SIDDHARTHA ACADEMY OF HIGHER EDUCATION

A DEEMED TO BE UNIVERSITY

(Under Section 3 of UGC Act, 1956)

SCHEME OF INSTRUCTIONS[B.Tech-SU24]

B.Tech. Degree Program for students admitted from the

Academic Year 2024-25

VELAGAPUDI RAMAKRISHNA SIDDHARTHA
SCHOOL OF ENGINEERING

Kanuru,Vijayawada-520007,AndhraPradesh
www.vrsiddhartha.ac.in

Vision

To be a centre of excellence in education, innovation and research with a global presence in arts, science, technology, medicine, management, legal studies, and social studies, enriching the frontier areas of national and international importance.

MISSION

- To create a transformative educational experience for students focused on problem-solving skills, communication abilities, interpersonal relations, and leadership.
- To cultivate a vibrant university community that attracts and retains diverse, world-class talent, creating a collaborative environment open to the free exchange of ideas where research, creativity, innovation, and entrepreneurship can flourish, and ensuring individuals achieve their full potential.
- To impact society pragmatically—regionally, nationally, and globally—by engaging with industry, outstanding national and international universities, and research organizations.
- To be a global university that nurtures excellence in education and innovation, fostering a knowledgeable society

DEPARTMENT VISION

- To impart quality education and strive for centre of excellence in research.

DEPARTMENT MISSION

- To prepare future technocrats for a global workplace through excellence in teaching and research. The department endeavors to prepare the students professionally skilful, intellectually proficient and socially responsible.

Program: B.Tech. Electrical and Electronics Engineering

Program Educational Objectives (PEOs)

- **PEO1:**Excel in chosen career and/or higher education.
- **PEO2:** Exhibit professionalism, ethical attitude, communication skills, team work and adapt to current trends by engaging in lifelong learning.
- **PEO3:**Demonstrate technical competence in solving engineering problems that are economically feasible and socially acceptable.

PROGRAMME OUTCOMES
PO1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
PO3. Design/Development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4.Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of, and need for sustainable development.
PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11. Project Management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.
PSO1: Understand, analyze and design systems that efficiently generate, transmit, distribute and utilize electric power**.**
PSO2: To expertise in the technology associated with efficient conversion and control of electrical power to the required form**.**

SIDDHARTHA ACADEMY OF HIGHER EDUCATION

Deemed to be University

V R School of Engineering

-B.Tech–SU24 Course Structure

Scheme of Instruction for FIRST and SECOND Year

Semester-I **CONTACTHOURS: 29**

S.No	Course Code	Course Category	CourseName	L	T	P	Credits
1	24MA101	BS	Mathematics-I Linear Algebra, Series and Calculus	3	0	2	4
2	24CY102	BS	Engineering Chemistry	3	0	0	3
3	24BY101	BS	Biology for Engineers	3	0	0	3
4	24CS101	ES	Problem Solving with Python	3	0	3	4.5
5	24ME181	ES	Engineering Graphics	1	0	3	2.5
6	24CY181	BS	Chemistry Lab	0	0	2	1
7	24ME182	ES	Workshop Practice	0	0	3	1.5
8	24UC183	MC	Sports & Yoga/NSS/NCC	0	0	3	0
			Total	13	0	16	**19.5**

Semester-II **CONTACTHOURS: 29**

S.No	Course Code	Course Category	Course Name	L	T	P	Credits
1	24MA102	BS	Mathematics-II Differential Equations & Computational methods	3	0	2	4
2	24PH102	BS	Engineering Physics	3	0	0	3
3	24EN101	HS	Communicative English	3	0	3	4.5
4	24EE101	ES	Electrical Network Analysis	3	0	0	3
5	24IT101	ES	Programming using ‘C’	2	0	2	3
6	24UC181	ES	Design Thinking	0	0	2	1
7	24PH182	BS	Physics Lab	0	0	2	1
8	24UC182	ES	AI Tools and Applications	0	0	2	1
9	24UC101	MC	Essence of Indian Knowledge Tradition	2	0	0	0
			Total	16	0	13	**20.5**

Semester-III **CONTACTHOURS:26**

S.No	Course Code	Course Category	CourseName	L	T	P	Credits
1	24MA202	BS	Complex Analysis, Transform Techniques & Statistics (EEE/ECE/EIE)	4	0	0	4
2	24EE201	ES	AC Network Analysis	2	0	2	3
3	24EE202	PC	Analog Electronics	3	0	0	3
4	24EE203	PC	DC Machines & Transformers	3	0	0	3
5	24EE204	PC	Digital Electronics	3	0	0	3
6	24EE281	PC	DC Machines & TransformersLab	0	0	3	1.5
7	24EE282	ES	Analog & Digital Electronics Lab	0	0	3	1.5
8	24UC201	HS	Universal Human Values-II	2	1	0	3
			Total	17	1	8	**22**

Semester-IV **CONTACTHOURS:30**

S.No	Course Code	Course Category	CourseName	L	T	P	Credits
1	24EE205	ES	Electrical Measurements and Sensors	3	0	0	3
2	24EE206	PC	Power Generation and Transmission	3	0	0	3
3	24EE207	PC	Linear Integrated Circuits & Applications	3	0	2	4
4	24EE208	PC	AC Machines	3	1	0	4
5	24EE209	PC	Linear Control Systems	3	0	2	4
6	24EE283	PC	AC MachinesLab	0	0	3	1.5
7	24EE284	PC	Electrical Measurements and Control Systems Lab	0	0	3	1.5
8	24EN281	HS	English for Professionals (Soft Skills-II)	0	0	2	1
9	24UC202	MC	ProfessionalEthics	2	0	0	0
			Total	17	1	12	**22**

24MA202 Complex Analysis, Transform Techniques & Statistics

(ECE/EEE / EIE)

Category: Basic Sciences (BS) 4L 0T 0P 4C

Pre-requisite: 10+2 Mathematics

Course Description:

An overview of limit, continuity, differentiability, and analyticity of complex variable functions, construction of analytic functions and expansion of functions, theorems to solve contour integration with their applications in engineering problems. Familiarize the concepts of distinct transformation techniques

Course Aims and Objectives:

- Teach methods to construct analytic/complex potential functions
- Impart the concept of singularities, expansions of complex variable functions about the singular point, and contour integration
- Introducing various transform techniques to analyze continuous and discrete systems in engineering applications

Course Outcomes:

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

CO 1: Employ methods to construct analytic functions [K3]

CO 2: Determine the series expansions of complex variable function and evaluate contour integration [K3]

CO 3: Apply Laplace transform techniques to convolute functions [K3]

CO 4: Use Fourier series and Fourier transforms to solve periodic and non-periodic functions [K3]

CO 5: Find line and parabola of best fit, correlation coefficient and regression lines [K3]

Course Structure:

Unit 1: Analytic Functions

Contents

Analytic Functions: Limit of a complex function, derivative of f(z), Cauchy-Riemann equations in cartesian and polar coordinates, analytic functions, harmonic functions, orthogonal systems.

