepts with necessary expressions.

UNIT-I: (9 Lectures)

Review of Semi Conductor Physics: Hall effect, continuity equation, law of junction, Fermi Dirac function, Fermi level in intrinsic and extrinsic Semiconductors

Junction Diode : energy band diagram of PN junction Diode, Open circuited p- n junction, Biased p-n junction.

UNIT-II: Special Semiconductor Devices: (9 Lectures)

p-n junction diode, current components in PN junction Diode, diode equation, V-I Characteristics, temperature dependence on V-I characteristics, Diode resistance, Diode capacitance Zener Diode, Breakdown mechanisms, Zener diode applications, LED, Varactor Diode, Photodiode, Tunnel Diode, UJT, PN-PN Diode, Construction, operation and V-I characteristics

UNIT-III: (9 Lectures)

Rectifiers: Basic Rectifier setup, half wave rectifier, full wave rectifier, bridge rectifier, derivations of characteristics of rectifiers, rectifier circuits-operation, input and output waveforms.

Filters: Inductor filter(Series inductor), Capacitor filter(Stunt inductor), π - Filter, comparison of various filter circuits in terms of ripple factors.

UNIT-IV: Transistor Characteristics

(9 Lectures)

BJT: Junction transistor, transistor current components, transistor equation, transistor configurations, transistor as an amplifier, characteristics of transistor in Common Base, Common Emitter and Common Collector configurations, Ebers-Moll model of a transistor, punch through/ reach through, Photo transistor, typical transistor junction voltage values.

FET: FET types, construction, operation, characteristics, parameters, MOSFET-types, construction, operation, characteristics, comparison between JFET and MOSFET.

UNIT-V:

(9 Lectures)

Transistor Biasing and Thermal Stabilization : Need for biasing, operating point, load line analysis, BJT biasing- methods, basic stability, fixed bias, collector to base bias, self bias, Stabilization against variations in V_{BE} , I_c , and β , Stability factors, (S,S',S"), Bias compensation, Thermal runaway, Thermal stability.

FET Biasing- methods and stabilization.

Text Books:

1. Electronic Devices and Circuits- J. Millman, C. Halkias, satyabrata jit Tata Mc-Graw Hill,4th Edition, 2015.
2. Electronic Devices and Circuits- S Salivahanan, N Suresh kumar- Tata Mc-Graw Hill, 2012

Reference Books:

1. Electronic Devices and Circuits-K. Satya Prasad, VGS Book Links, 2nd Edition, 2014.
2. Electronic Devices and Circuits – Bell, Oxford, 5th Edition, 2010.

Web Resources:

1. physics.info/semiconductors/
2. www.allaboutcircuits.com/technical-articles/characteristics-of-junction-diodes/
3. www.academia.edu/8160398/Transistor_Biasing_and_Stabilisation
4. <http://203.202.233.187/moodle/course/view.php?id=1074>

Course Code	Course Name	Course Structure			
		L	T	P	C
P21EST13	Data Structures	3	0	0	3

Internal Marks: 30

External Marks: 70

Course Prerequisite: C Programming**Course Objectives:**

1. Comprehensive knowledge of data structures and ability to implement the same in software applications.
2. Exposure to algorithmic complexities, recursive algorithms, searching techniques.
3. Exposure to sorting technique, Applying stack techniques for logical operations.
4. Applying queue techniques for logical operations, Exposure to list representation models in various types of applications.
5. Implementation of tree in various forms, Advanced understanding of other variants of trees and their operations.
6. Orientation on graphs, representation of graphs, graph traversals, spanning trees Graphs.

Course Outcomes: After going through this course the student will be able to

1. Student will be able to choose appropriate data structure as applied to specified problem definition.
2. Implement appropriate sorting/searching technique for given problem
3. Implement operations like searching, insertion, and deletion, traversing mechanism etc. on various data structures.
4. Students will be able to implement Linear and Non-Linear data structures

UNIT-I:**(9 Lectures)****Data Structure, Recursion & Searching:** Preliminaries of algorithm, Algorithm analysis and complexity. Data Structure: Definition, types of data structures.**Recursion:** Definition, Design Methodology and Implementation of recursive algorithms, Types of recursion (Linear, binary and Tail), recursive algorithms for factorial function, GCD Computation, Fibonacci sequence.**Searching:** List Searches using Linear Search, Binary Search.**UNIT-II:****(10 Lectures)****Sorting Techniques:** Basic Concepts, Sorting by: Insertion (Insertion Sort), Selection (heap sort), Exchange(Bubble sort, Quick Sort) Merging(Merge sort) Algorithms.**Stacks:** Basic Stack operations, Representation of a stack using arrays, Stack Applications: Reversing list, Infix to postfix transformation.**UNIT-III:****(10 Lectures)**

Queues: Introduction, Representation of a Queue using arrays, Queue Operations, Applications of queues- Round Robin Algorithm, Circular Queues, Priority Queues.

Linked List: Introduction, single linked list, representation of a linked list in memory, Operations on a single linked list, Reversing a single linked list, Applications: single linked list to represent polynomial expressions, Double linked list. , Circular linked list

UNIT-IV:

(9 Lectures)

Trees: Basic tree concepts, Binary Trees: Properties, Representation of Binary Trees using arrays, operations on a Binary tree, Binary Tree Traversals (recursive).

Advanced Tree Concepts: Binary search tree, Basic concepts, BST operations: Searching, insertion, deletion, Balanced search trees-AVL Trees.

UNIT-V:

(7 Lectures)

Graphs: Basic concepts, Graph Representations- Adjacency matrix, Adjacency lists, Graph algorithms: Graph Traversals (BFS & DFS), applications: Dijkstra's shortest path, Minimum Spanning Tree using Prim's & Kruskal's Algorithm.

Text Books:

1. Data Structures, 2/e, Richard F, Gilberg , Forouzan, Cengage,2007.
2. Data Structures and Algorithms, G.A.V.Pai, TMH, 2008
3. Data Structures and Algorithms Made Easy, Narasimha Karumanchi , Second Edition, 2011.

Reference Books:

1. Data Structure with C, Seymour Lipschutz, TMH,2010.
2. Classic Data Structures, 2/e, Debasis ,Samanta,PHI,2009
3. Fundamentals of Data Structure in C, 2/e, Horowitz, Sahni, Anderson Freed, University Press.

Web Resources:

1. www.geeksforgeeks.org
2. www.hackr.io.
3. www.letsfindcourse.com

Course Code	Course Name	Course Structure			
		L	T	P	C
P21BSL01	Applied Physics Lab	0	0	3	1.5

Internal Marks: 15

External Marks: 35

Course Prerequisite: The basics of analytical and conceptual understanding of physics.

Course Objectives:

1. Deploy scientific method of experiments in the laboratory.
2. Develop the procedures and observational skills for appropriate use of simple and complex apparatus.
3. Enable analytical techniques, statistical analysis and graphical analysis.
4. Reinforce ideas and concepts covered in lecture host of experiments.
5. Train to find the radius of curvature of a Plano-convex lens forming Newton's rings.

Course Outcomes:

1. Apply the phenomenon of interference and diffraction of light waves.
2. Implement the concept of resonance in LCR circuit and sonometer.
3. Analyze the S determine its dependent properties.
4. Evaluate the behavior of electronic components and its characteristics.

LIST OF EXPERIMENTS: (any eight of the following to be done)

1. Determination of Radius of Curvature of Plano-Convex lens by forming Newton's Rings.
2. Determination of Wavelengths of various spectral lines using diffraction grating with the normal incidence method.
3. Study of magnetic field along the axis of a current carrying coil and to verify Stewart-Gee's method.
4. Determination of energy gap of PN junction Diode.
5. Determination of hall coefficient and carrier concentration using Hall effect
6. Study of V-I characteristics of Zener diode.
7. Determination of frequency of a vibrating bar or electrical tuning fork using Melde's apparatus.
8. Determination of acceleration due to gravity using compound pendulum
9. Verification of laws of transverse waves by Sonometer.
10. Determination of Velocity of sound by volume resonator.
11. Determination of rigidity modulus by Torsional Pendulum.

Text Books:

1. Physics lab manual, department of physics, PACE Institute of Technology and Sciences.
2. Madhusudhanrao, "Engineering Physics lab manual" Ist edition, Scietech Publication, 2015.



Course Code	Course Name	Course Structure			
		L	T	P	C
P21ESL05	Electronic Devices and Circuits Lab	0	0	3	1.5

Internal Marks: 15

External Marks: 35

Course Prerequisite: Engineering Physics

Course Objectives:

1. To study basic electronic components.
2. To observe characteristics of electronic devices

Course Outcomes: At the end of the course student can able to

1. Measure voltage, frequency and phase of any waveform using CRO.
2. Generate sine, square and triangular waveforms with required frequency and amplitude using function generator.
3. Analyze the characteristics of different electronic devices such as diodes, transistors etc., and simple circuits like rectifiers etc.

PART-A ELECTRONIC WORKSHOP PRACTICE (2 lab sessions)

1. Identification, Specifications, Testing of R, L, C Components (Colour Codes), Potentiometers, Switches (SPDT, DPDT, and DIP), Coils, Gang Condensers, Relays, Bread Boards.
2. Identification, Specifications and Testing of Active Devices, Diodes, BJTs, Lowpower JFETs, MOSFETs, Power Transistors, LEDs, LCDs, Optoelectronic Devices, SCR, UJT, DIACs, TRIACs, Linear and Digital ICs.
3. Soldering practice – Simple Circuits using active and passive components.
4. Study and operation of
 - a) Multimeters (Analog and Digital)
 - b) Function Generator
 - c) Regulated Power Supplies.
 - d) CRO

PART-B List of Experiments: (Minimum of Ten Experiments has to be performed) (in 8 lab sessions)

1. P-N Junction Diode Characteristics :forward and reverse bias
2. Zener Diode V-I Characteristics.
3. Zener Diode as Voltage Regulator.
4. Half wave Rectifier with & without filters
5. Full wave Rectifier with & without filters

6. Full wave Rectifier with & without filters BJT Characteristics (CE Configuration) : Input &Output
7. BJT Characteristics (CB Configuration) : Input &Output
8. FET Characteristics (CS Configuration) : Drain & Transfer Characteristics
9. FET Characteristics (CG Configuration) : Drain & Transfer Characteristics
10. Transistor as an inverter.
11. UJT Characteristics
12. CRO Operation and its Measurements

Equipment Required:

1. Regulated Power supplies
2. Analog /Digital Storage Oscilloscopes
3. Analog /Digital Function Generators
4. Digital Multimeters
5. Decade Résistance Boxes/Rheostats
6. Decade Capacitance Boxes
7. Ammeters (Analog or Digital)
8. Voltmeters (Analog or Digital)
9. Active & Passive Electronic Components

Course Code	Course Name	Course Structure			
		L	T	P	C
P21ESL06	Data Structures Lab	0	0	3	1.5

Internal Marks: 15

External Marks: 35

Course Prerequisite: C- Programming

Course Objectives:

1. To choose the appropriate data structure and algorithm design method for a specified application.
2. To solve problems using data structures such as linear lists, stacks, queues, hash tables, binary trees, heaps binary search trees, and graphs and writing programs for these solutions.

Course Outcomes: At the end of the course student can able to

1. Analyze worst-case running times of algorithms using asymptotic analysis and implement various data structures like linked lists.
2. Understand and implement stacks and queues using arrays and linked lists.
3. Analyze and implement various searching and sorting algorithms.
4. Design and implement appropriate hash function and collision-resolution algorithms

List of Experiments:

Exercise 1:

Write recursive program for the following

- a. Write recursive C program for calculation of Factorial of an integer
- b. Write recursive C program for calculation of GCD (n, m)
- c. Write recursive program which computes the n^{th} Fibonacci number

Exercise 2:

- a. Write recursive C program for functions to perform Linear search for a Key value in a given list.
- b. Write recursive C program for functions to perform Binary search for a Key value in a given list.

Exercise 3:

- a. Write C program that implement Bubble sort, to sort a given list of integers in ascending order.
- b. Write C program that implement Quick sort, to sort a given list of integers in ascending order

Exercise 4:

- a. Write C program that implement Insertion sort, to sort a given list of integers in ascending order
- b. Write C program that implement merge sort, to sort a given list of integers in ascending order

Exercise 5:

- a. Write C program that implement stack (its operations) using arrays
- b. Write C program that implement stack (its operations) using Linked list

Exercise 6:

- a. Write a C program that uses Stack operations to Convert infix expression into postfix expression
- b. Write C program that implement Queue (its operations) using arrays.
- c. Write C program that implement Queue (its operations) using linked lists

Exercise 7:

- a. Write a C program that uses functions to create a singly linked list
- b. Write a C program that uses functions to perform insertion operation on a singly linked list
- c. Write a C program that uses functions to perform deletion operation on a singly linked list.

Exercise 8:

- a. Write a C program to Create a Binary Tree of integers
- b. Write a recursive C program for Traversing a binary tree in preorder, inorder and postorder.

Exercise 9:

Write a C program for BST operations (insertion, deletion)

Exercise 10:

- a. Write a C program for finding minimum spanning tree in a graph by using Prim's algorithm.
- b. Write a C program for finding minimum spanning tree in a graph by using Kruskal's algorithm.

Course Code	Course Name	Course Structure			
		L	T	P	C
P21MCT02	Biology for Engineering	2	0	0	0

Internal Marks: 30

External Marks: 70

Course Prerequisite: Nil**Course Objectives:**

1. Overall understanding of living organisms and their characteristics
2. Basic understanding of the biological principles of cell biology
3. Awareness on basic organization of organisms
4. Understanding about the machinery of the cell functions
5. Basic knowledge on biological problems that requires engineering expertise

Course Outcomes: After going through this course the student will be able to

1. The overview of biological observations that lead to major discoveries.
2. The concept of the cell, various stages of cell cycle, ultrastructure of Eukaryotic cell, Glycolysis and Krebs cycle
3. Analysis of biomolecules, identification of DNA in the molecular basis
4. The concepts of recessiveness and dominance during the passage of genetic material from parent to offspring
5. Chromosomal disorders, the concept of origin of life with detailed description of Darwinian evolution and Lamarckism

UNIT-I: History of Biology**(5 Lectures)**

Science and Engineering; Definition of Biology, Characteristics of living organisms, Diversity in the living world, Applications of biology; **Biological classification of organisms:** Nomenclature, History of biological classification, Systematic Hierarchy, **Classification of the five kingdoms:** Monera, Protista, Fungi, Plantae and animalia.

Major contributions of prominent scientists: Aristotle, Antonie van Leeuwenhoek, Linnaeus, William Harvey, Louis Pasteur, Watson & Crick, Charles Darwin, Salim-Moizuddin Abdul Ali and Yellapragada Subbarao.

UNIT-II: Cell Biology and Immunology**(10 Lectures)**

Ultra structure of animal cell: Plasma membrane, Golgi complex, Endoplasmic reticulum, Mitochondria, Glycolysis, Krebs cycle, Lysosomes, Ribosomes, chromosomes, and Nucleus. Cell divisions: Cell cycle stages, Mitotic phase, meiosis.

Immunity: Innate immunity, Acquired immunity. Immunoglobulins: structure and biological properties of immunoglobulin classes, Immune disorder: AIDS.

UNIT-III: Biomolecules**(10 Lectures)**

Introduction, properties of biomolecules, Carbohydrates: structure, classifications and functions of carbohydrates. Proteins: structure, classification and functions of proteins. Lipids: characteristic features of lipids, important functions in biological systems, classification of lipids and vitamins.

Nucleic acids: structure and properties of DNA & RNA. Enzymes: Mode of action of enzymes, properties of enzymes, classification and nomenclature of enzymes, importance of enzymes.

UNIT-IV: Genetics and Evolution

(10 Lectures)

Introduction, reasons for Mendel's success, characters selected by Mendel, Mendel's laws: 1. Law of dominance 2. Law of segregation or Law of purity of gametes 3. Law of independent assortment. Monohybrid cross, Dihybrid cross, Test cross, back cross. Multiple alleles and Blood grouping, Sex determination in human. Chromosomal disorders in human- Klinefelter's syndrome, Turner's syndrome and Down's syndrome. Protein synthesis: Transcription and Translation.

Evolution: Evolutionary concepts: Theory of special creation, Cosmozoic theory, Theory of spontaneous generation or abiogenesis, Biogenesis theory, Theory of catastrophism, Theory of organic evolution. Origin of life: Primitive atmosphere and molecules, Biological evolution, Experimental chemical origin of life. Theories of evolution: Lamarckism and Darwinism.