Description:

This unit introduces students to the concept of analyticity of complex variable functions which is essential in analyzing flow problems

Exercises/Projects:

Derivation of Cauchy-Riemann equations in Cartesian and polar coordinates, related problems

construction of analytic functions/harmonic conjugates/orthogonal systems when the real or imaginary part of f(z) is given

Examples/Applications/Case Studies:

Application to flow/field problems: If the potential function is $\log(x^2+y^2)$. Find the flux and complex potential function.

Learning Outcomes:

- Understand the concepts of Limit, Continuity, differentiability and analyticity of f(z)
- Verification of analyticity of single valued complex variable function
- Find the analytic function by direct method and Milnes Thomson method

Specific Resources:

MIT OpenCourseWare: Complex Variables with Applications

- https://ocw.mit.edu/courses/18-04-complex-variables-with-applications-spring- 2018/pages/lecture-notes/

NPTEL: Complex Analysis

- https://archive.nptel.ac.in/courses/111/103/111103070/

Unit 2: Complex Integration

Contents

Complex integration: Complex integration(Definition only),Cauchy's integral theorem(without proof) series of complex terms-Taylor and Laurent Series (without proofs), zeros and singularities of analytic function, residues, calculation of residues, residue theorem(without proof), bilinear transformation.

Description: This unit focuses on expansion of functions in series and contour integration

Exercises/Projects:

- Expansions of functions as Taylor and Laurent series
- Find nature of singularities of complex variable function
- Find contour integration using Cauchy's theorem, and residue theorem

Examples/Applications/Case Studies:

- Application of residue theorem to evaluate real definite integrals
- Evaluation around unit circle, evaluation around semi-circle

Learning Outcomes:

- Determine nature of singularities and expansions of function in series
- Find contour integration

Specific Resources:

MIT OpenCourseWare: Complex Variables with Applications

- https://ocw.mit.edu/courses/18-04-complex-variables-with-applications-spring- 2018/pages/lecture-notes/

NPTEL: Complex Analysis

- https://archive.nptel.ac.in/courses/111/103/111103070/

Unit 3: Laplace Transforms

Contents

Introduction, definition, condition for existence, transform of elementary functions properties of Laplace transforms, transforms of periodic functions, integrals, multiplication by t^n and division by t, evaluation of integrals by Laplace transforms, inverse transforms, method of partial fractions, convolution theorem.

Description: This unit teaches the students the concepts of Laplace and Inverse Laplace transforms of time-bound functions

Exercises/Projects:

- Find Laplace transform and Inverse Laplace transform
- Find transform of periodic, integrals, derivatives of functions and apply them to evaluate improper integrals

Examples/Applications/Case Studies:

- Solving differential equations
- Model and analyze dynamic systems in control theory
- In the study of probability distributions and stochastic process

Learning Outcomes:

- Determine Laplace and Inverse transform of a function

Specific Resources:

MIT OpenCourseWare: Differential Equations

- https://ocw.mit.edu/courses/18-03sc-differential-equations-fall-2011/pages/unit-iii-fourier-series-and-laplace-transform/laplace-transform-basics/
- https://ocw.mit.edu/courses/18-03sc-differential-equations-fall-2011/pages/unit-iii-fourier-series-and laplace-transform/partial-fractions-and-inverse-laplace-transform/

NPTEL: Transform Techniques for Engineers

- https://archive.nptel.ac.in/courses/111/106/111106111/

Unit 4: Fourier series and Transforms

Contents

Fourier series: Euler's formulae, conditions for a Fourier expansion, functions having point of discontinuity, change of interval, even and odd functions.

Fourier transforms: Fourier integral theorem (without proof & No problems), Fourier sine and cosine integrals (without proof & No problems), Fourier transforms, Fourier sine and cosine transforms.

Description: This unit prepares the students to find Fourier series of periodic function and Fourier transforms of non-periodic functions.

Exercises/Projects:

- Find Fourier integral, Fourier sine and cosine integrals
- Evaluate Fourier transform, Fourier sine and cosine transforms

Examples/Applications/Case Studies:

- Signal processing
- Oscillation of beam
- Conduction of heat

Learning Outcomes:

- Find Fourier transform of a function

Specific Resources:

Introduction to Fourier analysis - Course

MIT OpenCourseWare: Computational Science and Engineering

- https://ocw.mit.edu/courses/18-085-computational-science-and-engineering-i-fall-2008/resources/lecture-33-filters-fourier-integral-transform/

NPTEL: Transform Techniques for Engineers

- https://archive.nptel.ac.in/courses/111/106/111106111/

Unit 5: Statistics

Contents

Curve fitting, method of least squares, working procedure to fit straight line and parabola, correlation, coefficient of correlation, lines of regression.

Description: This unit briefs the students on the concepts of curve fitting, correlation, and regression.

Exercises/Projects:

- Fit straight line and parabola to the given data.
- Find a correlation between two data sets.
- Find the line of regression

Examples/Applications/Case Studies:

- Expressing the data in the form of a best-fit line or parabola.
- Studying the linear relationship between two variables.

Learning Outcomes:

- Compute line and parabola of best fit, correlation, and lines of regression.
- Specific Resources:
- NPTEL:: Mathematics - Regression Analysis

Textbook(s) / Reference(s)

Textbook:

[1]. Grewal B. S,"***Higher Engineering Mathematics***", 44th edition, 2017, Khanna Publishers.

References:

[1]. Kreyszig Erwin. "***Advanced Engineering Mathematics***", 9th edition, 2013, Wiley Publishers.

[2]. Jain R.K. &Iyengar S.R.K,"***Advanced Engineering Mathematics***" 5th edition, 2021, Alpha Science International Ltd.

[3]. Ramana B V, "***Higher Engineering Mathematics***", 1st edition, 2007, Tata MC Graw Hill.

24EE201-AC Network Analysis
(EEE)

Category: Engineering Science (ES) 2L 0T 2P 3C

Pre-requisite: Electrical Network Analysis

Course Description:

This course covers three-phase electrical systems, including phase sequence, star and delta connections, and power relations in balanced and unbalanced circuits. It explores three-phase power measurement methods and power factor determination using wattmeters. The course delves into inductance, mutual coupling, and coupled circuits. Fundamental network theorems such as superposition, reciprocity, Thevenin's, and maximum power transfer are studied for AC network analysis. Finally this course deals with network functions.

Course Aims and Objectives:

This course aims to provide a comprehensive understanding of three-phase electrical systems, coupled circuits, and network theorems. It equips students with the analytical skills necessary to solve electrical circuit problems and apply theoretical concepts in practical power and network applications.