UNIT-V: Human Health & Diseases And Applied Biology

(10 Lectures)

Common diseases in humans: Health, Disease, Pathogens, Transmission, Bacterial diseases: Typhoid, Pneumonia, Diphtheria, Tetanus, Plague, Cholera, Tuberculosis, Syphilis, Gonorrhoea, Leprosy, Peptic ulcers; Viral diseases: Common cold, Measles, Rubella, Rabies, Chickenpox, Flu, Smallpox, Chikungunya, Poliomyelitis, AIDS; Fungal diseases: Ringworm; Protozoan diseases: Malaria, Amoebic dysentery and Helminth diseases: Filariasis, Ascariasis.

Applied Biology: rDNA technology; Industrial use of microorganisms- alcohols, acids and vitamins; enzymes, pollution control, vaccines, hormones. Monoclonal antibodies and stem cells.

Reference Books:

1. Biology: A global approach: Campbell, N.A.; Reece, J.B.; Urry, Lisa; Cain, M, L.; Wasserman, S. A.; Minorsky, P.V.; Jackson, R. B. Pearson Education Ltd
2. Outlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H., John Wiley and Sons
3. Principles of Biochemistry (V Edition), By Nelson, D. L.; and Cox, M. M.W.H. Freeman and Company
4. Molecular Genetics (Second edition), Stent, G. S.; and Calender, R.W.H. Freeman and company, Distributed by Satish Kumar Jain for CBS Publisher
5. Microbiology, Prescott, L.M J.P. Harley and C.A. Klein 1995. 2nd edition Wm, C. Brown Publishers

Web Resources:

1. Human health and diseases: <https://www.emedicalprep.com/study-material/biology/biology-in-human-lefare/human-health-and-disease>

2. **Aristotle's biology:** https://en.wikipedia.org/wiki/Aristotle%27s_biology.
3. **Sir Ronald Ross:**https://en.wikipedia.org/wiki/Ronald_Ross.
4. **Recombinant DNA Technology:**<https://microbenotes.com/recombinant-dna-technology-steps-applications-and-limitations/>
5. **Nucleic acids:**<https://www.khanacademy.org/science/ap-biology/genetics/expression-and-regulation/dna-and-rna-structure/a/nucleic-acids>.



Course Code	Course Name	Course Structure			
		L	T	P	C
P21BST08	Transformation Techniques and Differential Equations	3	0	0	3

Internal Marks: 30

External Marks: 70

Course Prerequisite:

- 1) Differentiation
- 2) Integration

Course Objectives: The student will be able

1. To understand Fourier series representation of Periodic signals.
2. To The Fourier transform can be used to interpolate functions and to smooth signals.
3. To solve finite difference equations using Z-transforms.
4. To enlighten the learners in the concept of differential equations and multi-variable calculus.
5. To equip the students with standard concepts and tools at an intermediate to advanced level mathematics to develop the confidence and ability among the students to handle various real-world problems and their applications.

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

1. Find or compute the Fourier series of periodic signals.
2. Know and be able to apply integral expressions for the forwards and inverse Fourier transform for range of non-periodic waveforms.
3. Solving methods for finite difference equations using Z-transforms.
4. Familiarize with functions of several variables which is useful in optimization.
5. Identify the solution methods for partial differential equation related to various engineering fields.

UNIT-I: Fourier series

(8 Lectures)

Fourier series: Introduction – Periodic functions – Fourier series of periodic function –Dirichlet’s conditions – Even and odd functions – Change of interval – Half-range sine and cosine series.

UNIT-II: Fourier Transforms

(10 Lectures)

Fourier Transforms: Fourier integral theorem (without proof) –Fourier sine and cosine integrals– Sine and cosine transforms –Properties–inverse transforms –Finite Fourier transforms.

UNIT-III: Z-TRANSFORMS

(8 Lectures)

Introduction-properties-Damping rule-Shifting rule-Initial and Final value theorems – Inverse Z transform-Convolution theorem-Solution of difference equation by Z-transform

UNIT-IV: Partial differentiation

(10 Lectures)

Introduction – Homogeneous function – Euler’s theorem – Total derivative – Chain

rule – Jacobian – Functional dependence – Taylor’s and Mc Laurent’s series expansion of functions of two variables.

Applications: Maxima and Minima of functions of two variables without constraints and Lagrange’s method (with constraints).

UNIT-V: PDE of first order & Second order and Applications (9 Lectures)

Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions – Solutions of first order linear (Lagrange) equation and nonlinear (standard types) equations.

Second order PDE: Solutions of linear partial differential equations with constant coefficient – RHS term of the type e^{ax+by} , $\sin(ax+ by)$, $\cos(ax+ by)$, $x^m y^n$

Applications of PDE: Method of separation of Variables

Text Books:

1. B. S. Grewal, Higher Engineering Mathematics, 44th Edition, Khanna Publishers.
2. B.V. Ramana, Higher Engineering Mathematics, 2007 Edition, Tata Mc. Graw Hill Education.

Reference Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, Wiley-India.
2. H. K. Das, Advanced Engineering Mathematics, 22nd Edition, S. Chand & Company Ltd.
3. David Poole, Linear Algebra- A modern introduction, 4th edition, Cengage.
4. Peter O’ Neil, Advanced Engineering Mathematics, Cengage
5. Srimantha Pal, S C Bhunia, Engineering Mathematics, Oxford University Press.

text Web Resources:

1. <http://tutorial.math.lamar.edu/Classes/DE/DE.aspx>
2. <http://mathworld.wolfram.com/topics>
3. <http://www.nptel.ac.in/course.php>

Course Code	Course Name	Course Structure			
		L	T	P	C
P21EET01	Electrical Circuits Analysis - II	3	0	0	3

Internal Marks: 30

External Marks: 70

Course Prerequisite: Electrical Circuits Analysis - I

Course Objectives: The student will be able

1. To Analyze the network theorems and understand the applications of network topology to electrical circuits
2. To Analyze the concepts of balanced and unbalanced three-phase circuits.
3. To understand the behavior of RLC networks for DC and Sinusoidal excitations.
4. To study the performance of R-L, R-C and R-L-C circuits with variation of one of the parameters and to understand the concept of resonance
5. To calculate the various two port network parameters and to know interconnections.

Course Outcomes: After going through this course the student will be able to

1. Analyze the network theorems and solve Electrical networks with network topology concepts.
2. Solve three-phase circuits under balanced and unbalanced condition
3. Observe transient behavior of electrical networks with DC and AC excitations
4. Interpret R, L, C network with variation of any one of the parameters i.e., R, L, C and f
5. Determine the parameters for different types of network and their interrelations.

UNIT-I: Network Theorems –II (10 Lectures)

Network Theorems – Millman's Theorem, Substitution Theorem – Compensation Theorem Numerical Problems.

Graph Theory: Definitions of Graph and Tree, Basic cut set and tie set matrices for planar networks, Duality and Dual networks.

UNIT-II: Balanced and Unbalanced Three phase circuits (9 Lectures)

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

Analysis of three phase unbalanced circuits: Loop method, Star-Delta transformation technique, two-wattmeter method for measurement of three phase power.

UNIT-III: Transient Analysis in DC Circuits (8 Lectures)

Transient response of First order (R-L, R-C) and second order (R-L-C) circuits using differential and Laplace equations.

Transient Analysis in AC Circuits: Transient response of First order (R-L, R-C) and second order (R-L-C) circuits using differential and Laplace equations.

UNIT-IV: Resonance (9 Lectures)

Series and parallel Resonance, Half power frequencies, Bandwidth and Q factor, Relation between half power frequencies, Numerical Problems

UNIT-V: Two Port Networks (9 Lectures)

Two port network parameters – Z, Y, ABCD and Hybrid parameters and their interrelations, Cascaded networks.

Text Books:

1. Engineering Circuit Analysis by William Hayt and Jack E.Kemmerley, McGraw Hill Company, 6th edition, 2007.
2. Network Analysis by Van Valkenburg; Prentice-Hall of India Private Ltd, 2015.

Reference Books:

1. Fundamentals of Electrical Circuits by Charles K.Alexander and Mathew N.O.Sadiku, McGraw Hill Education (India), 2013.
2. Linear Circuit Analysis by De Carlo, Lin, Oxford publications, 2008.
3. Electric Circuits– (Schaum's outlines) by MahmoodNahvi&JosephEdminister, Adapted by KumaRao, McGraw Hill, 5th Edition-2012.
4. Electric Circuits by David A. Bell, Oxford publications, 2009.
5. Introductory Circuit Analysis by Robert L Boylestad, Pearson Publications,2013.
6. Circuit Theory (Analysis and Synthesis) by A.Chakrabarathi, DhanpatRai& Co, 2009.

Web Resources:

1. www.allaboutcircuits.com
2. www.electronics-tutorials.ws

Course Code	Course Name	Course Structure			
		L	T	P	C
P21EET02	Electromagnetic Fields	3	0	0	3

Internal Marks: 30

External Marks: 70

Course Prerequisite: Applied Physics , Mathematics

Course Objectives: The student will be able

1. To study the production of electric field and potentials due to different configurations of static charges.
2. To study the properties of conductors and dielectrics, calculate the capacitance of various configurations and understand the concept of conduction and convection current densities.
3. To study the magnetic fields produced by currents in different configurations, application of ampere's law and the Maxwell's second and third equations.
4. To study the magnetic force and torque through Lorentz force equation in magnetic field environment like conductors and other current loops. To develop the concept of self and mutual inductances and the energy stored.
5. To study time varying and Maxwell's equations in different forms and Maxwell's fourth equation for the induced e.m.f.

Course Outcomes: After going through this course the student will be able to

1. Compute the production of electric field and potentials due to different configurations of static charges.
2. Calculate the capacitance of various configurations and understand the concept of conduction and convection current densities.
3. Calculate the magnetic fields produced by currents in different configurations, application of ampere's law and the Maxwell's second and third equations.
4. Estimate the magnetic force and torque through Lorentz force equation in magnetic field environment like conductors and other current loops. Develop the concept of self and mutual inductances and the energy stored.
5. Understand the concept of time varying and Maxwell's equations in different forms and Maxwell's fourth equation for the induced e.m.f.

UNIT-I: Network Electrostatics – I

(9 Lectures)

Coordinate systems: Introductory to coordinate systems, rectangular, cylindrical and spherical coordinate systems.

Electrostatics: Coulomb's Law – Electric Field Intensity (EFI) – EFI due to a line and a surface charge, work done in moving a point charge in an electrostatic field, electric potential – potential gradient, Gauss's law – Maxwell's first law ($\text{div}(\mathbf{D}) = \rho_v$), Laplace's and Poisson's equations and solution of Laplace's equation in one variable.

UNIT-II: Electrostatics – II

(10 Lectures)

Electric dipole – dipole moment – potential and EFI due to an electric dipole, Torque

on an Electric dipole in an electric field, conductors and Insulators – their behavior in electric field. Polarization, boundary conditions between conductor to dielectric, dielectric to dielectric and conductor to free space. Capacitance of parallel plates, spherical dielectrics, energy stored and energy density in a static electric field, current density, conduction and convection current densities, Ohm's law in point form – equation of continuity.

UNIT-III: Magnetostatics

(9 Lectures)

Biot-Savart's law and its applications viz. Straight current carrying filament, circular, square, rectangle and solenoid current carrying wire – Maxwell's second Equation ($\text{div}(\mathbf{B})=0$), Ampere's circuital law and its applications viz. MFI due to an infinite sheet, long filament, solenoid, toroidal current carrying conductor, point form of Ampere's circuital law, Maxwell's third equation ($\text{Curl}(\mathbf{H})=\mathbf{J}$) Magnetic force, moving charges in a magnetic field – Lorentz force equation, force on a current element in a magnetic field, force on a straight and a long current carrying conductor in a magnetic field, force between two straight long and parallel current carrying conductors.

UNIT-IV: Self and Mutual inductance:

(8 Lectures)

Self and Mutual inductance – determination of self-inductance of a solenoid and toroid and mutual inductance between a straight long wire and a square loop wire in the same plane – energy stored and density in a magnetic field.

UNIT-V: Electro Dynamic Field

(9 Lectures)

Faraday's laws of electromagnetic induction – integral and point forms, Maxwell's fourth equation ($\text{Curl}(\mathbf{E})=-\frac{\partial \mathbf{B}}{\partial t}$), statically and dynamically induced EMF – modification of Maxwell's equations for time varying fields, displacement current, Poynting theorem and Poynting vector.

Text Books:

1. "Engineering Electromagnetics" by William H. Hayt & John. A. Buck Mc. Graw-Hill Companies, 8th Edition. 2006.
2. "Field theory" by gangadhar K.A, khanna publishers, New delhi, 15th edition, 2004

Reference Books:

1. "Principles of Electro Magnetics" by Sadiku, Oxford Publications, 4th edition
2. "Introduction to Electro Dynamics" by D J Griffiths, Prentice-Hall of India Pvt.Ltd, 2nd edition
3. "Electromagnetic Field Theory" by Yaduvir Singh, Pearson.
4. Fundamentals of Engineering Electromagnetics by Sunil Bhooshan, Oxford higher Education.

Web Resources:

1. <https://www.niehs.nih.gov/health/topics/agents/emf/index.cfm>
2. <https://b-ok.cc/book/1268675/9b2a83>
3. <https://b-ok.cc/book/3558383/6a6c16>
4. <https://www.emfields-solutions.com/>
5. <https://www.electrical4u.com>
6. <https://indiabix.com>
7. <http://www.ece.uah.edu>



Course Code	Course Name	Course Structure			
		L	T	P	C
P21EET03	Electrical Machines-I	3	0	0	3

Internal Marks: 30

External Marks: 70

Course Prerequisite: Electrical Circuits, Engineering Physics

Course Objectives: The student will be able

1. To Understand the construction, principle of operation and performance of DC machines.
2. To Learn the characteristics, performance, methods of speed control and testing methods of DC motors.
3. To predetermine the performance of single phase transformers with equivalent circuit models.
4. To Understand the methods of testing of single-phase transformer.
5. To Analyze the three phase transformers and achieve three phase to two phase conversion.

Course Outcomes: After going through this course the student will be able to

1. Assimilate the concepts of electromechanical energy conversion.
2. Mitigate the ill-effects of armature reaction and improve commutation in dc machines.
3. Understand the torque production mechanism and control the speed of dc motors.
4. Analyze the performance of single phase transformers.
5. Predetermine regulation, losses and efficiency of single phase transformers.
- 6.

UNIT-I:

(10 Lectures)

Electromechanical Energy Conversion and introduction to DC machines Principles of electromechanical energy conversion - singly excited and multi excited systems

DC Generator Construction and principle of operation of DC Generator– EMF equation for generator –Excitation techniques– characteristics of DC generators –applications of DC Generators

UNIT-II:

(8 Lectures)

Operation of DC motors Construction and principle of operation of DCMotorBack-emf and torque equations of dc motors – Armature reaction and commutation – characteristics of DC motors – Losses and Efficiency

Starters and its Applications Applications of DC motors.Necessity of a starter – starting by 3 point and 4-point starters.

UNIT-III:**(9 Lectures)**

Speed Control of motors and Testing of DC Machines Speed control of DC Motors– testing of DC machines – brake test, Swinburne’s method –Hopkinson’s method –field’s test-Load test on DC Machines

Single-phase Transformers Types and constructional details – principle of operation –emf equation – operation on no load and on load – lagging, leading and unity power factors loads –phasor diagrams of transformers – equivalent circuit.

UNIT-IV:**(9 Lectures)**

Performance of transformers and auto transformers Regulation – Losses and Efficiency – effect of variation of frequency and supply voltage on losses – All Day Efficiency.

Tests on single phase transformers:open circuit and short circuit tests – Sumpner’s test – separation of losses – parallel operation with equal voltage ratios – auto transformer – equivalent circuit – comparison with two winding transformers.

UNIT-V:3-Phase Transformers**(9 Lectures)**

Types of Polyphase connections –Relation between line and phase voltages and current in three phase transformer- Uses of tertiary winding – Concept of Tap Changing - off load and on load tap changers – Scott connection of transformer for phase conversion.

Text Books:

1. Electrical Machines by P.S. Bhimbra, Khanna Publishers,7th edition, 2011.
2. Electric Machinery by A.E.Fitzgerald, Charleskingsley, Stephen D.Umans, TMH, 6th edition, 2003.

Reference Books:

1. Electrical Machines by D. P.Kothari, I. J. Nagarth, McGraw Hill Publications, 4th edition, 2010.
2. Electrical Machines by R.K.Rajput, Lakshmi publications, 5th edition.
3. Electrical Machinery by AbijithChakrabarathi and SudhiptaDebnath, McGraw Hill, 1st edition.
4. Electrical Machinery Fundamentals by Stephen J Chapman McGraw Hill education, 4th edition, 2010.
5. Electric Machines by MulukutlaS.Sarma&MukeshkPathak, CENGAGE Learning, 1st edition, 2008.
6. Theory & Performance of Electrical Machines by J.B.Guptha. S.K.Kataria& Sons, 1st edition, 2009.