- To understand the fundamentals of three-phase electrical systems, including phase sequence, star and delta connections, and power calculations.
- To analyze and measure three-phase power using different wattmeter methods and determine power factor variations.
- To explain the principles of self and mutual inductance, coupled circuits, and their equivalent models.
- To apply circuit theorems such as superposition, reciprocity, Thevenin’s, Norton’s, and maximum power transfer for network analysis.
- To understand and analyze the network functions.

Course Outcomes:

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

CO1: **Understanding** of three-phase circuits, including star and delta connections, phase sequence, and power relationships. [K2]

CO2: **Apply** different wattmeter methods to measure three-phase power and analyze power factor variations in electrical loads. [K3]

CO3: **Understand** and **analyze** self-inductance, mutual inductance, coefficient of coupling, and conductively coupled equivalent circuits. [K3]

CO4: **Apply** mesh and node analysis to AC circuits, and also applies theorems such as superposition, Thevenin’s, Norton’s, and maximum power transfer and reciprocity theorems to solve electrical AC circuits. [K3]

CO5: **Understand** and analyze network functions, including driving-point and transfer functions, to design stable and realizable electrical circuits. [K3]

Course Structure:

Unit 1: Three-Phase Circuits

Contents

Introduction, advantages of a three-phase system, phase sequence, interconnection of three phases, , star connection, delta connection, voltage, current and power relations in a balanced star connected load, voltage, current and power relations in a balanced delta connected load, balanced star/delta and delta/star conversions, comparison between star and delta connections, three-phase unbalanced circuits.

Description:

This module introduces three-phase electrical systems, covering phase sequence and interconnection methods. It explains star and delta connections, including voltage, current, and power relations in balanced loads. Conversions between star and delta configurations are discussed, along with their comparisons. The analysis of three-phase unbalanced circuits is also included.

Examples/ Applications/ Case Studies:

- Three-phase systems are widely used for supplying electricity to residential, commercial, and industrial sectors.
- High-voltage transmission lines use three-phase systems to reduce losses and improve efficiency.
- Analyzing the role of power factor correction using capacitors in reducing electricity costs.
- Three-Phase vs. Single-Phase power comparative study on efficiency, cost, and reliability in industrial applications.

Exercises/Projects:

- Identify phase sequence and determine the effect of incorrect sequencing in a given system.
- Compute line and phase voltages/currents for balanced star and delta connections.
- Solve problems to determine active, reactive, and apparent power in balanced star and delta loads.
- Use smulation tools to simulate voltage and current behavior in both star and delta configurations.
- Investigate the effects of an unbalanced three-phase load on power distribution and system stability.

Learning Outcomes:

- Students will be able to understand three-phase systems and connections, including phase sequence, interconnection methods, and star and delta connections.
- Students will be able to derive and compare voltage, current, and power relationships in balanced star and delta-connected loads, including conversions between the two.
- Students will be able to assess and solve problems related to three-phase unbalanced circuits, understanding their impact on system performance and efficiency.

Specific Resources: (web)

- https://archive.nptel.ac.in/courses/108/105/108105159/
- https://archive.nptel.ac.in/courses/108/105/108105053/

Unit 2: Measurement of Three-Phase Power

Contents

Measurement of three-phase power - three wattmeter method, two wattmeter method and one wattmeter method, measurement of power factor by two-wattmeter method, variation in wattmeter readings with load power factor (lag and lead p.f. loads), measurement of reactive power with two watt meter and single wattmeter methods.

Description:

- This module teaches how to measure three-phase power using different wattmeter methods (one, two, and three-wattmeter). It covers measuring power factor with the two-wattmeter method, and how wattmeter readings change with lagging and leading power factors. It also introduces the measurement of reactive power using the two-wattmeter and single-wattmeter methods.

Examples/Applications/Case Studies:

- **Examples:** Measuring power factor in industrial motors, reactive power in power grids, and power in commercial buildings using wattmeter methods.
- **Applications:** Energy management in industries, power factor correction in motors, and grid monitoring in three-phase systems.
- **Case Studies:** Power factor compensation in manufacturing, reactive power measurement in distribution networks, and power measurement in hydroelectric plants.

Exercises/Projects:

- Solve problems on power calculation using three-wattmeter and two-wattmeter methods, analyze wattmeter reading variations, and calculate reactive power.
- Build a power measurement setup, measure power factor for a given circuit, calibrate wattmeter's, and measure power factor in renewable energy systems.

Learning Outcomes:

- Students will be able to measure active, reactive, and apparent power using wattmeter methods.
- Students will be able to determine and analyze power factor with the two-wattmeter method.
- Students will be able to understand variations in wattmeter readings under different load conditions.

Specific Resources: (web)

- https://archive.nptel.ac.in/courses/108/105/108105159/
- https://archive.nptel.ac.in/courses/108/105/108105053/

Unit 3: Coupled Circuits

Contents

Introduction-self inductance, mutual inductance, coefficient of coupling, inductances in series and parallel, dot convention, coupled circuits, conductively coupled equivalent circuits.

Description:

- This module covers the fundamentals of inductance, focusing on self-inductance, mutual inductance, and the coefficient of coupling. It explores the behavior of inductors in series and parallel, introduces the dot convention for coupled inductors, and examines coupled circuits and their equivalent models. Understanding these concepts is essential for analyzing transformers, electrical motors, and other inductive components in circuits.

Examples /Applications /Case Studies:

- Calculating total inductance in series and parallel configurations, analyzing mutual inductance in coupled inductors, and using the dot convention to understand transformer windings.
- Used in transformers, electric motors, inductive coupling in communication systems, and power supplies.
- Design of a transformer circuit, analyzing inductive coupling in power transmission systems, and modeling conductively coupled circuits in a motor's stator and rotor.

Exercises /Projects:

- Solve problems involving self-inductance, mutual inductance, and inductances in series/parallel. Apply the dot convention to analyze coupled inductors and compute the coefficient of coupling.

- Design and simulate a coupled inductor circuit using the dot convention, analyze a transformer's equivalent circuit using simulation tools.

Learning Outcomes:

- Students will be able to the concepts of self-inductance, mutual inductance, and the coefficient of coupling in inductive circuits.
- Students will be able to analyze and calculate inductance in series and parallel configurations.
- Students will be able to apply the dot convention for coupled inductors and model coupled circuits.
- Students will be able to solve practical problems involving inductive coupling and equivalent circuits in applications such as transformers and motors.

Specific Resources :(web)

- https://archive.nptel.ac.in/courses/108/105/108105159/
- https://archive.nptel.ac.in/courses/108/105/108105053/

Unit 4: Network Theorems (Application to AC Circuits)

Contents

Introduction, mesh analysis, nodal analysis, superposition theorem, reciprocity theorem, Thevenin's theorem, Norton's, theorem and maximum power transfer theorem.

Description:

- This module covers key network theorems used for simplifying and analyzing electrical circuits. It includes the mesh analysis, nodal analysis, superposition, reciprocity theorems, Thevenin's theorem and maximum power transfer theorem. These theorems help in solving complex circuits by reducing them to simpler forms, enabling easier calculation of voltages, currents, and power.

Examples /Applications /Case Studies:

- Used in analyzing AC circuits.
- Essential in network simplifications for power distribution systems.
- Used in communication and filter network design.

Exercises /Projects:

- Solve a circuit using mesh analysis and compare results with node analysis.
- Apply superposition theorem to a circuit with three independent sources.
- Verify reciprocity theorem for a simple resistive network.

Learning Outcomes:

- Students will be able to understand and apply mesh and nodal analysis to solve electrical circuits.
- Students will be able to utilize superposition, Thevenin's theorem, maximum power transfer theorem and reciprocity theorems in circuit simplifications.
- Students will be able to gain hands-on experience through case studies and exercises.
- Students will be able to develop problem-solving skills applicable to real-world electrical network designs.

Specific Resources :(web)

- https://archive.nptel.ac.in/courses/108/105/108105159/
- https://archive.nptel.ac.in/courses/108/105/108105053/

Unit 5: Network Functions

Contents

Introduction, driving-point functions, transfer functions, analysis of ladder networks, poles and zeros of network functions, restrictions on pole and zero locations for driving-point functions, restrictions on pole and zero locations for transfer functions.

Description:

- Network functions describe the mathematical relationship between input and output voltages or currents in electrical networks. They play a crucial role in analyzing and designing electrical circuits, particularly in signal processing and control systems.

Examples /Applications /Case Studies:

- Use of network functions in filter design.
- Analysis of transient and steady-state responses in RLC circuits.
- Applications in communication systems and electrical power distribution.

Exercises /Projects:

- Derive the network function for a simple RC circuit.
- Simulate a given network function using circuit simulation software.

Learning Outcomes:

- Students will be able understand the concept of network functions.
- Students will be able recognize their significance in electrical circuit analysis and design.

Specific Resources :(web)

- https://archive.nptel.ac.in/courses/108/105/108105159/
- https://archive.nptel.ac.in/courses/108/105/108105053/

Textbook(s)/Reference(s):

Textbooks:

[1].Hayt. William H & Kemmerly Jack & Phillips Jack., & Steven M. Durbin, "***Engineering Circuit Analysis***",9th edition, 2020, Mc Graw Hill Education.

[2]. Ravish R Singh, "***Network Analysis and Synthesis***",1st edition, 2013, McGraw-Hill Education,

References:

[1]. Roy Choudhury, D "***Networks and Systems***", 2nd edition, 2013. New Age International Publications

[2]. Edminister Joseph., & Nahvi Mahmood, "***Electric Circuits, Schaum's Outline Series***",7th edition, 2017,Tata McGraw Hill Publishing Company, New Delhi.

[3]. Alexander, Charles. K., & Matthew .N.& Sadiku .O, "***Fundamentals of Electric Circuits***",5th edition, 2021, McGraw-Hill Education.

[4]. A.Chakrabarti, "***Circuit Theory Analysis and Synthesis***",6th edition, Dhanpat Rai &Co.,

List of experiments

Unit 1:

- Simulation of three phase balanced and unbalanced star connected circuits
- Simulation of three phase balanced and unbalanced delta connected circuits

Unit 2:

- Measurement of power by two wattmeter method in balanced and unbalanced three phase circuits using virtual labs.
- Measurement of reactive power using single-wattmeter method.

Unit 3:

- Estimation of self & mutual inductance of coupled circuits.
- Measure total inductance in series and parallel configurations.

Unit 4:

- Verification of reciprocity theorem using virtual labs.
- Verification of maximum power transfer theorem using virtual labs.
- Mesh and nodal analysis using simulation tool.

Unit 5:

- Simulation of driving point function.
- Simulation of transfer function.

24EE304 - ANALOG ELECTRONICS

Category: Engineering Science (ES) 3L 0T 0P 3C
Pre-requisite: Engineering Physics, Electrical Network Analysis

Course Description:

This course introduces fundamental concepts of analog electronic circuits, covering semiconductor devices, transistor operation, amplifiers, power amplifiers, and oscillators. The topics include diodes, rectifiers, transistor biasing, and frequency response of amplifiers, feedback amplifiers, and oscillator circuits. The course provides a foundation for understanding analog signal processing and electronic circuit design, essential for electrical and electronics engineering applications.

Course Aims and Objectives:

- To introduce the fundamental principles of semiconductor devices and analog circuits.
- To analyze the characteristics and applications of diodes, transistors, and amplifiers.
- To evaluate small-signal models, gain, and frequency response of BJT and MOSFET amplifiers.
- To understand the working of power amplifiers and tuned amplifiers.
- To analyze the role of feedback amplifiers and oscillators in circuit design.

Course Outcomes:

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

CO1: Understand the structure, characteristics, and applications of semiconductor devices. [K2]

CO2: Analyze the biasing techniques and operation of BJT and MOSFET amplifiers. [K3]

CO3: Evaluate the small-signal models, gain, and frequency response of single-stage and multistage amplifiers. [K4]

CO4: Analyze the operation of power amplifiers and tuned amplifiers and their applications.[K3]

CO5: Examine the advantages of negative feedback and the principles of oscillators. [K4]

Course Structure

Unit 1: Semiconductor Devices and Basic Circuits

Contents:

PN Junction Diode-structure, operation, and V-I characteristics rectifiers-half-wave and full-wave rectifiers, ripple factor, efficiency, filters (capacitor, inductor, and π-filters), limiting and clamping circuits, voltage multipliers, display devices-LED, photodiodes, solar cell, laser diodes– construction, operation, characteristics and applications, zener diode-characteristics, reverse bias characteristics, voltage regulation.

Description:

This unit introduces the PN junction diode, its structure, operation, and V-I characteristics. It covers rectifiers used for AC to DC conversion, including half-wave and full-wave rectification with filters. It explores limiting and clamping circuits for waveform shaping and discusses display devices (LEDs, photodiodes, solar cells, laser diodes) and their applications. The Zener diode is examined for voltage regulation and breakdown characteristics.

Examples/Applications:

- Application: Designing a Zener diode voltage regulator.
- Example: Implementing a rectifier circuit for a DC power supply.

Exercises/Projects:

- Design and simulate a rectifier circuit and verify its output waveforms.
- Analyze the voltage regulation performance of a Zener diode circuit.

Learning Outcomes:

- Understand the working of PN junction diodes and rectifiers.
- Analyze V-I characteristics and applications of Zener diodes.
- Explain the operation of LEDs, photodiodes, and laser diodes.
- Apply diode principles in rectification and voltage regulation.

Specific Resources (web):

https://nptel.ac.in/courses/108108112

Unit 2: Transistors and Biasing Techniques

Contents:

Bipolar Junction Transistor (BJT)-structure, operation, characteristics (CE, CB, CC configurations), Field Effect Transistor (FET)-JFET and MOSFET-construction, operation, and characteristics, Biasing Techniques-fixed bias, voltage divider bias, self-bias- stability and thermal runaway.