Web Resources:

1. <https://www.niehs.nih.gov/health/topics/agents/emf/index.cfm>

2. <https://b-ok.cc/book/1268675/9b2a83>
3. <https://b-ok.cc/book/3558383/6a6c16>
4. <https://www.emfields-solutions.com/>
5. <https://www.electrical4u.com>
6. <https://indiabix.com>
7. <http://www.ece.uah.edu>



Course Code	Course Name	Course Structure			
		L	T	P	C
P21EET04	Power System-I	3	0	0	3

Internal Marks: 30

External Marks: 70

Course Prerequisite: Power Systems**Course Objectives:** The student will be able

1. To study the principle of operation of different components of a thermal power and hydro electric power plant.
2. To study the working principle of nuclear power plant.
3. To study the constructional and operation of air and gas Insulated substations.
4. To study the constructional details of different types of cables and power factor.
5. To study the different types of load curves and tariffs applicable to consumers

Course Outcomes: After going through this course the student will be able to

1. Able to understand the of thermal powerplants.
2. Able to understand the working principle of nuclear powerplant.
3. Able to understand the different types of cables and power factor.
4. Able to understand the constructional and operation of air and gas Insulated substations.
5. Able to understand the different types of load curves and tariffs applicable to consumers

UNIT-I: Hydroelectric Power Stations: (9 Lectures)

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 (8 Lectures)

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: Classification of Air and Gas Insulated substations (9 Lectures)

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, installation and maintenance of GIS, comparison of air insulated substations and gas insulated substations.

UNIT-IV: Power factor

(9 Lectures)

Power factor, Power factor triangle, Causes of low power factor, Disadvantages of low power factor, Power factor improvement, Power factor improvement equipment, Calculations of power factor correction.

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.

UNIT-V: Economic Aspects of Power Generation & Tariff

(10 Lectures)

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. A Text Book on Power System Engineering by M.L.Soni, P.V.Gupta, U.S.Bhatnagar and A. Chakrabarti, Dhanpat Rai & Co. Pvt. Ltd, 2016.
2. Generation, Distribution and Utilization of Electric Energy by C.L.Wadhawa, New age International (P) Limited, Publishers, 3rd edition.

Reference Books:

1. Elements of Electrical Power Station Design by M V Deshpande, PHI, New Delhi, 2009.

Course Code	Course Name	Course Structure			
		L	T	P	C
P21EEL01	Electrical Circuits Lab	0	0	3	1.5

Internal Marks: 15

External Marks: 35

Course Prerequisite: ELECTRICAL CIRCUITS

Course Objectives:

1. To verify Kirchhoff's laws.& demonstrate various theorems
2. To find the Resonance frequency for Series and Parallel RLC Circuit
3. To determine the various parameters of a two port networks
4. To determine Parameters of a choke coil.

Course Outcomes: At the end of the course student can able to

1. Apply Kirchhoff's laws & various theorems
2. Determination of Series and Parallel RLC Circuit
3. Two port parameters of a given electric circuits
4. Determine Parameters of a choke coil.

(Out of 14 Any 10 of the following experiments are to be conducted)

1. Verification of Kirchhoff's circuit laws.
2. Verification of Superposition theorem
3. Verification of Thevenin's and Norton's Theorems
4. Verification of Maximum power transfer theorem
5. Verification of Compensation theorem
6. Verification of Reciprocity and Millman's Theorems
7. Series and parallel resonance
8. Determination of Impedance (Z) and Admittance (Y) Parameters for a two port network
9. Determination of Transmission and Hybrid parameters
10. Determination of Parameters of a choke coil.
11. Determination of cold and hot resistance of an electric lamp.
12. Locus diagrams of R-L(L Variable) and R-C (C Variable) series circuits
13. Determination of self, mutual inductances and coefficient of coupling
14. Measurement of 3-phase power by two wattmeter method for unbalanced loads

Course Code	Course Name	Course Structure			
		L	T	P	C
P21EEL02	Electrical Machines-I Lab	0	0	3	1.5

Internal Marks: 15

External Marks: 35

Course Prerequisite: Electrical Circuits Lab

Learning Objectives:

1. To plot the magnetizing characteristics of DC shunt generator and understand the mechanism of self-excitation.
2. To control the speed of the DC motors.
3. Determine and predetermine the performance of DC machines.
4. To pre determine the efficiency and regulation of transformers and lossess their Performance.

Course Outcomes:

1. Select range of apparatus based on the ratings of DC Machines and Transformers.
2. Determine equivalent circuit parameters of transformers
3. Evaluate the efficiency of the machine by analyzing test results
4. Study speed control methods for dc machines

Any 10 of the following experiments are to be conducted

1. Magnetization characteristics of DC shunt generator. Determination of critical field resistance and critical speed.
2. Load test on DC shunt generator. Determination of characteristics.
3. Brake test on DC shunt motor. Determination of performance curves.
4. Load test on DC compound generator. Determination of characteristics.
5. Hopkinson's test on DC shunt machines. Predetermination of efficiency.
6. Swinburne's test and Predetermination of efficiencies as Generator and Motor.
7. Brake test on DC compound motor. Determination of performance curves.
8. Load test on DC series generator. Determination of characteristics
9. O.C. & S.C. Tests on Single phase Transformer
10. Sumpner's test on single phase transformers
11. Scott connection of transformers
12. Parallel operation of Single phase Transformers

Course Code	Course Name	Course Structure			
		L	T	P	C
P21EEL03	Electrical Workshop	0	0	3	1.5

Internal Marks: 15

External Marks: 35

Course Prerequisite: Engineering Physics

Course Objectives:

1. To demonstrate the usage of measuring equipment
2. To train the students in setting up simple wiring circuits
3. To impart methods in electrical machine wiring

Course Outcomes:

After the completion of the course the student should be able to:

1. Explain the limitations, tolerances, safety aspects of electrical systems and wiring.
2. Select wires/cables and other accessories used in different types of wiring

Any 10 of the following experiments are to be conducted

List of Experiments:

1. Study of various electrical tools and symbols.
2. Study various types of electrical cables/wires, switches, fuses, fuse carriers, MCB, ELCB, RCCB and MCCB with their specifications and usage.
3. Soldering and de-soldering practice.
4. Identification of various types of resistors and capacitors and understand the usage digital multi-meter.
5. Identification of various semiconductor devices.
6. Study of Moving Iron, Moving Coil, Electrodynamic and Induction type meters.
7. Fluorescent lamp wiring.
8. Wiring of lighting circuit using two-way control (stair case wiring)
9. Go down wiring/ Tunnel wiring
10. Hospital wiring.
11. Measurement of voltage, current, power in DC circuit.
12. Wiring of power distribution arrangement using single phase MCB distribution board with ELCB, main switch and energy meter for calculating Power and Power Factor.
13. Measurement of earth resistance.
14. Wiring of backup power supply for domestic Installations including inverter, battery and load.
15. Troubleshooting of domestic electrical equipment's (tube light and fan).

16. Understand the usage of CRO, function generator. & Regulated power supply and Measurement of ac signal parameters using CRO.
17. Assembling electronic components on bread board.
18. Obtain V-I characteristics of Light Emitting Diode.



Course Code	Course Name	Course Structure			
		L	T	P	C
P21EES01	Skill Oriented Course-I	1	0	2	2

Internal Marks: 0

External Marks: 50

1. There are five (05) skill-oriented courses shall be offered during III to VII semesters and students must register and pass the courses successfully.
2. For skill oriented/skill advanced course, one theory and two practical hours (1-0-2) or two theory hours (2-0-0) may be allotted as per the decision of concerned BOS.
3. Out of the five skill courses; (i) two shall be skill-oriented courses from the same domain and shall be completed in second year (ii) Of the remaining three skill courses, one shall be necessarily be a soft skill course and the remaining 2 shall be skill-advanced courses either from the same domain or job-oriented skill courses, which can be of inter disciplinary nature.
4. Students may register the interdisciplinary job-oriented skill courses based on the prerequisites and eligibility in consultation with HOD of the Department.
5. The student shall be given an option to choose either the skill courses being offered by the college or to choose a certificate course being offered by Industries/Professional bodies/APSSDC or any other accredited bodies. However, the department has to assign mentors in the college to monitor the performance of the students.
6. If a student chooses to take a Certificate Course offered by industries/Professional bodies/APSSDC or any other accredited bodies, in lieu of the skill advanced course offered by the Department, then the department shall mark overall attendance of the student for the remaining courses in that semester excluding the skill course in all the calculations of mandatory attendance requirements upon producing a valid certificate. However, the student is deemed to have fulfilled the attendance requirement of the course, if the external agency issues a certificate with satisfactory condition.
7. If the certificate issued by external agency is marked with unsatisfactory condition, then the student shall repeat the course either in the college or at external agency.
8. The credits will be awarded to the student upon producing the successful Course Completion Certificate from the agency/professional bodies and after passing in the viva-voce examination conducted at college as per college norms at the end of the semester.
9. The job-oriented skill courses may be registered at the department or at any accredited external agency.
10. A student shall submit a record/report on the on the list skills learned.

11. If the student completes job-oriented skill course at external agency, a certificate from the agency shall be included in the report.
12. The course will be evaluated at the end of the semester for 50 marks (record: 15 marks and viva-voce: 35 marks) along with laboratory end examinations in the presence of external (appointed by the Chief Controller of Examinations) and internal examiner (course instructor or mentor).
13. There are no internal marks for the job-oriented skill courses.
14. For II-I & II-II Semesters Students can register a course in below domain or any other core domain with prior written approval of Head of the Department.
 - (a) Solar Cells
 - (b) Electrical Vehicle Design
 - (c) Electrical Auto CAD
 - (d) Aurdino
 - (e) Raspberry pi
 - (f) Internet of Things
 - (g) AI applications in Electrical Engineering
 - (h) Machine Learning applications in Electrical Engineering
 - (i) SciLab
 - (j) LabView
 - (k) MultiSim
 - (l) MATLAB
 - (m) Simulink
 - (n) Octave

Course Code	Course Name	Course Structure			
		L	T	P	C
P21EST14	Python Programming	3	0	0	3

Internal Marks: 30

External Marks: 70

Course Prerequisite: NIL**Course Objectives:**

1. To read and write simple Python programs.
2. To develop Python programs with conditionals and loops.
3. To define Python functions and apply OOP concept.
4. To use Python data structures — lists, tuples, dictionaries.
5. To develop GUI applications in Python.

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

1. Understand the basics of python programming.
2. Understand control flow and implement various data structures provided by python.
3. Implement packages, methods and functions.
4. Develop real-world applications using oops and exception handling.
5. Build GUI Applications in Python.

UNIT-I:**(8 Lectures)**

Introduction: History of Python, Need of Python Programming, Applications Basics of Python Programming Using the REPL(Shell), Running Python Scripts, Variables, Assignment, Keywords, Input-Output, Indentation.

UNIT-II:**(9 Lectures)**

Types, Operators and Expressions: Types - Integers, Strings, Booleans, Expressions and order of evaluations, Control Flow- if, if-elif-else, for, while, break, continue, pass.

Data Structures Lists - Operations, Slicing, Methods; Tuples, Sets, Dictionaries, Sequences, Comprehensions..

UNIT-III:**(10 Lectures)**

Functions - Defining Functions, Calling Functions, Passing Arguments, Keyword Arguments, Default Arguments, Variable-length arguments, Anonymous Functions, Fruitful Functions (Function Returning Values), Scope of the Variables in a Function - Global and Local Variables.

Modules: Creating modules, import statement, from. Import statement, name spacing,

Python packages: Introduction to PIP, Installing Packages via PIP, Using Python Packages

UNIT-IV:**(9 Lectures)**

Object Oriented Programming OOP in Python: Classes, 'self variable', Methods, Constructor Method, Inheritance, Overriding Methods, Data hiding.

Error and Exceptions: Difference between an error and Exception, Handling Exception, try except block, Raising Exceptions, User Defined Exceptions.

UNIT-V:

(9 Lectures)

Brief Tour of the Standard Library & Files - Operating System Interface - String Pattern Matching, Mathematics, Internet Access, Dates and Times, Data Compression, Multithreading, GUI Programming, Turtle Graphics, file operations.

Text Books:

1. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016 (<http://greenteapress.com/wp/thinkpython/>).
2. Guido van Rossum and Fred L. Drake Jr, "An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.

Reference Books:

1. John V Guttag, "Introduction to Computation and Programming Using Python", Revised and expanded Edition, MIT Press , 2013
2. Kenneth A. Lambert, "Fundamentals of Python: First Programs", CENGAGE Learning, 2012.
3. Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
4. Charles Dierbach, "Introduction to Computer Science using Python: A Computational Problem Solving Focus, Wiley India Edition, 2013.

Web Resources:

1. <https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/>
2. <https://www.codecademy.com/learn/learn-python>
3. <https://www.codementor.io/collections/learn-python-bwbc63ulz>
4. <http://www.diveintopython3.net/>
5. <https://www.python.org/3/>
6. <https://www.learnpython.org>

Course Code	Course Name	Course Structure			
		L	T	P	C
P18EET05	Electrical Machines-II	3	0	0	3

Internal Marks: 30

External Marks: 70

Course Prerequisite: Basic Electrical and Electronics Engineering, Electrical Machines-1

Course Objectives: The student will be able

1. To understand the principle of operation and performance of 3-phase induction motor.
2. To quantify the performance of induction motor and induction generator in terms of torque and slip.
3. To understand the torque producing mechanism of a single phase induction motor.
4. To understand the principle of emf generation, the effect of armature reaction and redetermination of voltage regulation in synchronous generators.
5. To study parallel operation and load sharing of synchronous generators.
6. To understand the operation, performance and starting methods of synchronous Motors

Course Outcomes: After going through this course the student will be able to

1. Explain the operation and performance of three phase induction motor..
2. Analyze the torque-speed relation, performance of induction motor and induction generator.
3. Implement the starting of single phase induction motors.
4. Develop winding design and predetermine the regulation of synchronous generators.
5. Explain hunting phenomenon, implement methods of starting and correction of powerfactor with synchronous motor.

UNIT-I:

(8 Lectures)

3-phase induction motors Construction details of squirrel cage and slip ring induction motors – production of rotating magnetic field – principle of operation – slip speed, slip, rotor emf - rotor frequency – rotor current and pf at standstill and during running conditions - rotor power input, rotor copper loss and mechanical power developed and their interrelationship, – Equivalent circuit – phasor diagram

UNIT-II:

(10 Lectures)

Characteristics and testing methods of induction motors Torque equation – expressions for maximum torque and starting torque and Their inter relations – torque slip characteristics – double cage and deep bar rotors – crawling and cogging – speed control of induction motor with V/f control method – no load and blocked rotor tests – circle diagram for predetermination of performance-Numerical problems. – induction generator operation

UNIT-III:**(9 Lectures)**

Starting methods of 3-phase induction motors Methods of starting of three phase Induction motors: DOL, Auto transformer, Star-Delta, starter resistance and rotor resistance methods. **Single phase induction motors:** Constructional features- problem of starting-double revolving field theory- equivalent circuit- Methods of starting. AC series motors.

UNIT-IV:**(9 Lectures)**

Construction, operation, voltage regulation and parallel operation of synchronous generator: Constructional features of non-salient and salient pole machines –types of armature windings – distribution, pitch and winding factors – E.M.F equation –improvements of waveform and armature reaction –phasor diagrams- voltage regulation by synchronous impedance method – MMF method and Potier triangle method– two reaction analysis of salient pole machines and phasor diagram. Parallel operation with infinite bus and other alternators – synchronizing power – loadsharing.

UNIT-V:**(9 Lectures)**

Synchronous motor – operation, starting and performance Synchronous motor principle and theory of operation – phasor diagram – starting torque – variation of current and power factor with excitation – capability curves - synchronous condenser – mathematical analysis for power developed – hunting and its suppression – methods of starting – applications.

Text Books:

1. Electrical Machines by P.S. Bhimbra, Khanna Publishers
2. Electric Machinery by A.E.Fitzgerald, Charles Kingsley, Stephen D.Umans, TMH

Reference Books:

1. Performance and design of AC machines – M.G. Say
2. Alternating Current Machines by A.F.Puchstein, T.C. Lloyd, A.G. Conrad, ASIA Publishing House
3. Electrical Machinery Fundamentals by Stephen J Chapman McGraw Hill education, 2010.
4. Electrical Machines by R.K.Rajput, Lakshmi publications, 5th edition

Web Resources:

1. https://onlinecourses.nptel.ac.in/noc21_ee13/preview

Course Code	Course Name	Course Structure			
		L	T	P	C
P21EET06	Power Systems-II	3	0	0	3

Internal Marks: 30

External Marks: 70

Course Prerequisite: Power systems- I

Course Objectives: The student will be able

1. To compute inductance/capacitance of transmission lines and to understand the concepts of GMD/GMR.
2. To study the short, medium and long length transmission lines, their models and performance.
3. To study the effect of travelling waves on transmission lines.
4. To study the factors affecting the performance of transmission lines
5. To discuss sag and tension computation of transmission lines as well as to study the performance of overhead insulators.