Description:

This unit introduces BJTs and FETs, focusing on their structure, operation, and biasing techniques. It covers the characteristics of CE, CB, and CC amplifiers, explores JFET and MOSFET characteristics, and explains various biasing methods to ensure thermal stability and prevent runaway.

Examples/Applications:

- **Application:** MOSFET switching in power electronic circuits.
- **Example:** Biasing techniques for JFET in amplifier circuits.

Exercises/Projects:

- Design and analyze the input-output characteristics of a BJT amplifier.
- Study the biasing stability of MOSFET circuits.

Learning Outcomes:

- Explain the structure and characteristics of BJTs and FETs.
- Analyze biasing techniques and their effects on transistor operation.
- Understand the thermal stability of biasing circuits.
- Apply transistors in amplifier and switching circuits.

Specific Resources (web):

NPTEL Course on Transistor Biasing

Unit 3: Small Signal and Frequency Response of Amplifiers

Contents:

Small Signal Analysis of BJT Amplifiers-CE, CB, CC configurations-voltage gain, input/output impedance, MOSFET amplifiers-CS and CD configurations-gain and frequency response, frequency response of amplifiers-low-frequency and high-frequency response, multistage amplifiers-cascade, cascode, and differential amplifiers.

Description:

This unit focuses on the analysis of small-signal amplifiers, covering BJT and MOSFET amplifier configurations. It introduces frequency response analysis to understand the gain behavior over different frequency ranges and examines multistage amplifiers like cascade, cascode, and differential amplifiers for signal amplification.

Examples/Applications:

- Application: High-gain amplification using a common-emitter BJT amplifier.
- Example: MOSFET-based low-noise amplifier design.

Exercises/Projects:

- Design and simulate a BJT common-emitter amplifier circuit.
- Analyze the frequency response of a MOSFET amplifier.

Learning Outcomes:

- Analyze small-signal models for BJT and MOSFET amplifiers.
- Evaluate gain and frequency response of different amplifier configurations.
- Understand the frequency limitations in amplifier design.
- Design and simulate common amplifier circuits.

Specific Resources (web):

NPTEL Course on Analog Circuits

Unit 4: Power and Tuned Amplifiers

Contents:

Power Amplifiers-class A, class B, class AB, class C, and push-pull class B amplifiers-operation, efficiency, and distortion, tuned amplifiers-single-tuned and double-tuned amplifiers, neutralization techniques , applications of power and tuned amplifiers in industry.

Description:

This unit introduces power amplifiers, focusing on their efficiency and distortion characteristics. It explains tuned amplifiers, their role in signal processing, and the importance of neutralization techniques for stability.

Examples/Applications:

- Application: Differential amplifier in operational amplifier circuits.
- Example:RF power amplifier design for communication.

Exercises/Projects:

- Implement a power amplifier circuit and evaluate its efficiency.
- Analyze a tuned amplifier circuit for signal reception.

Learning Outcomes:

- Explain different power amplifier classes and their operation.
- Analyze the frequency response of tuned amplifiers.
- Understand the role of power amplifiers in industry applications.

Specific Resources (web):

NPTEL Course on Power Amplifiers

Unit 5: Feedback Amplifiers and Oscillators

Contents:

Feedback Amplifiers: Voltage/current series and shunt feedback- effect on gain and bandwidth, oscillators-RC oscillators-phase shift, wien bridge, LC oscillators-hartley, colpitts, crystal.

Description:

This unit explores feedback amplifiers, covering negative and positive feedback and their impact on gain and bandwidth. It also discusses oscillator design, including RC and LC oscillators for signal generation.

Examples/Applications:

- Application: Crystal oscillator for stable frequency generation in communication circuits.
- Example: Design of a Wien bridge oscillator for signal generation.

Exercises/Projects:

- Build and test a Hartley or Colpitts oscillator circuit.
- Compare the frequency stability of different oscillator circuits.

Learning Outcomes:

- Understand the advantages of feedback circuits.
- Analyze different oscillator topologies.
- Design and implement oscillators like Wien Bridge and Colpitts.

Specific Resources (web):

NPTEL Course on Oscillators

https://archive.nptel.ac.in/courses/108/105/108105158/

Textbooks and References:

Textbooks:

1. David A. Bell, "***Electronic Devices and Circuits***", 5th edition, Oxford University Press, 2008.
2. Sedra and Smith, "***Microelectronic Circuits***", 7th edition, Oxford University Press, 2017.

References:

1. Balbir Kumar & Shail B. Jain, "***Electronic Devices and Circuits***", PHI Learning, 2nd edition, 2014.
2. Thomas L. Floyd, "***Electronic Devices: Conventional Current Version***", 10th edition, Pearson, 2017.
3. Donald A. Neamen, "***Electronic Circuit Analysis and Design***", 3rd edition, Tata McGraw-Hill, 2003.
4. Robert L. Boylestad, "***Electronic Devices and Circuit Theory***", 11th edition, Pearson, 2013

24EE203-DC Machines and Transformers

Category: **Professional Core** (PC) 3L 0T 0P 3C

Pre-requisite: Electrical Network analysis

CourseDescription:

This course covers the fundamentals of electromechanical energy conversion, focusing on electrical systems, magnetic systems and their relationship to mechanical forces. It explores the operation and characteristics of DC generators, including armature reaction, compensating windings, and excitation methods. The course also delves into DC motors, examining motor principles, back EMF, torque equations, and efficiency testing methods like direct and indirect methods. Additionally, the course covers transformers, starting with single-phase transformer construction, EMF equations, and practical applications, including testing methods like open circuit and short circuit tests. The study extends to three-phase transformers, including various connections like the Scott and auto-transformer connections. Finally, the course addresses parallel operation, transformer losses, efficiency, and applications.

CourseAimsandObjectives:

- To introduce the principles of Electromechanical energy conversion
- To impart knowledge on the construction, working principles, and characteristics of DC generators.
- Toexplain the operation, speed control techniques, and testing methods for DC motors.
- To teach concepts of single-phase transformers.
- To introduce three phase transformer and different types of connections.

CourseOutcomes:

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

CO1:**Understand** the construction and operation of DC generators.

CO 2: **Analyze** the operation and characteristics of DC motors.

CO 3:**Analyze** the different speed control and testing methods.

CO4:**Analyze** and **evaluate** the performance of single-phase transformers.

CO 5: **Analyze** and **evaluate** the performance of three-phase transformers.

CourseStructure:

Unit1:D.C Generators

Contents

Principle of electro-mechanical energy conversion, construction of DC generator, principle of operation, EMF equation, armature reaction,types of DC generators, operating characteristics of DC generators, applications of DC generator.

Description:

This section covers definition of a DC generator, parts of a DC machines, working principle and operation of a DC generator, Faraday's law of electromagnetic induction, Fleming's right hand rule, mathematical equation for an EMF. It includes armature reaction and its effects, different types of D.C. generator and its applications and operating characteristics of a DC generator.

Examples/Applications/CaseStudies:

Applications:

- **Power Generation**: DC generators are used in power generation systems, such as those used in remote areas or in emergency situations.
- **Battery Charging**: DC generators are used in battery charging systems, such as those used in electric vehicles and renewable energy systems.
- **Welding**: DC generators are used in welding systems, such as those used in industrial manufacturing and construction.

Exercises/Projects:

- Design a basic simple loop DC generator proto type model.
- Simulate a DC generator using simulink and investigate the effect of field current on the performance of the generator.

Learning Outcomes:

- Understand the construction, working principle, and EMF equation of a DC generator, including induced voltage calculation.
- Identify different types of DC generators and analyze the impact of armature reaction on their performance.

Specific Resources: (web)

- NPTEL :: Electrical Engineering - NOC:Electrical Machines - I
- https://archive.nptel.ac.in/courses/108/105/108105017/

Unit2:DC Motors

Contents

Principle of operation, significance of back EMF, torque equation, types of DC motors,and characteristics of DC motors, necessity of starter-starting methods for different types of motors,applications of DC motors.

Description:

This section covers the operation of DC motors, including back EMF, torque production, and characteristics. Necessity of a starter, various starting methods for different motors also it highlights applications of DC motors .

Examples/Applications/CaseStudies:

- **DC Motor:**

  Application: Mining locomotives use DC motors for reliable underground Transportation.

  Example: Analyzing motor efficiency in low-ventilation environments.

- **DCSeries motor:**

  Application: Using DC series motors in cranes and hoists for high starting torque.

  Example: Analyzing the torque-speed characteristics of a DC series motor under different load conditions.

Exercises/Projects:

- Disassemble a DC motor and identify its main components (armature, field winding, commutator, brushes, etc.). Explain the function of each component.
- Design a three-point starter for a DC shunt motor and simulate its working using MATLAB/Simulink or any circuit simulator.

LearningOutcomes:

- Students will develop the ability to compare different DC motor types (shunt, series, and compound) and select appropriate motors for different applications based on load and efficiency requirements.

SpecificResources:(web)

- https://archive.nptel.ac.in/courses/108/102/108102146/
- https://innovationspace.ansys.com/courses/courses/electric-vehicle-performance/lessons/torque-speed-and-back-emf-in-motors-lesson-5/

Unit3: Speed Control and Testing of DC Motors

Contents

Speed control methods: armature voltage and field control method, losses and efficiency, testing of DC machines-brake test on dc shunt motor, swinburne's test, hopkinson's test.

Description:

This section covers the discussion of starting methods, speed control techniques, efficiency, and testing methods like brake, Swinburne's tests and Hopkinson's test.

Examples/Applications/CaseStudies:

- **DC Motor:**

  Application: DC motors are used in power tools.

  Example: DC motors are used in power tools, such as drills, saws, and sanders.

- **DCSeries motor:**

  Application: Electric locomotives and trolleybuses

  Case Study: Analyzing the efficiency and performance of DC motors in locomotives

Exercises/Projects:

- Conduct a brake test on a DC shunt motor to determine efficiency and compare results with theoretical predictions.
- Simulate speed control techniques for a DC motor using MATLAB or circuit simulation software and validate through practical experiments.

LearningOutcomes:

Students will be able to analyze speed control methods for DC motors and apply techniques like armature voltage and field control in different applications.

SpecificResources:(web)

- https://archive.nptel.ac.in/courses/108/102/108102146/?utm_source=chatgpt.com
- https://innovationspace.ansys.com/courses/learning-track/electrical-machines-i/
- https://innovationspace.ansys.com/courses/courses/electric-vehicle-performance/lessons/torque-speed-and-back-emf-in-motors-lesson-5/

Unit4: Single Phase Transformer

Contents

Transformer construction, principle of operation, EMF equation, ideal transformer, practical transformer, phasor diagram, equivalentcircuit, transformer losses, regulation and efficiency, all day efficiency, auto transformer, transformer testing- open circuit and short circuit tests.

Description:

This section covers transformer construction, working principles, EMF equation, phasor diagrams, equivalent circuits, losses, efficiency (including all-day efficiency), and voltage regulation. It also explores autotransformers and transformer testing (open-circuit and short-circuit tests).

Examples/Applications/CaseStudies:

- **Power Distribution Systems:**

  Application: Step-up and step-down transformers are used to minimize transmission losses and improve efficiency in power distribution networks.

  Example: Analyzing the voltage regulation and efficiency of a distribution transformer supplying residential loads.

- **Industrial Automation & Motor Control:**

  Application: Autotransformers are used in motor starters to reduce inrush current and provide variable voltage.

  Example: Comparing the performance of an autotransformer starter with a conventional direct-on-line (DOL) starter in industrial motors.

Exercises/Projects:

- Build two transformer circuits—one using a standard two-winding transformer and the other using an autotransformer with the same inductance and voltage rating. Measure efficiency and voltage regulation, discussing the advantages and differences observed.
- Run a transformer under load conditions for an extended period and measure temperature rise in windings. Analyze the impact of heat on efficiency and transforming life.

LearningOutcomes:

- Students will understand transformer construction, working principles, EMF equation, and the differences between ideal and practical transformers.
- Students will analyze transformer efficiency, voltage regulation, and losses through theoretical calculations and experimental testing.

SpecificResources :(web)

- https://nptel.ac.in/courses/108102146
- https://archive.nptel.ac.in/courses/108/105/108105155/

Unit5: Three-Phase Transformer

Contents

Three phase transformer construction, three phase transformer connections, parallel operation of three phase transformers, three winding transformers (Tertiary winding), open delta connection, tap changing of transformers.

Description:

This section covers three-phase transformer construction, connections (star, delta, open-delta), and parallel operation. It explores three-winding transformers with tertiary windings and their applications. Tap-changing methods for voltage regulation are also discussed.

Examples/Applications/Case Studies:

- **Power Distribution:**

  Application: Three-phase transformers are used in substations for efficient voltage transformation and load balancing.

  Example: Comparing star-delta and delta-star connections in industrial and residential power systems.

- **Industrial Backup Systems:**

  Application: Open-delta (V-V) connections provide emergency power when one transformer in a bank fails and also used for future expansion of load.

  Example: Analyzing the impact of an open-delta connection on power capacity and system stability.

Exercises/Projects:

- Construct an open-delta (V-V) transformer system and analyze its voltage and power capacity compared to a full three-phase system.
- Demonstrate on-load and off-load tap-changing methods. Measure voltage variations and assess their impact on power system stability.

LearningOutcomes:

- Students will understand three-phase transformer connections, including star, delta, and open-delta, and their impact on power distribution.
- Students will analyze transformer parallel operation, tertiary windings, and tap-changing methods for voltage regulation and efficiency improvement.