Course Outcomes:

1. E Able to understand parameters of various types of transmission lines during different operating conditions.
2. Able to understand the performance of short, medium and long transmission lines.
3. Student will be able to understand travelling waves on transmission lines.
4. Will be able to understand various factors related to charged transmission lines.
5. Will be able to understand sag/tension of transmission lines and performance of line insulators.

UNIT-I: Transmission Line Parameters (10 Lectures)

Calculation of Resistance, Inductance Conductor materials - Types of conductors – Calculation of resistance for solid conductors – Calculation of inductance for single phase 2 wire systems – Concept of GMD and GMR – Three phase Inductance calculations for Symmetrical and asymmetrical conductor configuration with and without transposition – Bundled conductors – Numerical Problems

Calculation of Capacitance Calculation of capacitance for 2 wire and 3 wire systems – Effect of ground on capacitance – Three phase Capacitance calculations for symmetrical and asymmetrical conductor configuration with and without transposition - Numerical Problems.

UNIT-II: Performance of Short, Medium and Long Transmission Lines

(10 Lectures)

Performance of Short, Medium Transmission Lines Classification of Transmission Lines – Short, medium, long line and their model representations – Nominal-T – Nominal-Pi and A, B, C, D Constants for symmetrical and Asymmetrical Networks – Numerical Problems – Mathematical Solutions to estimate regulation and efficiency of all types of lines.

Performance of Long Transmission Lines Long Transmission Line–Rigorous Solution – Interpretation of the Long Line Equations, —Surge Impedance and SIL of Long Lines–Wave Length and Velocity of Propagation of Waves -Numerical Problems

UNIT-III:**(8 Lectures)****Power System Transients**

Types of System Transients - Travelling or Propagation of Surges Def of Incident, Reflected and Refracted Waves– Attenuation–Distortion– Reflection and Refraction Coefficients Termination of lines with different types of conditions – Open Circuited Line–Short Circuited Line – T-Junction– Lumped Reactive Junctions.

UNIT-IV:**(8 Lectures)****Various Factors governing the Performance of Transmission line**

Skin and Proximity effects – Description and effect on Resistance of Solid Conductors – Ferranti effect – Charging Current

Corona – Description of the phenomenon–Factors affecting corona–Critical voltages and power loss–Radio Interference.

UNIT-V: Sag and Tension Calculations and Overhead Line Insulators**(9 Lectures)****Sag and Tension Calculations**

Sag and Tension calculations with equal and unequal heights of towers–Effect of Wind and Ice on weight of Conductor–Numerical Problems – Stringing chart and sag template and its applications

Overhead Line InsulatorsTypes of Insulators – String efficiency and Methods for improvement– Numerical Problems – Voltage distribution–Capacitance grading and Static Shielding.–Calculation of string efficiency-

Text Books:

1. Electrical power systems – by C.L.Wadhwa, New Age International (P) Limited, Publishers, 1998.
2. Modern Power System Analysis by I.J.Nagarath and D.P.Kothari, Tata McGraw Hill, 2ndEdition.

Reference Books:

1. Power system Analysis–by John J Grainger William D Stevenson, TMC Companies,4thedition
2. Power System Analysis and Design by B.R.Gupta, WheelerPublishing.
3. A Text Book on Power System Engineering by M.L.Soni, P.V.Gupta, U.S.BhatnagarA.Chakrab DhanpatRai & Co Pvt. Ltd.
4. Electrical Power Systems by P.S.R. Murthy,B.S.Publications.

Web Resources:

1. www.nptel.iitm.ac.in
2. www.electrical4u.com
3. www.easyengineering.net



Course Code	Course Name	Course Structure			
		L	T	P	C
P21EET07	Electrical Measurements & Instrumentation	3	0	0	3

Internal Marks: 30

External Marks: 70

Course Prerequisite: Basic Electrical Engineering**Course Objectives:** The student will be able

1. To study the principle of operation and working of different types of instruments for measurement of Electrical Quantities.
2. To study the working principle of operation of different types of instruments for measurement of power and power factor and Energy meter.
3. To understand the principle of operation and working of various types of bridges for measurement of parameters –resistance, inductance, capacitance and frequency.
4. To understand the principle of operation and working of transducers.
5. To study the principle of operation and working of DVMS, Power analyzer and applications of CRO.

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

1. Choose right type of instrument for measurement of ac and dc Electrical quantities.
2. Choose right type of instrument for measurement of power and power factor.
3. Select right type for measurement of R, L,C.
4. Understand the effectiveness of Transducer.
5. Able to understand Digital Meters.

UNIT-I: Analog Ammeter and Voltmeters**(8 Lectures)**

Classification – deflecting, control and damping torques,– PMMC, moving iron type and electrostatic instruments, Construction, Torque equation, Range extension, Effect of temperature, Errors and compensations, advantages and disadvantages. Instrument transformers: Current Transformer and Potential Transformer- construction, theory, errors.

UNIT-II: Analog Wattmeters and Power Factor Meters and Energy meter. (10 Lectures)

Electrodynamometer type wattmeter (LPF and UPF), Power factor meters and frequency meters: Dynamometer and M.I type (Single phase and three phase), construction, theory, torque equation, advantages and disadvantages. Construction of working principle of energy meters and errors

UNIT-III: Measurements of Electrical parameters**(10 Lectures)****DC Bridges:** Method of measuring low, medium and high resistance – sensitivity

of Wheat stone's bridge, Kelvin's double bridge for measuring low resistance, Loss of charge method for measurement of high resistance, Megger – measurement of earth resistance - Numerical Problems.

AC Bridges: Measurement of inductance – quality factor, Maxwell's bridge, Hay's bridge, Anderson's bridge, and measurement of capacitance and loss angle, De-sauty's bridge, Schering Bridge, Wien's bridge- Numerical Problems.

UNIT-IV: Transducers

(9 Lectures)

Definition, Classification, Resistive, Inductive and Capacitive Transducer, LVDT, Strain Gauge, Thermistors, Thermocouples, Piezo electric and Photo Diode Transducers, Digital shaft encoders, Hall effect sensors.

UNIT-V: Digital meters

(8 Lectures)

Sag and Tension Calculations Digital voltmeter – Successive approximation DVM, Ramp type DVM and Integrating type DVM – Digital frequency meter, Digital multimeter, Digital tachometer, Digital Energy Meter, LCR Q meter, Power Analyzer-Measurement of phase difference, Frequency, hysteresis loop using lissajous patterns in CRO.

Text Books:

1. Electrical Measurements and measuring Instruments by E.W. Golding and F.C.Widdis, fifth Edition, Wheeler Publishing.
2. Modern Electronic Instrumentation and Measurement Techniques by A.D. Helfrick and W.D. Cooper, PHI, 5th Edition, 2002.

Reference Books:

1. Electrical & Electronic Measurement & Instruments by A.K.SawhneyDhanpatRai& Co.Publications.
2. Electrical and Electronic Measurements and instrumentation by R.K.Rajput, S.Chand.
3. Electrical Measurements by Buckingham and Price, Prentice – Hall
4. Electrical Measurements by Forest K. Harris. John Wiley and Sons
5. Electrical Measurements: Fundamentals, Concepts, Applications by Reissland, M.U, New Age International (P) Limited, Publishers.
6. Electrical and Electronic Measurements by G.K.Banerjee, PHI Learning Private Ltd, New Delhi-2012.

Course Code	Course Name	Course Structure			
		L	T	P	C
P21EEL04	Electrical Machines - II Laboratory	0	0	3	1.5

Internal Marks: 15

External Marks: 35

Course Prerequisite: Electrical Machines - I

Course Objectives:

1. To control the speed of three phase induction motors.
2. To determine /predetermine the performance three phase and single phase induction motors.
3. To improve the power factor of single phase induction motor .
4. To predetermine the regulation of three-phase alternator by various methods, find X_d/ X_q ratio of alternator and asses the performance of three-phase synchronous motor

Course Outcomes: At the end of the course student can able to

1. Assess the performance of single phase and three phase induction motors.
2. Control the speed of three phase induction motor.
3. Predetermine the regulation of three-phase alternator by various methods.
4. Find the X_d/ X_q ratio of alternator and asses the performance of three-phase synchronous motor.
5. Determine the performance single phase AC series motor.

LIST OF EXPERMENTS

1. Brake test on three phase Induction Motor
2. No-load & Blocked rotor tests on three phase Induction motor
3. Regulation of a three -phase alternator by synchronous impedance & m.m.f. Methods
4. Regulation of three-phase alternator by Potier triangle method
5. V and Inverted V curves of a three—phase synchronous motor.
6. Determination of X_d and X_q of a salient pole synchronous machine
7. Equivalent circuit of single phase induction motor
8. Speed control of induction motor by V/f method.
9. Determination of efficiency of three-phase alternator by loading with three phase induction motor.
10. Power factor improvement of single-phase induction motor by using capacitors and load test on single-phase induction motor.
11. Parallel operation of three-phase alternator.
12. Brake test on single-phase AC series Motor.

13. Starting methods of a capacitor start and capacitor start run single-phase Induction motor.
14. Brake test on single-phase Induction Motor.



Course Code	Course Name	Course Structure			
		L	T	P	C
P21EEL05	Electrical Measurements & Instrumentation Laboratory	0	0	3	1.5

Internal Marks: 15

External Marks: 35

Course Prerequisite: Electrical Measurements

Course Objectives:

1. To understand the correct function of electrical parameters and calibration of voltage, current, single phase and three phase power and energy, and measurement of electrical characteristics of resistance, inductance and capacitance of a circuits through appropriate methods.
2. To understand the calibration of DC and AC Potentiometers.
3. To understand the testing of CT and PT.
4. To Understand and the characteristics of Thermo couples, LVDT, Capacitive transducer, piezoelectric transducer.
5. To understand the measurement of strain, Phase difference and frequency

Course Outcomes: At the end of the course student can able to

1. Measure the electrical parameters voltage, current, power, energy and electrical characteristics of resistance, inductance and capacitance.
2. Known the characteristics of transducers.
3. Measure the strains, frequency and phase difference.

LIST OF EXPERMENTS

1. Calibration of dynamometer wattmeter using phantom loading
2. Crompton D.C. Potentiometer - Calibration of PMMC ammeter and PMMC voltmeter
3. Kelvin's double Bridge - Measurement of resistance - Determination of tolerance. Methods
4. Capacitance Measurement using Schering Bridge.
5. Inductance Measurement using Anderson Bridge.
6. Calibration of LPF Wattmeter – by direct loading.
7. Equivalent circuit of single phase induction motor
8. testing of C.T. using mutual inductor – Measurement of % ratio error and phase angle of given C.T. by Null method.
9. P.T. testing by comparison – V.G as Null detector – Measurement of % ratio error and phase angle of the given P.T.
10. Calibration of Energy meter using phantom loading.
11. Measure the reactive power with 3 phase load.

12. LVDT – characteristics.
13. Capacitive transducers characteristics.
14. Piezoelectric transducer characteristics.
15. Measurement of strain using strain gauge.
16. Measurement of phase difference.



Course Code	Course Name	Course Structure			
		L	T	P	C
P21EES03	Skill Oriented Course-II	1	0	2	2

Internal Marks: 0

External Marks: 50

1. There are five (05) skill-oriented courses shall be offered during III to VII semesters and students must register and pass the courses successfully.
2. For skill oriented/skill advanced course, one theory and two practical hours (1-0-2) or two theory hours (2-0-0) may be allotted as per the decision of concerned BOS.
3. Out of the five skill courses; (i) two shall be skill-oriented courses from the same domain and shall be completed in second year (ii) Of the remaining three skill courses, one shall be necessarily be a soft skill course and the remaining 2 shall be skill-advanced courses either from the same domain or job-oriented skill courses, which can be of inter disciplinary nature.
4. Students may register the interdisciplinary job-oriented skill courses based on the prerequisites and eligibility in consultation with HOD of the Department.
5. The student shall be given an option to choose either the skill courses being offered by the college or to choose a certificate course being offered by Industries/Professional bodies/APSSDC or any other accredited bodies. However, the department has to assign mentors in the college to monitor the performance of the students.
6. If a student chooses to take a Certificate Course offered by industries/Professional bodies/APSSDC or any other accredited bodies, in lieu of the skill advanced course offered by the Department, then the department shall mark overall attendance of the student for the remaining courses in that semester excluding the skill course in all the calculations of mandatory attendance requirements upon producing a valid certificate. However, the student is deemed to have fulfilled the attendance requirement of the course, if the external agency issues a certificate with satisfactory condition.
7. If the certificate issued by external agency is marked with unsatisfactory condition, then the student shall repeat the course either in the college or at external agency.
8. The credits will be awarded to the student upon producing the successful Course Completion Certificate from the agency/professional bodies and after passing in the viva-voce examination conducted at college as per college norms at the end of the semester.
9. The job-oriented skill courses may be registered at the department or at any accredited external agency.
10. A student shall submit a record/report on the on the list skills learned.

11. If the student completes job-oriented skill course at external agency, a certificate from the agency shall be included in the report.
12. The course will be evaluated at the end of the semester for 50 marks (record: 15 marks and viva-voce: 35 marks) along with laboratory end examinations in the presence of external (appointed by the Chief Controller of Examinations) and internal examiner (course instructor or mentor).
13. There are no internal marks for the job-oriented skill courses.
14. For II-I & II-II Semesters Students can register a course in below domain or any other core domain with prior written approval of Head of the Department.
 - (a) Solar Cells
 - (b) Electrical Vehicle Design
 - (c) Electrical Auto CAD
 - (d) Aurdino
 - (e) Raspberry pi
 - (f) Internet of Things
 - (g) AI applications in Electrical Engineering
 - (h) Machine Learning applications in Electrical Engineering
 - (i) SciLab
 - (j) LabView
 - (k) MultiSim
 - (l) MATLAB
 - (m) Simulink
 - (n) Octave

Course Code	Course Name	Course Structure			
		L	T	P	C
P21EET08	Power Electronics	3	0	0	3

Internal Marks: 30

External Marks: 70

Course Prerequisite: Semi Conductor Devices, Mathematics, Control Systems

Course Objectives: The student will be able

1. To study the characteristics of various power semiconductor devices and firing circuits for SCR
2. To Understand the operation of single- phase AC-DC half wave and full-wave converters and perform harmonic analysis of input current
3. To Understand the operation of three phase AC-DC half wave and full-wave converters and single-phase AC/AC converters
4. To Understand the operation of different types of DC-DC converters
5. To learn the operation of PWM inverters for voltage control and harmonic mitigation

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

1. Explain the characteristics of various power semiconductor devices and analyze the static and dynamic characteristics of SCR and design firing circuits of SCR. characteristics of power MOSFET and IGBT.
2. Explain the operation of phase-controlled rectifiers.
3. Analyze the operation of three-phase full-wave converters and AC Voltage Controllers.
4. Analyze the operation and design of different types of DC-DC converters
5. Explain the operation of inverters and application of PWM techniques for voltage control and harmonic mitigation.

UNIT-I:

(8 Lectures)

Power Semi-Conductor Devices: Silicon controlled rectifier (SCR) – Two transistor analogy - Static and Dynamic characteristics – Turn on and Turn off Methods - Triggering Methods (R, RC and UJT) – Snubber circuit design. Static and Dynamic Characteristics of Power MOSFET and Power IGBT.

UNIT-II:

(10 Lectures)

Single-phase AC-DC Converters: Single-phase half-wave controlled rectifiers - R and RL loads with and without freewheeling diode - Single-phase fully controlled mid-point and bridge converter with R load, RL load & RLE load – Continuous conduction and Discontinuous conduction - Effect of source inductance in Single-phase fully controlled bridge rectifier – Expression for output voltages – Single-phase Semi-Converter with R load-RL load and RLE load– Continuous and Discontinuous conduction - Harmonic Analysis - Dual converter and its mode of operation - Numerical Problems.

UNIT-III:**(10 Lectures)**

Three-phase AC-DC Converters & AC – AC Converters: Three-phase half-wave Rectifier with R and RL load - Three-phase fully controlled rectifier with R and RL load - Three-phase semi converter with R and RL load - Expression for Output Voltage - Harmonic Analysis- Numerical Problems .Single-phase AC-AC power control by phase control with R and RL loads - Expression for rms output voltage -Single-phase step down and step up Cycloconverter Numerical Problems.

UNIT-IV:**(8 Lectures)**

DC-DC Converters: Operation of Basic Chopper – Analysis of Buck, Boost and Buck-Boost converters in Continuous Conduction Mode (CCM) and Discontinuous Conduction Modes (DCM) - Output voltage equations using volt-sec balance in CCM & DCM – Expressions for output voltage ripple and inductor current ripple – control techniques – Introduction to PWM control -Numerical Problems.

UNIT-V:**(9 Lectures)**

DC-AC Converters: Introduction - Single-phase half-bridge and full-bridge inverters with R and RL loads – Phase Displacement Control – PWM with bipolar voltage switching, PWM with unipolar voltage switching - Three-phase square wave inverters - 120° conduction and 180° conduction modes of operation - Sinusoidal Pulse Width Modulation - Current Source Inverter (CSI) - Numerical Problems.

Text Books:

1. EPower Electronics: Converters, Applications and Design, Ned Mohan, Tore M Undeland, William P Robbins, John Wiley & Sons.
2. Power Electronics: Circuits, Devices and Applications, M. H. Rashid, 2nd edition, Prentice Hall of India, 1998.
3. Power Electronics: Essentials and Applications, L. Umanand, Wiley, Pvt. Limited, India, 2009.

Reference Books:

1. Elements of Power Electronics, Philip T.Krein, 2nd Edition, Oxford University Press, 2017.
2. Power Electronics, Dr. P.S. Bimbhra, 6th Edition, Khanna Publishers, 2018.
3. Thyristorised Power Controllers, R.M.K. Sinha, A. Joshi, S.R. Doradla, G. K. Dubey, 2nd Edition, New Age International (P) Ltd., 2012.
4. Power Electronics, Daniel W. Hart, 1st Edition, McGraw-Hill, 2011.

Web Resources:

1. <https://www.niehs.nih.gov/health/topics/agents/emf/index.cfm>
2. <https://www.electrical4u.com>
3. <http://www.ece.uah.edu>

Course Code	Course Name	Course Structure			
		L	T	P	C
P21EET09	Control Systems	3	0	0	3

Internal Marks: 30

External Marks: 70

Course Prerequisite: Engineering Mathematics

Course Objectives: The student will be able

1. To learn the mathematical modeling of physical systems and to use block diagram algebra and signal flow graph to determine overall transfer function.
2. To analyze the time response of first and second order systems and improvement of performance using PI, PD, PID controllers. To investigate the stability of closed loop systems using Routh's stability criterion and root locus method.
3. To understand basic aspects of design and compensation of LTI systems using Bode diagrams.
4. To learn Frequency Response approaches for the analysis of LTI systems using Bode plots, polar plots and Nyquist stability criterion.
5. To learn state space approach for analysis of LTI systems and understand the concepts of controllability and observability.

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

1. Derive the transfer function of physical systems and determination of overall transfer function using block diagram algebra and signal flow graphs.
2. Determine time response specifications of second order systems and 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. Represent physical systems as state models and determine the response. Understand the concepts of controllability and observability.

UNIT-I:

(10 Lectures)

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 - transfer function of DC servo motor- AC servo motor - Mathematical Modelling of synchro transmitter and receiver -block diagram algebra - signal flow graph – reduction using Mason's gain formula.

UNIT-II:

(10 Lectures)

Time Response Analysis and Controllers: 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 Assessment Techniques : 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:

(8 Lectures)

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:

(7 Lectures)

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

UNIT-V:

(10 Lectures)

State Space Analysis of Linear Time Invariant (LTI) Systems: Concepts of state - state variables and state model - state space representation of transfer function -Transfer function from state space representation, solving the time invariant state equations - State Transition Matrix and its properties- concepts of controllability and observability.

Text Books:

1. Control Systems Engineering, I. J. Nagrath, M. Gopal, 5th Edition, New Age International (P) Ltd., 2007.
2. Modern Control Engineering, Katsuhiko Ogata, 5 th edition, Prenties-Hall India Pvt. Ltd., 2010.

Reference Books:

1. Control Systems Principles & Design, M.Gopal, 4th Edition, McGraw-Hill, 2012.
2. Automatic Control Systems, B. C. Kuo, Farid Golnaraghi, 8th Edition, John wiley & sons, 2003

Web Resources:

1. Swayam.gov.in
2. https://www.tutorialspoint.com/control_systems/control_systems_introduction.htm
3. <https://www.youtube.com/watch?v=XMfH2P2Fc6Q>

Course Code	Course Name	Course Structure			
		L	T	P	C
P21ECT04	Pulse and Digital Circuits	3	0	0	3

Internal Marks: 30

External Marks: 70

Course Prerequisite: Electronic Devices and Circuits, Network Analysis.

Course Objectives: The student will be able

1. To understand the Complete Response of R-C and R-L-C transient circuits.
2. Understand the concepts of wave shaping it's for any application.
3. To design various Multivibrators using Transistors and Sampling Gates.
4. To Introduce to Time-base Generators in sweep signal generation.
5. To discuss and realize the Logic Gates using Diodes and Transistors.

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

1. Explain the Complete Response of R-C and R-L-circuit.
2. Analyze the responses of sinusoidal and non-sinusoidal signals to various responses.
3. Demonstrate the concept of switching characteristics of diodes and transistors.
4. Construct the various Multivibrators Using Transistors and demonstrate time base generators.
5. Discuss and realize the Logic Gates using Diodes and Transistors.

UNIT-I:

(8 Lectures)

Linear Wave Shaping: High pass, low pass RC circuits, their Response for Sinusoidal, Step, Pulse, Square, and Ramp inputs. High pass RC Network as Differentiator and Low pass RC circuit as an integrator, Attenuators and its application as a CRO, RL and RLC circuits and their response for step input.

UNIT-II:

(10 Lectures)

Non-Linear Wave Shaping: Diode as a switch, Piece Wise Linear Diode Characteristics, Diode clippers, Transistor clippers, clipping at two independent levels, Comparators, applications of voltage comparators, Clamping operation, clamping circuits taking source and diode resistances taking into account, Clamping circuit theorem.

UNIT-III:

(10 Lectures)

Multivibrators: Transistor as a switch, break down voltages, Analysis and Design of Bistable, Monostable, Astable Multivibrators and Schmitt trigger circuit using BJT.

Sampling Gates: Basic Operating Principles of Sampling Gates, Diode Unidirectional Sampling Gate and Two-Diode Bi-Directional Sampling Gate, Four- Diode gates, Six-Diode Gates, Applications of Sampling Gates.

UNIT-IV:**(8 Lectures)**

Time Base Generators: General features of a time base signal, Methods of generating time base waveform, Sweep generation by UJT, basic principles in Miller and Bootstrap time base generators, Transistor Miller time base generator, Transistor Bootstrap time base generator, Transistor current time base generators.

UNIT-V:**(9 Lectures)**

Logic Families: Realization of digital logic gates with Diode Logic, Transistor Logic, Diode- Transistor Logic, Resistor Transistor Logic Transistor-Transistor Logic, Emitter Coupled Logic, CMOS logic, Comparison of Digital Logic Families.

Text Books:

1. Pulse, Digital and Switching Waveforms - J. Millman and H. Taub, Mothiki S Prakash Rao McGraw-Hill, 2nd Edition, 2007.
2. Solid State Pulse circuits - David A. Bell, PHI, 4th Edition, 2002..

Reference Books:

1. Integrated electronics, Jacob Miman, Christos, C. Halkias, 2nd Edition, Tata McGraw Hill Publication, 2017.
2. Pulse and Digital Circuits, A. Anand Kumar, 2nd Edition, PHI, 2005
3. Fundamentals of Pulse and Digital Circuits, Ronald J. Tocci, 3rd Edition, PHI, 2008.

text Web Resources:

1. www.npteliitm.ac.in
2. www.modernelectronics.org
3. www.electronicstoyou.com

Course Code	Course Name	Course Structure			
		L	T	P	C
P21EEP01	Renewable Energy Sources	3	0	0	3

Internal Marks: 30

External Marks: 70

Course Prerequisite: Power Systems - I

Course Objectives: The student will be able

1. To study the solar radiation data, extraterrestrial radiation, radiation on earth's surface.
2. To study solar thermal collections.
3. To study solar photo voltaic systems.
4. To study maximum power point techniques in solar pv and wind energy.
5. To study wind energy conversion systems, Betz coefficient, tip speed ratio, basic principle and working of hydro, tidal, biomass, fuel cell and geothermal systems.

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

1. Analyze solar radiation data, extraterrestrial radiation, and radiation on earth's surface.
2. Explain solar thermal collectors, solar thermal plants.
3. Design solar photo voltaic systems.
4. Develop maximum power point techniques in solar PV and wind energy systems.
5. Explain wind energy conversion systems, wind generators, basic principle and working of hydro, tidal, biomass, fuel cell and geothermal systems.

UNIT-I:

(9 Lectures)

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 - Radiation on tilted surfaces.

UNIT-II:

(9 Lectures)

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

UNIT-III:

(9 Lectures)

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

UNIT-IV:**(9 Lectures)**

Wind Energy: Sources of wind energy - Wind patterns –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.

UNIT-V:**(9 Lectures)**

Tidal, Biomass, fuel cells and geothermal power systems: Tidal power: Basics – Kinetic energy equation. Wave power: Basics – Kinetic energy equation. **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. **Geothermal:** Classification – Dry rock and hot aquifer – Energy analysis – Geothermal based electric power generation.

Text Books:

1. Renewable Energy Resources, John Twidell, Tony Weir, 2nd Edition, Taylor and Francis, 2013.

Reference Books:

1. Energy Science: Principles, Technologies and Impacts, John Andrews, Nicholas Alfred Jelley, Nick Jelley, 3rd Edition, Oxford University Press, 2017
2. Renewable Energy, Godfrey Boyle, 3rd Edition, Oxford University Press, 2010.
3. Handbook of Renewable Technology, Ahmed F Zobaa, Ramesh C Bansal, World Scientific, Singapore, 2011.
4. Renewable Energy Technologies: Ocean Thermal Conversion and Other sustainable Energy Option, R. Ramesh, K. Uday Kumar, M. Anandakrishnan, Narosa Publishing House, 1997.
5. Renewable Energy Technologies - A Practical Guide for Beginners, Chetong Singh Solanki, Prentice Hall India Learning Private Ltd., 2008.
6. Non conventional energy source, B.H.khan, 2nd edition, McGraw-Hill, 2009.

text Web Resources:

1. www.npteliitm.ac.in
2. <https://www.energy.gov/eere/renewable-energy>
3. <https://www.edfenergy.com/energywise/renewable-energy-sources>

Course Code	Course Name	Course Structure			
		L	T	P	C
P21EEP02	Energy Audit, Conservation & Management	3	0	0	3

Internal Marks: 30

External Marks: 70

Course Prerequisite: Power Systems

Course Objectives: The student will be able

1. To understand energy efficiency, scope, conservation and technologies.
2. To design energy efficient lighting systems.
3. To estimate/calculate power factor of systems and propose suitable compensation techniques.
4. To understand energy conservation in Space Heating and Ventilation – Air–Conditioning systems.
5. To calculate life cycle costing analysis and return on investment on energy efficient technologies.

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

1. Explain energy efficiency, conservation and various technologies.
2. Design energy efficient lighting systems.
3. Calculate power factor of systems and propose suitable compensation techniques.
4. Explain energy conservation in Space Heating and Ventilation – Air–Conditioning systems.
5. Calculate life cycle costing analysis and return on investment on energy efficient technologies.

UNIT-I:

(10 Lectures)

General Concepts of Energy Auditing: Basic Principles of Energy Audit and management Energy audit – Definitions – Concept – Types of audit – Energy index – Sankey diagrams – Load profiles – Energy conservation schemes and energy saving potential– Principles of energy management – Initiating, planning, controlling, promoting, monitoring, reporting – Energy manager – Qualities and functions –home energy audit.

UNIT-II:

(8 Lectures)

Energy Efficient Lighting System: Lighting Modification of existing systems – Replacement of existing systems – Priorities: Definition of terms and units –Types of lighting – Electric lighting fittings (luminaries) – Flood lighting – White light LED and conducting Polymers – Energy conservations.

UNIT-III:

(9 Lectures)

Power factor improvement: Power Factor and energy instruments Power factor – Methods of improvement – Location of capacitors – Power factor with nonlinear loads -Energy Instruments – Smart Watt-hour meter – Data loggers –Pyrometers – Lux meters – Tong testers – Power analyzer.

UNIT-IV:**(8 Lectures)****Energy efficiency in Space Heating and Ventilation-Air-Conditioning systems:**

Space Heating and Ventilation – Air-Conditioning and Water Heating: Introduction – Heating of buildings – Transfer of Heat-Space heating methods – Ventilation and air-conditioning – Insulation-Cooling load – Electric water heating systems – Energy conservation in heating and cooling to domestic loads methods.

UNIT-V:**(10 Lectures)**

Economic Aspects and Financial Analysis: Economic Aspects and Analysis Economics Analysis – Depreciation Methods – Time value of money – Rate of return – Present worth method – Replacement analysis – Life cycle costing analysis – Energy efficient motors (basic concepts). Computation of Economic Aspects Calculation of simple payback method – Net present worth method, Case study in Energy auditing in home.

Text Books:

1. Energy Management, W.R. Murphy, G. A. McKay, 2nd Edition, Butterworth, Gurgaon Haryana. 2009.
2. Energy Efficient Electric Motors, To John.C, Andreas, 2nd edition, Marcel Dekker Inc Ltd, 2005.

Reference Books:

1. Electric Energy Utilization and Conservation, S. C. Tripathy, Tata McGraw Hill Ltd, 1991.
2. Energy Management, Paul O Callaghan, 1st Edition, Mc-Graw Hill, 1998.
3. Energy Management Hand Book, Steve Doty, W.C.Turner, 8th Edition, Fairmont Press, 2012.
4. Energy Management and Conservation, k v Sharma, P Venkataseshaiyah, 0th Edition, I K International Publishing House, 2011.

text Web Resources:

1. https://iare.ac.in/sites/default/files/iare_EAM_lecture%20notes.pdf
2. <https://www.jntufastupdates.com/jntuk-r16-3-2-eacm-material-pdf/>

Course Code	Course Name	Course Structure			
		L	T	P	C
P21EEP03	Electrical Machine Modelling	3	0	0	3

Internal Marks: 30

External Marks: 70

Course Prerequisite: Electrical Machines.

Course Objectives:

1. Unified theory of rotating machines.
2. The concept of phase transformation.
3. Mathematical modeling of machines single phase induction.
4. Develop concepts on mathematical modeling of electrical machines.
5. Analyze BLDC machine and switched reluctance machine based on mathematical modeling of BLDC and SRM.

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

1. Discuss about the basic concepts of machine modeling.
2. Develop mathematical model of dc motor.
3. Acquire knowledge on the abc to dq0 and dq0 to abc ransformations to develop mathematical model of single-phase induction machine..
4. Design control strategies based on dynamic modeling of 3-ph Induction machines and 3-phase synchronous machine.
5. Model synchronous machine and special electrical machines.

UNIT-I:

(9 Lectures)

Basic concepts of Modeling: Magnetically coupled circuits, review of basic concepts, magnetizing inductance, electromechanical energy conversion. Basic Two-pole Machine ,representation of Commutator machines, 3-phase synchronous machine with and without damper bars and 3-phase induction machine, Kron's primitive Machine-voltage, current and Torque equations.

UNIT-II:

(9 Lectures)

DC Machine Modeling: Mathematical model of separately excited D.C Motor – Steady State analysis-Transient State analysis-Sudden application of Inertia Load-Transfer function of Separately excited D.C Motor- Mathematical model of D.C Series motor, Shunt motor and Compound Motor-Linearization Techniques for small perturbations.

UNIT-III:

(9 Lectures)

Reference frame theory & Modeling of single phase Induction Machines: Linear transformation-Phase transformation - three phase to two phase transformation (abc to dq0) and two phase to three phase transformation dq0 to abc -Power equivalence- Mathematical modeling of single phase induction machines Variables observed from various frames of reference.

UNIT-IV:**(9 Lectures)**

Modeling of Three Phase Induction Machine: Generalized model in arbitrary reference frame-Electromagnetic torque-Derivation of commonly used Induction machine models- Stator reference frame model-Rotor reference frame model-Synchronously rotating reference frame model-state space model with flux linkages as variables. Two axis models for induction motor-d-q model based DOL starting of Induction Motors.

UNIT-V:**(9 Lectures)**

Modeling of Synchronous Machine & Special Machines: Circuits model of a 3-phase synchronous motor-Two axis representation of synchronous motor Synchronous machine inductances-voltage equations in the rotor's dq0 reference frame electromagnetic torque-current in terms of flux linkages-three phase synchronous machine model. Modeling of PM Synchronous motor, modeling of BLDC motor and modeling of Switched Reluctance motor.