SpecificResources:(web)

- https://archive.nptel.ac.in/courses/108/105/108105017/

Textbook(s)/Reference(s):

Textbooks:

1) I.J.Nagrath and D.P. Kothari, "***Electric Machines***", 4th edition, 2010,Tata McGraw-Hill Education Private Limited Publishing Company Ltd, New Delhi,.

2) Ashfaq Husain, " ***Electrical Machines***", 2nd edition, 2009,Dhanpat Rai & Co. (Pvt) Ltd,.

References:

1) P. S. Bhimbra, "***Electrical Machinery***", 7th edition, 2007, Khanna Publications,.
2) A.E. Clayton, "***The Performance & Design of DC Machines***", 1st edition, 2003, CBS publisher & distributors, Delhi,.
3) A.E Fitzgerald and Charles Kinsley, "***Electric Machinery***", 6th edition, 2002, Tata McGraw-Hill Education Private Ltd, New Delhi,
4) J.B. Gupta, "***Theory & Performance of Electrical Machines***", 15th edition, 2015, S.K.Kataria & Sons, New Delhi,
5) B.L.Theraja and A.K.Theraja, "***Electric Technology***", Volume-II, 2012, S Chand & Co. (Pvt.) Ltd, New Delhi,.

24EE204-Digital Electronics

Category: Professional Core(PC) 3L 0T 0P 3C

Pre-requisite: Basics of Boolean Algebra

Course Description:

This course provides a comprehensive understanding of digital logic design, covering fundamental concepts such as number systems, logic families, combinational and sequential circuits, and programmable logic devices. Students will learn about various logic gates, Boolean algebra, minimization techniques, flip-flops, counters, and memory devices. The course emphasizes the analysis, design, and implementation of digital circuits, equipping students with practical problem-solving skills applicable in modern computing and electronic systems.

Course Aims and Objectives:

The course aims to:

- Introduce fundamental concepts of digital electronics, including number systems and error detection techniques.
- Explore various digital logic families and their characteristics for circuit design.
- Develop the ability to simplify and design combinational logic circuits using Karnaugh maps and Quine-McCluskey methods.
- Teach the working principles of sequential circuits, including flip-flops, registers, and counters.
- Familiarize students with synchronous sequential logic circuits and programmable logic devices (PLDs).
- Enable students to apply digital design principles in real-world applications such as computing and embedded systems.

Course Outcomes:

Upon successful completion of this course, students will be able to:

- Demonstrate an understanding of number systems, error detection codes, and digital logic families.
- Apply Boolean algebra, Karnaugh maps, and minimization techniques to design and minimize combinational circuits.
- Design and implement combinational logic circuits, including adders, multiplexers, decoders, and code converters.
- Analyze and develop sequential logic circuits using flip-flops, registers, and counters.
- Apply programmable logic devices in digital system design.

COURSE STRUCTURE:

UNIT-I: Number Systems and Digital Logic Families

Contents:

Number Systems: Number systems and codes, error detection and correction codes**,** digital logic families-characteristics of digital logic families, introduction to RTL, DTL, TTL, ECL and MOS logic families**.**

Description: This unit covers different number systems, their conversions, and error detection/correction codes. It also introduces various digital logic families and their characteristics, including RTL, DTL, TTL, ECL, and MOS technologies.

Examples:

- Binary to decimal and hexadecimal conversions.
- Parity bit and Hamming code for error detection and correction.
- TTL-based logic gate circuit implementation.

Applications:

- Data communication and error detection in network systems.
- Microprocessor and microcontroller logic circuit design.
- Digital electronics and embedded system applications.

Exercises/Projects:

1. Convert numbers between different bases and verify results.
2. Implement a parity checker circuit.
3. Compare power consumption and speed of different logic families.

Learning Outcomes:

- Understand and convert between number systems.
- Identify and apply error detection and correction techniques.
- Compare and analyze digital logic families.

Specific Resources:

- https://nptel.ac.in/courses/106108099
- Online tutorials on logic families (e.g., Texas Instruments application notes).

UNIT-II: Minimization of Switching Functions and Combinational Logic Design

Contents:

Minimization of Switching Functions: SOP and POS forms, K-map representations, minimization using K-maps, simplification, don't care conditions, Quine-Mccluskey method, combinational logic design-adders, subtractors, multiplexers and de-multiplexers, decoders and encoders, code converters.

Description: This unit focuses on Boolean function simplification using Karnaugh maps and the Quine-McCluskey method. It also explores combinational circuit design including adders, subtractors, multiplexers, decoders, and code converters.

Examples:

- Simplifying Boolean expressions using K-maps.
- Designing a 4-to-1 multiplexer.
- Implementing a binary-to-Gray code converter.

Applications:

- Optimization of digital circuits for efficient hardware utilization.
- Designing arithmetic and data handling circuits in processors.

- Control logic for automation systems.

Exercises/Projects:

- Simplify given Boolean expressions using K-maps.
- Design a full-adder circuit using basic gates.
- Create a simple calculator using multiplexers and adders.

Learning Outcomes:

- Perform Boolean function simplification techniques.
- Design basic combinational circuits.
- Apply combinational logic to real-world applications.

Specific Resources:

- https://onlinecourses.nptel.ac.in/noc22_ee55/preview
- https://archive.nptel.ac.in/courses/108/106/108106177/

UNIT-III: Sequential Logic Circuits and Registers & Counters

Contents:

Sequential Logic Circuits-One-bit memory cell, SR, JK, D and T flip-flops, level triggering and edge triggering, conversion of flip-flops**,** registers and counters**-**shift registers, asynchronous and synchronous type, modulo and ring counters.

Description: This unit introduces sequential circuits, covering flip-flops and their conversions. It also discusses the different types of registers and counters used in digital systems.

Examples:

- Implementing a D flip-flop using JK flip-flops.
- Designing a 4-bit shift register.
- Creating a modulo-10 counter.

Applications:

- Memory elements in computing devices.
- Clock division and frequency synthesis in microprocessors.
- Data storage and transfer in digital communication.

Exercises/Projects:

- Implement different flip-flops using logic gates.
- Design a 4-bit ripple counter.
- Build a serial-in parallel-out shift register.

Learning Outcomes:

- Understand different types of flip-flops and their operations.
- Design and implement register and counter circuits.
- Apply sequential circuits to data storage and processing.

Specific Resources:

- https://archive.nptel.ac.in/courses/108/105/108105132/
- https://archive.nptel.ac.in/content/storage2/courses/122104013/node32.html

UNIT-IV: Synchronous Sequential Circuits and Programmable Logic Devices

Contents:

Synchronous Sequential Logic Circuits: Moore and Mealy models, state diagrams, state assignment, state table and excitation tables, state reduction, design of counters**.**

Description:

Synchronous sequential circuits are an essential part of digital system design, where outputs depend on both current inputs and past states. This unit introduces the Moore and Mealy models, which define the behaviour of sequential circuits, and explores techniques for designing and optimizing state machines. Students will learn to represent state transitions using state diagrams, assign states efficiently, create excitation tables, and minimize the number of states in a system. The unit also covers the design of various counters, including synchronous, modulo, and ring counters.