Text Books:

1. Generalized theory of Electrical Machinery, P.S.Bimbira, 7th Edition, Khanna Publishers, 2021.
2. Analysis of Electric Machinery and Drives Systems, Oleg Wasynczuk, Paul C. Krause, Scott D. Sudhoff, Steven D. Pekarek, 3rd Edition, Wiley-IEEE Press, 2013.
3. Electric Motor Drives - Modeling, Analysis & Control, R. Krishnan, 1st Edition, Pearson Publications, 2001.

Reference Books:

1. Electric Motor Drives - Modeling, Analysis & Control, R. Krishnan, PHI Learning Private Ltd, 2009.
2. Analysis of Electric Machinery and Drive Systems, Paul C. Krause, Oleg Wasynczuk, Scott D. Sudhoff, John Wiley & Sons, New York, 2004.
3. Power System Stability & Control, P. Kundur, 5th Edition, Tata Mcgraw Hill, 2008.

text Web Resources:

1. <https://nptel.ac.in/courses/108106023>
2. <https://www.mdpi.com/1996-1073/16/2/654>
3. <https://ideas.repec.org/a/gam/jeners/v16y2023i2p654-d1026163.html>

Course Code	Course Name	Course Structure			
		L	T	P	C
P21EEP04	Fundamentals of Electrical Vehicles	3	0	0	3

Internal Marks: 30

External Marks: 70

Course Prerequisite: Electrical Circuits, Engineering Physics**Course Objectives:**

1. To familiarize the students with the need and advantages of electric vehicles(EV).
2. To understand various power converters used in electric vehicles.
3. To familiar with different types of motors suitable for electric vehicles.
4. To have knowledge on latest developments in storage systems.
5. now various architecture of hybrid electric vehicles.

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

1. Illustrate different types of electric vehicles.
2. Select suitable power converters for EV applications.
3. Choose an effective motor for EV applications.
4. Analyse a battery management system for EV.
5. Design HEV configuration for a specific application.

UNIT-I:**(9 Lectures)**

Introduction: Introduction to Fundamentals of Vehicles - Components of conventional vehicles - drawbacks of conventional vehicles – Need for electric vehicles - History of Electric Vehicles – Types of Electric Vehicles – Advantages and applications of Electric Vehicles.

UNIT-II:**(9 Lectures)**

Power Electronics Converters for EVs: Components of Electric Vehicles– Power Converters - Controller and Electric Traction Motor – Rectifiers used in EVs – Bidirectional DC–DC Converters – Voltage Source Inverters – PWM inverters used in EVs.

UNIT-III:**(9 Lectures)**

Special Machines for EVs:Motors for Electric Vehicles - Characteristics of traction drive - Requirements of electric machines for EVs – Different motors suitable for Electric and Hybrid Vehicles – Induction Motors – Synchronous Motors – Permanent Magnetic Synchronous Motors – Brushless DC Motors – Switched Reluctance Motors (Construction details and working only)

UNIT-IV:**(9 Lectures)**

Energy Sources for EVs: Energy Sources for Electric Vehicles Batteries - Types of Batteries – Lithium-ion - Nickel-metal hydride - Lead-acid – Comparison of Batteries - Battery Management System – Ultra capacitors – Flywheels – Fuel Cell – it's working

UNIT-V:**(9 Lectures)**

Hybridization of Automobiles: Hybrid Electric Vehicles - Evolution of Hybrid Electric Vehicles – Advantages and Applications of Hybrid Electric Vehicles – Architecture of HEVs - Series and Parallel HEVs – Complex HEVs – Range extended HEVs – Examples - Merits and Demerits.

Text Books:

1. Electric and Hybrid Vehicles: Design Fundamentals, Iqbal Hussein, CRC Press, 2003.
2. Electric and hybrid vehicles, Denton Tom, Routledge, 2020.

Reference Books:

1. Power Converters for Electric Vehicles, Kumar L, Ashok, S. Albert Alexander, CRC Press, 2020.
2. Electric Vehicle Machines and Drives: Design - Analysis and Application, Chau - Kwok Tong, John Wiley & Sons, 2015.
3. Batteries for Electric Vehicles: Materials and Electrochemistry, Berg Helena, Cambridge University Press, 2015.
4. Advanced Electric Drive Vehicles, Ali Emadi, CRC Press, 2014.

text Web Resources:

1. <https://nptel.ac.in/courses/108106170>
2. <https://www.udemy.com/course/fundamentals-of-electric-vehicles/>
3. <https://indianinstituteofsolarenergy.com/courses/fundamentals-of-electric-vehicle-technology/>

Course Code	Course Name	Course Structure			
		L	T	P	C
P21EEL06	Power Electronics Lab	0	0	3	1.5

Internal Marks: 15

External Marks: 35

Course Prerequisite: Power Electronics**Course Objectives:**

1. To study the characteristics of various power electronic devices and analyze firing circuits and commutation circuits of SCR.
2. To analyze the performance of single-phase and three-phase full-wave bridge converters with both resistive and inductive loads.
3. To understand the operation of AC voltage regulator with resistive and inductive Loads.
4. To understand the working of Buck converter, Boost converter
5. To understand the working of series, parallel and PWM inverter.

Course Outcomes: At the end of the course student can able to

1. Analyse characteristics of various power electronic devices and design firing circuits for SCR.
2. Analyse the performance of single-phase ,three-phase full-wave bridge converters with both resistive and inductive loads.
3. Examine the operation of Single-phase AC voltage regulator and Cycloconverter with resistive and inductive loads.
4. Differentiate the working and control of Buck converter and Boost converter.
5. Differentiate the working & control of Square wave inverter and PWM inverter.

LIST OF EXPERMENTS (Any 10 of the following are to be conducted)

1. Study of Characteristics of Thyristor, MOSFET &IGBT.
2. Study of firing circuits for Thyristor.
3. Study of gate drive circuits for IGBT.
4. Single -Phase Half controlled converter with R and RL load.
5. Single -Phase fully controlled bridge converter with R and RL.
6. Single -Phase AC Voltage Regulator with R and RL Loads.
7. Single -Phase square wave bridge inverter with R and RL Loads.
8. Three- Phase fully controlled converter with RL-load..
9. Design and verification of voltages gain of Boost converter.
10. Design and verification of voltages ripple in buck converter.
11. 3-phase AC-AC voltage regulator with R-load.
12. Single -Phase series inverter with R and RL Loads.
13. Single Phase PWM Inverter.

Course Code	Course Name	Course Structure			
		L	T	P	C
P21EEL07	Control Systems Lab	0	0	3	1.5

Internal Marks: 15

External Marks: 35

Course Prerequisite: Control Systems

Course Objectives:

1. 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 Synchronos.
2. To understand the time response of control system and time domain specifications.
3. To understand the frequency response of control system with and without controllers and compensators.
4. To understand the stability in time and frequency domain using MATLAB and also to study the logic gates using PLC.
5. To understand the concept of transfer function for DC Motor

Course Outcomes: After going through this course, student can able to

1. Analyze the performance and working Magnetic amplifier, D.C and A.C. Servo motors and Synchronos.
2. Determine the time domain specifications of given system.
3. Design P,PI,PD,PID controllers & Lag, Lead, Lead-Lag compensators and Evaluate the temperature control of an oven using PID controller.
4. Judge the stability in time & frequency domain using MATLAB and also examine different logic gates using PLC.
5. Determine the transfer function of DC Motor.

LIST OF EXPERMENTS (Any 10 of the following are to be conducted)

1. Time response of Second order system.
2. Characteristics of Synchronos.
3. Effect of P, PD, PI, PID Controller on a second order systems.
4. Design of Lag and lead compensation – Magnitude and phase plot.
5. Transfer function of DC motor.
6. Bode Plot, Root locus, Nyquist Plots for the transfer functions of systems up to 5th order using MATLAB
7. Controllability and Observability Test using MAT LAB.
8. Temperature controller using PID.

9. Characteristics of magnetic amplifiers.
10. Characteristics of AC servo motor.
11. Characteristics of DC servo motor.
12. Study and verify the truth table of logic gates and simple Boolean expressions using PLC.



Course Code	Course Name	Course Structure			
		L	T	P	C
P21EES03	Skill Oriented Course-III	1	0	2	2

Internal Marks: 0

External Marks: 50

Course Prerequisite: No Prerequisite

Course Objectives:

1. To train the students with job oriented skills.

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

1. Apply the job oriented skills learned during the course in real-life problems.
2. Communicate the skills effectively acquired during the course.

Course Objective & Course Outcomes will be vary according to the student's opted course.

1. skill-advanced courses either from the same domain
 - (a) Solar Cells
 - (b) Electrical Vehicle Design
 - (c) Electrical Auto CAD
 - (d) Aurdino
 - (e) Raspberry pi
 - (f) Internet of Things
 - (g) AI applications in Electrical Engineering
 - (h) Machine Learning applications in Electrical Engineering
 - (i) SciLab
 - (j) LabView
 - (k) MultiSim
 - (l) MATLAB
 - (m) Simulink
 - (n) Octave
2. job-oriented skill courses of inter disciplinary nature
 - (a) Python for the AI
 - (b) Machine Learning
 - (c) Deep Learning
 - (d) Data Science
 - (e) Artificial Neural Network

- (f) Natural Language Processing
- (g) Full stack development
- (h) Azure
- (i) Microsoft Administrator



Course Code	Course Name	Course Structure			
		L	T	P	C
P21XXXXX	Professional Ethics and Human Values	3	0	0	3

Internal Marks: 30

External Marks: 70

Course Prerequisite: None**Course Objectives:**

1. To introduce the students to the Human values and help them to lead a peaceful life in the society by contributing to peace and safety in the society.
2. To help the students to know about the history of ethics and importance of social experimentation
3. To specify the students about the importance of their responsibility towards safety and risk as Engineers.
4. To specify the students about the importance of their responsibility as Engineers.
5. To help the student explore the ethical values globally.

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

1. To learn about the different Human values to be maintained by all the people.
2. To learn about the history of ethics and the importance of ethics for professionals and application of ethics in social experimentation.
3. To learn about the responsibilities of engineers for safety and risk.
4. To learn about the responsibilities and rights of engineers.
5. To learn about global work environment with respect to ethics.

UNIT-I:**(8 Lectures)**

Human Values: Morals, Values and Ethics – Integrity – Work Ethics – Service Learning – Civic Virtue – Respect for others – Living Peacefully – Caring – Sharing – Honesty – Courage – Value time – Co-operation – Commitment – Empathy – Self-confidence – Spirituality- Character.

UNIT-II:**(10 Lectures)**

Engineering Ethics: The History of Ethics-Purposes for Engineering Ethics-Engineering Ethics - Consensus and Controversy –Professional and Professionalism –Professional Roles to be played by an Engineer –Self Interest, Customs and Religion-Uses of Ethical Theories-Professional Ethics-Engineering and Ethics-Kohlberg’s Theory – Gilligan’s Argument –Heinz’s Dilemma.

Engineering as Social Experimentation: Comparison with Standard Experiments – Knowledge gained – Conscientiousness – Learning from the Past – Engineers as Managers, Consultants, and Leaders – Role of Codes – Codes and Experimental Nature of Engineering.

UNIT-III:**(10 Lectures)**

Engineers’ Responsibility for Safety and Risk: Safety and Risk, Concept of

Safety – Types of Risks – Voluntary v/s Involuntary Risk- Short term v/s Long term Consequences- Expected Probability- Reversible Effects- Threshold Levels for Risk- Delayed v/s Immediate Risk- Safety and the Engineer – Designing for Safety – Risk Benefit Analysis-Accidents.

UNIT-IV:**(8 Lectures)**

Engineers' Responsibilities and Rights: Collegiality-Techniques for Achieving Collegiality –Two Senses of Loyalty - obligations of Loyalty-misguided Loyalty – professionalism and Loyalty - Professional Rights –Professional Responsibilities – confidential and proprietary information-Conflict of Interest-solving conflict problems – Self interest, Customs and Religion- Ethical egoism-Collective bargaining Confidentiality-Acceptance of Bribes/Gifts-when is a Gift and a Bribe examples of Gifts v/s Bribes-problem solving-interests in other companies Occupational Crimes-industrial espionage-price fixing-endangering lives Whistle Blowing-types of whistle blowing-when should it be attempted preventing whistle blowing.

UNIT-V:**(9 Lectures)**

Global Issues: Globalization- Cross-culture Issues-Environmental Ethics-Computer Ethics computers as the instrument of Unethical behaviour-computers as the object of Unethical Acts-autonomous computers-computer codes of Ethics - Weapons Development-Ethics and Research-Analysing Ethical Problems in Research-Intellectual Property Rights.

Text Books:

1. Engineering Ethics and Human Values, M.Govindarajan, S.Natarajan, V.S. Senthil Kumar, PHI Learning Pvt. Ltd, 2009.
2. Professional Ethics and Morals, Prof.A.R.Aryasri, Dharanikota Suyodhana,Maruthi Publications.
3. Professional Ethics and Human Values, A.Alavudeen, R.Kalil Rahman, M. Jayakumaran- 1st Edition, Laxmi Publications, 2015.
4. Professional Ethics and Human Values, Prof. D.R. Kiran, 2nd Edition, McGraw Hill, 2014.

Reference Books:

1. Indian Culture, Values and Professional Ethics, PSR Murthy, 2nd Edition, BS Publication, 2013.
2. Ethics in Engineering, Mike W. Martin and Roland Schinzinger, 3rd Edition, Tata McGraw-Hill,2003.
3. Engineering Ethics, Harris, Pritchard and Rabins, India Edition, 5th Edition, Wadsworth Publishing Co Inc, 2013.

text Web Resources:

1. crescent.education/wp-content/.../12/Crescent-human-values-professional-ethics.pdf
2. <https://www.crectirupati.com/.../HVPE-MBA-K%20YAMUNA-LECTURE%20NOTES>
3. <https://lecturenotes.in/subject/576/professional-ethics-and-human-values-pehv>
4. <https://nptel.ac.in/courses/109104068/30>
5. https://onlinecourses.nptel.ac.in/noc18_mg25



Course Code	Course Name	Course Structure			
		L	T	P	C
P21EET11	Power System Analysis	3	0	0	3

Internal Marks: 30

External Marks: 70

Course Prerequisite: Power Systems-I & II

Course Objectives: The student will be able

1. To develop the impedance diagram (p.u) and formation of Ybus .
2. To learn the different load flow methods.
3. To learn the Zbus building algorithm and short circuit calculation for symmetrical faults.
4. To learn the effect of unsymmetrical faults on power system.
5. To learn the stability of power systems and methods to improve stability.

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

1. Draw impedance diagram for a power system network and calculate per unit quantities.
2. Apply the load flow solution to a power system using different methods.
3. Form Zbus for a power system networks and analyse the effect of symmetrical faults.
4. Find the sequence components for power system Components and analyse its effects of unsymmetrical faults.
5. Analyse the stability concepts of a power system.

UNIT-I:

(8 Lectures)

Per Unit Representation & Circuit Topology: Per Unit Quantities–Single line diagram– Impedance diagram of a power system –bus incidence matrices – Primitive network representation – Formation of Y– bus matrix by singular transformation and direct inspection methods.

UNIT-II:

(9 Lectures)

Power Flow Studies: Necessity of power flow studies – Derivation of static power flow equations – Power flow solution using Gauss-Seidel Method – Newton Raphson Method (Rectangular and polar coordinates form) –Decoupled and Fast Decoupled methods (Algorithmic approach) – Numerical Problems on 3–bus system only.

UNIT-III:

(9 Lectures)

Z-Bus formulation and Symmetrical: Formation of Z–Bus: Partial network– Algorithm for the Modification of Zbus Matrix(with out Mutual Impedance) for different cases– Modification of Z–Bus for the changes in network-Numerical problems.

Symmetrical Fault Analysis: Short Circuit on Synchronous Machine – Three Phase Short Circuit Currents - Short circuit MVA calculations for Power Systems – Numerical Problems.

UNIT-IV:

(10 Lectures)

Symmetrical Components: Concept of symmetrical components – symmetrical

components of unbalanced three phase systems – Power in terms of sequence components – Sequence impedances and Sequence networks of Unloaded generator ,“ – Construction of Sequence Networks of a power System-Numerical Problems.

Unsymmetrical Fault analysis: Various types of faults: LG– LL– LLG Faults on unloaded alternator, Open Conductor faults -Numerical problems.

UNIT-V:

(9 Lectures)

Power System Stability: Elementary concepts of Stability, Steady state – Dynamic and Transient Stabilities – Power Angle Curve - Swing equation – Equal area criterion of stability – Applications of Equal area criterion – Factors affecting transient stability – Methods to improve steady state and transient stability – Numerical problems.

Text Books:

1. Power System Analysis, Grainger and Stevenson, 1st Edition, Tata McGraw Hill, 1994.
2. Modern Power system Analysis, I.J.Nagrath, D .P.Kothari, 3rd edition, Tata McGraw Hill Publishing Company, 2007.

Reference Books:

1. Power System Analysis by HadiSaadat, 3rd edition, Tata McGraw Hill, 2010.
2. Power System Analysis and Design, J.Duncan Glover, M.S.Sarma, T.J.Overbye, 5th edition, Cengage Learning publications, 2011.

text Web Resources:

1. <https://nptel.ac.in/courses/108105067>
2. <https://nptel.ac.in/courses/117105140>
3. <https://www.classcentral.com/course/swayam-power-system-analysis-14243>
4. www.electrical4u.com

Course Code	Course Name	Course Structure			
		L	T	P	C
P21EET12	Switch Gear and Protection	3	0	0	3

Internal Marks: 30

External Marks: 70

Course Prerequisite: Power Systems-II**Course Objectives:**

1. To provide the basic principles and operation of various types of circuit breakers.
2. To know the classification, operation and application of different types of electromagnetic protective relays.
3. To explain protective schemes for generator and transformers.
4. To gain the knowledge of various protective schemes used for feeders and bus bars.
5. To explain the principle and operation of different types of static relays.
6. To understand different types of over voltages in a power system and principles of different neutral grounding methods.

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

1. Illustrate the principles of arc interruption for application to high voltage circuit breakers of air -oil - vacuum - SF6 gas type.
2. Analyze the working principle and operation of different types of electromagnetic protective relays.
3. Acquire knowledge of protective schemes for generator and transformers for different fault conditions.
4. Classify various types of protective schemes used for feeders and bus bar protection and types of static relays and digital relays.
5. Analyze the operation of different types of over voltages protective schemes required for insulation co-ordination and types of neutral grounding.

UNIT-I:**(9 Lectures)**

Circuit Breakers: Application oriented evolution of Switchgear – Fuse, Miniature Circuit Breaker (MCB)– Elementary principles of arc interruption – Restriking Voltage and Recovery voltages – Restriking phenomenon - RRRV– Average and Max. RRRV– Current chopping and Resistance switching– Concept of oil circuit breakers– Description and operation of Air Blast– Vacuum and SF6 circuit breakers– Circuit Breaker ratings and specifications– Concept of Auto reclosing – Application Spectrum Numerical examples

UNIT-II:**(9 Lectures)**

Electromagnetic Protection: Relay connection, Properties of Relay – Balanced beam type attracted armature relay - induction disc and induction cup relays –Torque equation - Relays classification–Instantaneous, Inverse Time, DMT and

IDMT types– Applications of relays: Over current and under voltage relays– Directional relays– Differential relays and percentage differential relays– Universal torque equation– Distance relays: Impedance– Reactance– Mho and offset mho relays– Characteristics of distance relays and comparison.

UNIT-III:**(9 Lectures)**

Generator Protection: Protection of generators against stator faults– Rotor faults and abnormal conditions– restricted earth fault and inter turn fault protection– Numerical examples.

Transformer Protection: Percentage differential protection– Design of CT's ratio– Buchholz relay protection– Numerical examples.

UNIT-IV:**(9 Lectures)**

Feeder and Bus bar Protection: Over current Protection schemes – PSM - TMS – Numerical examples – Carrier current and three zone distance relay using impedance relays. Protection of bus bars by using Differential protection.

Static Relays & Digital Relay: Static relays: Introduction – Classification of Static Relays – Basic Components of Static Relays, Microprocessor based Digital Relay.

UNIT-V:**(9 Lectures)**

Protection against over voltage: Generation of over voltages in power systems– Protection against lightning over voltages– Valve type and zinc oxide lightning arresters, Insulation Coordination.

Grounding: Grounded and ungrounded neutral systems – Effects of ungrounded neutral on system performance – Methods of neutral grounding: Solid–resistance–Reactance–Arcing grounds and grounding Practices.

Text Books:

1. Power System Protection and Switchgear, Badri Ram, D.N Viswakarma, 3rd Edition, Tata McGraw Hill Publications, 2022.
2. Power system protection- Static Relays with microprocessor applications, T.S. Madhava Rao, 2nd Edition, Tata McGraw Hill, 2017.

Reference Books:

1. Fundamentals of Power System Protection, Paithankar, S.R.Bhide, 2nd Edition, PHI, 2010.
2. Art & Science of Protective Relaying, C R Mason, Wiley Eastern Ltd, 1966.
3. Protection and Switchgear, Bhavesh Bhalja, R.P. Maheshwari, Nilesh G.Chothani, 2nd Edition, Oxford University Press, 2018.

text Web Resources:

1. <https://www.digimat.in/nptel/courses/video/108107167/L03.html>
2. https://www.youtube.com/playlist?list=PLLy_2iUCG87BIJ6Z1iVIRCx2Crf9_fJMB

Course Code	Course Name	Course Structure			
		L	T	P	C
P21ECT05	Linear and Digital IC Applications	3	0	0	3

Internal Marks: 30

External Marks: 70

Course Prerequisite: Electronic Devices and Circuits, Switching Theory and Logic Design

Course Objectives:

1. Understand the basic features of Operational Amplifier and its applications.
2. Analyze the design of Op-Amp based Active Filters, Waveform generators, Functionality of 555 Timer and 565 ICs and their applications.
3. Design of various types of ADCs and DACs.
4. Explain digital IC's and its applications.
5. Learn about different Sequential Logic IC's and Memories.

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

1. Explain the concepts of Operational Amplifier and its features and apply the concepts of Op- Amps in the design of Summing Amplifier, Subtractors, Comparators, differentiators, Integrators and Voltage Regulators.
2. Analyze and design Op-Amp based circuits namely Active Filters, Waveform generators; Design and apply Astable and Mono-stable multi vibrator modes using 555 Timer IC; Conceptualize Phase Locked Loop using 565 IC and explain its applications.
3. Analyze and design DACs and ADCs using various methods of implementation.
4. Explain the structure digital integrated circuits and their applications.
5. Analysis of Sequential logic IC's and Memories.

UNIT-I:

(9 Lectures)

OP-Amp Block Diagram (Symbolic Representation), Characteristics of Op-Amp, Ideal and Practical Op-Amp specifications, DC and AC Characteristics, Definitions of Input and Output Off-set voltage and currents slow rate, CMRR, PSRR. Features of 741 Op-Amp, General Linear Applications of Op-Amp: Adder, Subtractor - Modes of operation Inverting, Non- Inverting, Differential, Instrumentation Amplifier, Differentiators and Integrators, Nonlinear Applications- Comparators, Schmitt Trigger, Introduction to Voltage Regulators, Design of Voltage Regulator using IC723.

UNIT-II:

(9 Lectures)

Applications of OPAMP IC741, IC-555 & IC 565: Introduction to Active Filters, Characteristics of Band pass, Band reject and All Pass Filters, Analysis and Design of 1st order and 2nd order LPF & HPF Butterworth Filters, Waveform Generators – Triangular, Sawtooth, Square Wave, IC555 Timer - Functional Diagram,

Monostable and Astable Operations, Applications, IC565 PLL – Block Schematic, Description of Individual Blocks, Applications.

UNIT-III: (9 Lectures)

Data Converters: Introduction- Basic DAC techniques- weighted resistor DAC, R-2R ladder DAC, Different types of ADCs - Flash type ADC, Successive approximation ADC and dual slope ADC, DAC and ADC Specifications

UNIT-IV: (9 Lectures)

Digital Integrated Circuits: Classification of Integrated Circuits, Comparison of Various Logic Families, Combinational Logic ICs - Specifications and Applications of Binary Parallel Binary adder -Subtractor (74x181), Look Ahead Carry Generator (IC74x182), Decoders (IC74x138), encoders (IC74x148), multiplexers (IC74x151) and demultiplexers (IC74x155), parity circuits (IC74x280), Magnitude comparators (IC74x682).

UNIT-V: (9 Lectures)

Sequential Logic IC's and Memories: Latches (IC74x373) and flip flops IC74x175), Ring Counter (IC74x163), Johnson Counter (IC74LS164.), Design of Modulus N Synchronous Counters (74x102), Shift Registers (IC74x194), LFSR counter (IC74HC164). Memories - ROM Architecture, Types of ROMS & Applications, RAM Architecture, Static & Dynamic RAMs.

Text Books:

1. Op-Amps & Linear Integrated Circuits, Ramakanth A. Gayakwad, 4th Edition, PHI, 2003.
2. Digital Design Principles & Practices, John F. Wakerly, 3rd Edition., PHI/ Pearson Education Asia, 2005.
3. VHDL Primer , J. Bhasker, 3rd Edition, Pearson Education/ PHI. 2015.
4. Operational Amplifiers & Linear Integrated Circuits, Sanjay Sharma, 2nd Edition, SK Kataria & Sons, 2010.
5. Linear Integrated Circuits, D. Roy Chowdhury, 2nd Edition., New Age International (p) Ltd, 2003.

Reference Books:

1. Linear Integrated Circuits and Applications, Salivahana, 2nd Edition, McGraw Hill, 2017.
2. Fundamentals of Digital Logic with VHDL Design, Stephen Brown, Zvonko Vranesic, 3rd Edition, McGrawHill, 2017.

text Web Resources:

1. https://swayam.gov.in/nd1_noc20_ee55/preview

2. https://www.tutorialspoint.com/linear_integrated_circuits_applications/index.htm
3. <https://nptel.ac.in/courses/108/108/108108111/>
4. <https://nptel.ac.in/courses/117/108/117108040/>
5. <https://nptel.ac.in/courses/117/106/117106088/>



Course Code	Course Name	Course Structure			
		L	T	P	C
P21EEP05	Power Semiconductor Drives	3	0	0	3

Internal Marks: 30

External Marks: 70

Course Prerequisite: Power Electronics, Mathematics, Control Systems**Course Objectives:**

1. To learn the fundamentals of electric drive and different electric braking methods.
2. To analyze the operation of three phase convertercontrolled dc motors and four quadrant operation of dc motors using dual converters.
3. To discuss the converter control of dc motors in various quadrants.
4. To understand the concept of speed control of induction motor by using AC voltage controllers and voltage source inverters, principles of static rotor resistance control and various slip power recovery schemes.
5. To understand the speed control mechanism of synchronous motors.

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

1. Identify the fundamentals of electric drive and different electric braking methods.
2. Analyze the operation of three phase converter fed dc motors and four quadrant operations of dc motors using dual converters.
3. Design the converter control of dc motors in various quadrants of operation.
4. Determine the concept of speed control of induction motor by using AC voltage controllers and voltage source inverters, differentiate the stator side control and rotor side control of three phase induction motor.
5. Examine the speed control mechanism of synchronous motors.

UNIT-I:**(10 Lectures)**

Fundamentals of Electric Drive: Electric drive – Fundamental torque equation – Load torque components – Nature and classification of load torques – Steady state stability – Load equalization– Four quadrant operation of drive (hoist control) – Braking methods: Dynamic – Plugging – Regenerative methods.

UNIT-II:**(8 Lectures)**

Controlled Converter Fed DC Motor Drives: Speed controlled techniques – Single and Three phasehalf and fullycontrolled converter fed separately and self-excited DC motor drive – Continuous current operation – Output voltage and current waveforms – Speed-torque expressions – Speed-torque characteristics – Principle of operation of dual converters and dual converter fed DC motor drives -Numerical problems. quadrant DC-DC converter fed separately excited and self-excitedDC motors – Continuous current operation– Output voltage and current waveforms – Speed–torque expressions – Speed–torque characteristics –Four quadrant operation – Closed loop operation (qualitative treatment only).

UNIT-III:**(9 Lectures)**

Data Converters: Introduction- Basic DAC techniques- weighted resistor DAC, R-2R ladder DAC, Different types of ADCs - Flash type ADC, Successive approximation ADC and dual slope ADC, DAC and ADC Specifications

UNIT-IV:**(9 Lectures)**

Control of 3- ϕ Induction Motor Drive - Stator side control of 3-phase Induction motor Drive: Stator voltage control using 3-phase AC voltage regulators – Waveforms –Speed torque characteristics– Variable Voltage Variable Frequency control of induction motor by voltage source and current source inverter – Comparison of VSI and CSI – Closed loop v/f control of induction motor drives (qualitative treatment only).

Rotor side control of 3-phase Induction motor Drive: Static rotor resistance control – Slip power recovery schemes – Static Scherbius drive – Static Kramer drive – Performance and speed torque characteristics – Advantages –Applications

UNIT-V:**(9 Lectures)**

Control of Synchronous Motor Drives: Separate control & self-control of synchronous motors – Operation of self-controlled synchronous motors by VSI– Closed Loop control operation of synchronous motor drives (qualitative treatment only).–Variable frequency control–Pulse width modulation.

Text Books:

1. Fundamentals of Electric Drives, G K Dubey, 2nd Edition, Narosa Publications, 2010.
2. Power Semiconductor Drives, S.B.Dewan, G.R.Slemon, A.Straughen, Wiley India, 2009.

Reference Books:

1. Electric Motors and Drives Fundamentals, Types and Applications, Austin Hughes, Bill Drury, 4th Edition, Newnes, 2013.
2. Thyristor Control of Electric drives, Vedam Subramanyam, Tata McGraw Hill Publications, 1987.
3. Power Electronic Circuits, Devices and applications, M.H.Rashid, 4th Edition, PHI, 2023.
4. Power Electronics Handbook, Muhammad H.Rashid, 4th Edition, Elsevier,2018.

text Web Resources:

1. <https://www.niehs.nih.gov/health/topics/agents/emf/index.cfm>
2. <https://www.electrical4u.com>
3. <https://www.allaboutcircuits.com/technical-articles/a-review-on-power-semiconductor-devices/>

4. <https://www.careerride.com/mcq-tag-wise.aspx?Key=Power%20semiconductor%20devices&Id=19>



Course Code	Course Name	Course Structure			
		L	T	P	C
P21EEP06	Utilisation of Electrical Energy	3	0	0	3

Internal Marks: 30

External Marks: 70

Course Prerequisite: Electrical Machines, Power Electronics and Drives, Power Systems –II

Course Objectives:

1. To study the basic principles of illumination and its measurement and its design.
2. To understand the operating principles and characteristics of traction motors with respect to speed, temperature, loading conditions.
3. To study with the different types of heating and welding techniques.
4. To understand the basic principle of electric traction including speed–time curves of different traction services.
5. To Introduce the concepts of various types of energy storage systems.

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

1. Identify various illumination methods produced by different illuminating sources.
2. Identify a suitable motor for electric drives and industrial applications.
3. Identify most appropriate heating and welding techniques for suitable applications.
4. Distinguish various traction system and determine the tractive effort and specific energy consumption.
5. Validate the necessity and usage of different energy storage schemes for different applications and comparisons.

UNIT-I:

(9 Lectures)

Illumination fundamentals: Introduction - terms used in illumination–Laws of illumination–Polar curves–Integrating sphere–Lux meter–Sources of light.

Various Illumination Methods: Discharge lamps - MV and SV lamps – Comparison between tungsten filament lamps and fluorescent tubes–Basic principles of light control– Types and design of lighting and flood lighting–LED lighting - Energy conservation.

UNIT-II:

(9 Lectures)

Selection of Motors: Choice of Motor - Type of Electric Drives - Starting And Running Characteristics – Speed Control– Temperature Rise – Applications of Electric Drives–Types of Industrial Loads–Continuous–Intermittent And Variable Loads–Load Equalization - Introduction To Energy Efficient Motors.

UNIT-III:

(9 Lectures)

Electric Heating: Advantages and methods of electric heating–Resistance heating induction heating and dielectric heating.

Electric Welding: Electric welding–Resistance and arc welding–Electric welding equipment–Comparison between AC and DC Welding.

UNIT-IV:

(10 Lectures)

Electric Traction: System of electric traction and track electrification– Review of existing electric traction systems in India– Special features of traction motor– Mechanics of train movement–Speed–time curves for different services – Trapezoidal and quadrilateral speed time curves. Calculations of tractive effort– power – Specific energy consumption for given run–Effect of varying acceleration and braking retardation– Adhesive weight and braking retardation adhesive weight and coefficient of adhesion-Numerical problems.

UNIT-V:

(8 Lectures)

Introduction to Energy Storage Systems: Need For Energy Storage - Types of Energy Storage-Thermal - Electrical - Magnetic And Chemical Storage Systems - Comparison of Energy Storage Technologies-Applications.

Text Books:

1. Utilization of Electric Energy, E. Openshaw, Taylor, Orient Blackswan, 1971.
2. Art & Science of Utilization of Electrical Energy, Partab, Dhanpat Rai & Sons, 2014.

Reference Books:

1. Utilization of Electrical Power Including Electric drives and Electric Traction, N.V.Suryanarayana, 2nd Edition, New Age International (P) Limited Publishers,2017.
2. TGeneration, Distribution and Utilization of Electrical Energy, C.L. Wadhwa, 3rd Edition, New Age International (P) Limited – Publishers, 2015.

text Web Resources:

1. <https://www.niehs.nih.gov/health/topics/agents/emf/index.cfm>
2. <https://b-ok.cc/book/1268675/9b2a83>
3. <https://b-ok.cc/book/3558383/6a6c16>

Course Code	Course Name	Course Structure			
		L	T	P	C
P21EEP07	Control and Integration of Renewable Energy Source	3	0	0	3

Internal Marks: 30

External Marks: 70

Course Prerequisite: Renewable Energy Sources**Course Objectives:**

1. A strong understanding of power systems, their operation and control focused on the issues related to the integration of distributed renewable generation into the network.
2. Strong foundation for power system equipments used for integration.
3. Detailed knowledge about power quality and its management along with approaches for grid stabilization.
4. Deep understanding about integration techniques for RE sources.
5. Deep understanding integration of alternate sources of energy.

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

1. Apply advanced knowledge of electrical power system operations and control to analyse the challenges and opportunities for distributed renewable generation in both large interconnected grid and microgrid settings.
2. Assess renewable energy applications and projects in the context of integration into both the physical and economic electricity markets.
3. Describe the principles and requirements of the next generation future power network, incorporating distributed generation and storage and demand management.
4. Understand the principles, power and limitations of complex power networks incorporating distributed generation and storage.
5. Understanding integration of alternate sources of energy Techniques.

UNIT-I:**(9 Lectures)**

Introduction: Various techniques of utilizing power from renewable energy sources, concept of nano/micro/mini grid. Need of integrating large renewable energy sources, issues related to integration of large renewable energy sources, rooftop plants. Concept of VPP.

UNIT-II:**(9 Lectures)**

Power system equipments for grid integration Synchronous generator: Synchronization/integration to existing grid, load sharing during parallel operation, stability (swing equation and solution)

Induction Generator: working principle, classification, stability due to variable speed and counter measures Power

Electronics: need of power electronic equipments in grid integration, converter, inverter, chopper, ac regulator and cyclo converters for AC/DC conversion.

UNIT-III: (9 Lectures)

Power quality and management: THD, voltage sag, voltage swell, frequency change and its effects, network voltage management, frequency management, system protection, grid codes.

UNIT-IV: (9 Lectures)

Grid stabilization: Scheduling and dispatch, Forecasting, reactive power and voltage control, frequency control, operating reserve, storage systems. electric vehicles Ancillary services in Indian Electricity Market (regulatory aspect), CERC and CEA orders (technical and safety standards).

UNIT-V: (9 Lectures)

Integration of alternate sources of energy: Introduction, principles of power injection: converting technologies, power flow; instantaneous active and reactive power control approach; integrating multiple renewable energy sources; DC link integration; AC link integration; HFAC link integration; islanding and interconnection

Text Books:

1. Integration of Alternative Sources of Energy, Felix A. Farret and M. Godoy Simoes, Wiley- IEEE Press, 2006.
2. Grid integration of solar photovoltaic systems, Majid Jamil, M. Rizwan, D.P.Kothari, 1st Edition, CRC Press (Taylor & Francis group), 2017.

Reference Books:

1. Renewable Energy Grid Integration, Marco H. Balderas, Nova Science Publishers, New York, 2009.
2. Wind Power Integration Connection and System Operational Aspects, B. Fox, D. Flynn L. Bryans, N. Jenkins, M. O' Malley, R. Watson, D. Mil borrow, IET Power and Energy Series 50 (IET digital library), 2007.

text Web Resources:

1. www.nptel.iitm.ac.in
2. <https://www.pnnl.gov/grid-integration-renewable-energy>

Course Code	Course Name	Course Structure			
		L	T	P	C
P21EEP08	IOT Applications in Electrical Engineering	3	0	0	3

Internal Marks: 30

External Marks: 70

Course Prerequisite: Electrical Circuits, Engineering Physics**Course Objectives:**

1. To provide knowledge of basic IoT Network Architectures.
2. To know the IoT Processing, Connectivity and Communication technologies.
3. To provide knowledge of Arduino boards and basic components and Develop skills to design and implement various smart system application
4. To provide knowledge of programming skills, application development and prototyping using Python.
5. To know the knowledge of Raspberry Pi and IoT Applications.

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

1. Understand the basic principles and terminologies of computer networking, network security, WSN, M2M, CPS, sensors and actuators.
2. Describe various data types in IoT applications, connectivity protocols in IoT, communication protocols in IoT.
3. Understand basic concepts of Arduino UNO and Design smart system applications using Arduino UNO.
4. Apply Python programming for Problem solving and application development.
5. Understand the working of Raspberry Pi and develop IoT applications.

UNIT-I:**(9 Lectures)**

Introduction to IoT: Introduction-Network types-IoT Protocol and Architecture-Network Security- Wireless Sensor Networks (WSN)- Machine-to-Machine (M2M) Communications- Cyber Physical Systems (CPS)- Differentiate between WSN, M2M, and CPS- IoT Sensors and Actuators-Advantages and Disadvantages of IoT.

UNIT-II:**(9 Lectures)**

IoT Processing, Connectivity and Communication: Data format- Importance of Processing in IoT- Processing Topologies IoT Device Design and Selection Considerations- IEEE 802.15.4-Thread- ISA100.11A- Wireless HART- RFID- LoRaWi-Fi- Bluetooth- Infrastructure Protocols- Discovery Protocols- Data Protocols- Identification Protocols.

UNIT-III:**(9 Lectures)**

Introduction to Arduino Programming: Introduction-Features of Arduino-Types of Arduino board-Arduino UNO- Arduino IDE overview-Sketch Structure-Data types- Function libraries-Operators in Arduino-Control statement-Loops- Arrays String-Math Library-Random number-Interrupts-Example program: Blink LED-Traffic Control system- Pulse Width Modulation- Analog to Digital Conversion- Wireless

Connectivity to Arduino- Integration of Sensors with Arduino Integration of Actuators with Arduino.

UNIT-IV:**(9 Lectures)**

Introduction to Python Programming: Introduction to Python- Variables and Data types- Operators-Num Py-mat plot lib Array- Pandas-Lists- Loops- Conditional statements-Functions-Strings-Tuples- Sets-Dictionaries- Array- Data Visualization- File handling.

UNIT-V:**(9 Lectures)**

Introduction to Raspberry Pi and IoT Applications: Introduction to Raspberry Pi-Basic architecture- Working of Raspberry Pi-Pin configuration- Example program: Blink LED- Capture Image using Raspberry Pi -Implementation of IoT with Raspberry Pi: Sensor and actuator interfaced with Raspberry Pi-IoT application-Speed control of DC and AC machines- Measuring parameters of DC machine, AC machine and solar panel.

Text Books:

1. Introduction to IoT, S. Misra, A. Mukherjee, A. Roy, 1st Edition, Cambridge University Press, 2022.
2. Introduction to Industrial Internet of Things and Industry 4.0, S. Misra, C. Roy, A. Mukherjee, CRC Press, 2021.
3. Building Arduino Projects for the Internet of Things Experiments with Real-World Applications, Adeel Javed, Apress, 2016.
4. Think Python, Allen B. Downey, 2nd Edition, O'Reilly learning Platform, 2016.
5. Python Programming an Introduction to Computer Science, John Zelle, Tom Sumner, 3rd Edition, Independent Publisher, 2012.
6. Internet of things: Principles and Paradigms, Rajkumar Buyaa and Amir V Dastjerdi, Morgan Kaufmann, 2016.
7. Internet of Things: A Hands On Approach, A Bahga & V Madiseti Orient Blackswan Private Limited, 2015.

Reference Books:

1. IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things, David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry, Cisco Press, 2017.
2. Learning Python, Mark Lutz, 4th Edition, O'Reilly, 2009.
3. Designing the Internet of Things, Adrian McEwen, Hakim Cassimally, 1st Edition, Wiley, 2013.
4. The Internet of Things: Keyapplications and Protocols, Olivier Hersent, David Boswarthick, Omar Elloumi, 1st Edition, Wiley, 2012.

text Web Resources:

1. <http://digimat.in/nptel/courses/video/108108123/L37.html>
2. <https://www.electricaltechnology.org/2016/07/internet-of-things-iot-and-its-applications-in-electrical-power-industry.html>
3. <https://www.quora.com/Is-the-IoT-course-best-suited-for-an-electrical-engineering-graduate>



Course Code	Course Name	Course Structure			
		L	T	P	C
P21EEL08	Electrical Simulation Lab	0	0	3	1.5

Internal Marks: 15

External Marks: 35

Course Prerequisite:Electrical Simulation Lab

Course Objectives:

1. To simulate integrator circuit, differentiator circuit, Boost converter, Buck converter, full convertor and PWM inverter.
2. To simulate transmission line by incorporating line, load and transformer models.
3. To perform transient analysis of RLC circuit.

Course Outcomes: After going through this course, student can able to

1. Able to simulate integrator circuit, differentiator circuit, Boost converter, Buck converter, full convertor and PWM inverter.
2. Able to simulate transmission line by incorporating line, load and transformer models.
3. Able to perform transient analysis of RLC circuit.

LIST OF EXPERMENTS (Any 10 of the following are to be conducted)

1. Simulation of transient response of RLC circuits
 - a. Response to pulse input
 - b. Response to step input
 - c. Response to sinusoidal input
2. Analysis of three phase circuit representing the generator transmission line and load.
 - a. Balanced
 - b. Unbalanced
3. Simulation of single-phase full converter using RLE loads
4. Single phase AC voltage controller using RL loads
5. Stability Analysis of Linear Time Invariant Systems using MATLAB
 - a. Bode Plot
 - b. Nyquist Plot
 - c. Root Locus Plot
6.
 - a. Simulation of Boost converters
 - b. Simulation of Buck converters
7.
 - a. Integrator circuits using op-amp
 - b. Differentiator circuits using op-amp
8. Simulation of single-phase inverter with PWM control
9. Simulation of Dynamic Systems-Single area Power Systems- using SIMULINK

10. a. PSpice Simulation of DC Circuits Thevenin's Equivalent
b. PSpice Simulation of DC circuits Transfer function
11. Simulation of three phase full converter using MOSFET and IGBTs
12. Simulation of D.C separately excited motor using transfer function approach



Course Code	Course Name	Course Structure			
		L	T	P	C
P21EEL09	Power Systems Lab	0	0	3	1.5

Internal Marks: 15

External Marks: 35

Course Prerequisite: Power Systems and power system operation and control.

Course Objectives:

1. To understand the fault analysis of the 3 – phase transformer and 3-phase alternator.
2. To determine the ABCD parameters of transmission lines, dielectric strength of the transformer oil and to calibrate the tong tester.
3. To identify the earth fault.
4. To analyze the AC and DC load flow studies.
5. To control the load frequency of two area systems and to understand the economic load dispatch.

Course Outcomes: After going through this course, student can able to

1. Understand the fault analysis of the 3 – phase transformer and 3-phase alternator.
2. Determine the ABCD parameters of transmission lines, dielectric strength of the transformer oil and to calibrate the tong tester.
3. Identify the earth fault.
4. Analyze the AC and DC load flow studies.
5. Control the load frequency of two area systems and to understand the economic load dispatch.

LIST OF EXPERMENTS

(Any 6 of the following are to be conducted)

1. Sequence impedances of 3-Phase Transformer.
2. Sequence impedances of 3-Phase Alternator by Fault Analysis.
3. Sequence impedances of 3-Phase Alternator by Direct method.
4. ABCD parameters of Transmission line.
5. Load flow studies using Gauss-seidel method.
6. Load flow studies using N-R method.
7. Dielectric strength of Transformer oil.
8. Calibration of Tong Tester.

(Any 6 of the following are to be conducted)

1. Over current relay with earth fault.

2. Over voltage relay with earth fault.
3. DC Load flow studies in Power systems.
4. Transient Stability Analysis.
5. Two area load frequency control with & without controller.
6. Economic load dispatch with & without losses.
7. V-I Characteristics of Solar PV system.



Course Code	Course Name	Course Structure			
		L	T	P	C
P21EES04	Skill Oriented Course-IV	1	0	2	2

Internal Marks: 0

External Marks: 50

Course Prerequisite: No Prerequisite

Course Objectives:

1. To train the students with job oriented skills.

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

1. Apply the job oriented skills learned during the course in real-life problems.
2. Communicate the skills effectively acquired during the course.

Course Objective & Course Outcomes will be vary according to the student's opted course.

1. skill-advanced courses either from the same domain
 - (a) Solar Cells
 - (b) Electrical Vehicle Design
 - (c) Electrical Auto CAD
 - (d) Aurdino
 - (e) Raspberry pi
 - (f) Internet of Things
 - (g) AI applications in Electrical Engineering
 - (h) Machine Learning applications in Electrical Engineering
 - (i) SciLab
 - (j) LabView
 - (k) MultiSim
 - (l) MATLAB
 - (m) Simulink
 - (n) Octave
2. job-oriented skill courses of inter disciplinary nature
 - (a) Python for the AI
 - (b) Machine Learning
 - (c) Deep Learning
 - (d) Data Science
 - (e) Artificial Neural Network

- (f) Natural Language Processing
- (g) Full stack development
- (h) Azure
- (i) Microsoft Administrator



Course Code	Course Name	Course Structure			
		L	T	P	C
P21XXXXX	Design Thinking for Innovation	2	0	0	0

Internal Marks: 30

External Marks: 70

UNIT-I: Design thinking Evolution

Definitions and stories. Design thinking Importance, and Impact-History and Evolution of Design Thinking, - Three Space of Innovation in Design Thinking- knowledge funnel - Design Thinking Process, -Design thinking mindset for innovation

UNIT-II: Building confidence, Mindset and Building Team

Myths of Innovation- Myths of Creativity-Creative Confidence-Innovators DNA - 5 forces of growth (SEPIA),- 5 frictional forces (DCAFE),- 3 capacity levers (VAL)- Building Design Teams.

UNIT-III: Empathy-Define

Initial Problem Description - beginner's mindset-5whys,- persona development- Empathy mapping-interview with empathy and stories collection-Question the critical assumptions -Reframe Problem Definition – (PoV) point of view- how might we

UNIT-IV: Ideation

Ideation and Visualization- Brainstorming-SCAMPER-Mind mapping-sketch –structure idea-Storyboard-Customer Co-Creation-Provocation-Role-play

UNIT-V: Prototyping -Testing

Step-by-step prototyping & low fidelity prototyping -Testing Prototyping -feedback capturing grid, conduct A/B Testing-Experiment grid, user retrospective board- Create a Pitch of the prototype

Text Books:

1. An AVA Book, “Design Thinking”, AVA Publishing, 2010
2. Dr.BalaRamaduri, “Karmic Design Thinking”, 2020, ISBN:978-9354190100

Reference Books:

1. proach”, 3rd edition, Springer, 2007
2. Tom Kelley, Jonathan Littman, “Ten Faces in Innovation”, Currency Books, 2006
3. Liedtka, Jeanne and Ogilvie, Timothy, Ten Tools for Design Thinking
4. The Design Thinking Playbook: Mindful Digital Transformation of Teams, Products, Services, Businesses, and Ecosystems by Michael Lewrick
5. The Myths of Innovation by Scott Berkun, Publisher(s): O’Reilly Media, IncISBN: 9781449389628

6. The Myths of Creativity: The Truth About How Innovative Companies and People Generate Great Ideas, D Burkus Jossey-Bass, San Francisco, CA (2014), 214 pp, ISBN: 978-1-118-61114-2
7. Creative Confidence: Unleashing the Creative Potential within Us All by (Author), David Kelley (Author)
8. The innovator's DNA: mastering the five skills of disruptive innovators Author: Dyer, Jeff Gregersen, Hal B, 1958-Christensen, Clayton M Published: Boston, Mass: Harvard Business Press, [2011]
9. Collective Genius: The Art and Practice of Leading Innovation, Authors: Linda A Hill, Greg Brandeau, Emily Truelove, Kent Lineback
10. Change by Design, by Tim Brown
11. Unmukt-Science and Art of Design Thinking Authors Arun Jain School of Design Thinking 2019
12. The Design Thinking Play Book by Michael Lewrick, Patrick Link & Larry Leifer, Wiley Press, 2018
13. The Design of Business: Why Design Thinking Is the Next Competitive Advantage. Martin, R. (2009). Boston, MA: Harvard Business Press.

Online Resources:

1. <https://www.interaction-design.org/literature/topics/design-thinking>
2. <https://www.interaction-design.org/literature/article/how-to-develop-an-empathic-approach-in-design-thinking>
3. <https://medium.com/dc-design/what-is-human-centered-design-6711c09e2779>
4. <https://think.design/user-design-research/user-testing/>
5. Mentor-DesignThinking.pdf (aim.gov.in)
6. Mentor-DesignThinking.pdf (aim.gov.in)