Examples:

- Moore and Mealy Machine Example – Designing a sequence detector that detects "101" in an input stream.
- State Diagram Example – Representing the behaviour of a simple traffic light controller.
- Counter Design Example – Implementing a 4-bit synchronous counter using JK flip-flops.

Exercises:

- Draw the state diagram for a sequence detector that detects "1101".
- Design a synchronous counter that counts from 0 to 9 and resets.
- Construct the excitation table for a given state transition table.
- Perform state reduction on a given state diagram.

Learning Outcomes:

By the end of this unit, students will be able to:

- Differentiate between Moore and Mealy models and apply them in digital circuits.
- Construct state diagrams, state tables, and excitation tables for given sequential circuits.
- Apply state reduction and assignment techniques for optimization.
- Design and implement various types of synchronous counters.
- Analyse and troubleshoot state machine behaviour in practical applications.

Specific Resources:

- *https://tkiet.digimat.in/nptel/courses/video/106105185/L39.html*
- *https://onlinecourses.nptel.ac.in/noc20_ee32/preview*

UNIT-V: Programmable Logic Devices

Contents:

Programmable Logic Devices: Read only memory, ROM organization, design of combinational circuit using ROM, Programmable Logic Array (PLA), PLA Programming table and Programmable Array Logic (PAL).

Description:

This unit introduces Programmable Logic Devices (PLDs), which provide flexibility in digital circuit design. students will explore read only memory (ROM) and its organization, learning how to implement combinational circuits using ROM. The unit also covers the structure and application of Programmable Logic Arrays (PLA) and Programmable Array Logic (PAL), which allow for efficient hardware implementation of logic functions.

Examples:

- **Designing a Combinational Circuit using ROM** – Implementing a full adder using a ROM lookup table.
- **PLA Implementation** – Using a PLA to realize a Boolean function.
- **PAL Implementation** – Designing a simple BCD-to-Excess-3 code converter using PAL.

Exercises:

- Explain how ROM can be used to implement a combinational circuit.
- Design a 3-to-8 decoder using ROM.
- Construct a PLA programming table for a given set of Boolean expressions.
- Compare PLA and PAL in terms of functionality and flexibility.
- Implement a binary-to-Gray code converter using PAL.

Learning Outcomes:

By the end of this unit, students will be able to:

- Describe the architecture and organization of Read-Only Memory (ROM).
- Design combinational circuits using ROM as a lookup table.
- Understand the working principles of PLA and PAL and their differences.
- Develop and optimize logic functions using PLA programming tables.
- Implement digital logic functions using different PLD architectures.

Specific Resources:

- *https://archive.nptel.ac.in/courses/117/108/117108040/*
- http://www.digimat.in/nptel/courses/video/108105132/L60.html

Textbook(s) / Reference(s):

Text Books:

[1] R P Jain, "***Modern Digital Electronics***", 4th edition, 2010, Tata Mc. Graw Hill Publication, New Delhi,

[2] M. Morris Mano, "***Digital Logic and Computer Design***", Pearson India Education Services Ltd., 2016.

Reference Books:

[1] Taub& Schilling, "***Digital integrated Electronics***", Mc Graw-Hill, Delhi, 1986.

[2] Anand Kumar, "***Fundamentals of Digital Circuits***" 2nd edition, 2009,Prentice Hall of India.

[3] Gordon J Deboo& Clifford N. Burrous, "***Integrated Circuits and Semiconductor Devices***", 2nd edition, International Student Edition, Tata McGraw-Hill,

24EE281- DC MACHINES AND TRANSFORMERS LABORATORY

Category: Professional Core Lab **0L 0T 03P 1.5C**
Pre-requisite:

COURSE OBJECTIVES:

- To develop practical skills in handling electrical machines.
- To understand the performance characteristics of DC machines
- To evaluate the efficiency by testing of DC machines
- To study the transformer phase conversions
- To evaluate the efficiency by testing of transformer.

Upon successful completion of the course, the student will be able to:

CO1. Design and conduct experiments.
CO2. Analyze and present experimental results.
CO3. Exhibit professional behavior

LIST OF EXPERIMENTS:
PART-A
DC MACHINES:

1. Open circuit characteristics of a separately excited DC generator.
2. Load characteristics of a separately excited DC generator.
3. Load characteristics of a DC shunt generator.
4. Load characteristics of DC series generator.
5. Speed control of DC shunt motor
6. Brake test on DC compound motor.
7. Brake test on DC series Motor.
8. Swinburne's test on DC shunt motor

PART-B

TRANSFORMERS:

9. Open circuit and short circuit tests on single-phasetransformers
10. Sumpner's test on single-phase transformers
11. Parallel operation of single-phase transformers
12. Load test on three-phasetransformers.
13. Scott connection of three-phase transformers.
14. Vector grouping of three-phase transformers.

(Minimum of 10 experiments must be conducted)

24EE282-ANALOG AND DIGITAL ELECTRONICS LABORATORY

0L 0T 3P 1.5C

COURSE OBJECTIVES:

- To enable students to understand the behavior of semiconductor devices through hands-on experimentation.
- To familiarize students with active and passive circuit elements.
- To study the operation and characteristics of transistors such as BJT and FET.
- To analyze amplifier, gain, and frequency response characteristics.
- To understand the functionality of positive and negative feedback systems.
- To understand truth tables of digital logic gates and flip-flops
- To design combination logic circuits
- Designing sequential logic circuits

Upon successful completion of the course, the student will be able to:

- CO1. Design and conduct experiments.
- CO2. Analyze and present experimental results.
- CO3. Exhibit professional behavior

LIST OF EXPERIMENTS

PART-A

ANALOG ELECTRONICS

1. Characteristics of PN Junction diode and Zener diode
2. Characteristics of single-phase half-wave and full-wave rectifiers with inductive and capacitive filters
3. Design a voltage regulator using a Zener diode
4. Characteristics of NPN transistor under common emitter and common base configurations
5. Characteristics of JFET and draw the equivalent circuit
6. Design and frequency response characteristics of a common emitter amplifier
7. Design and analysis of a differential amplifier using FET
8. Design and Analysis of a single-tuned amplifier
9. Design and testing of RC phase shift oscillator

PART-B

DIGITAL ELECTRONICS

1. Realization of logic gates using discrete components and universal gates.
2. Implementation of a given boolean function using logic gates in both SOP and POS forms.
3. Design and verify operation of half adder and full adder
4. Verification of flip-flops using logic gates.
5. Design of binary to gray and gray to binary converters.
6. Implementation of 4-bit parallel adder using7483 IC.
7. Design of BCD-7 segment display driver.
8. Design of synchronous counter using flip flops and IC 74163.
9. Design of asynchronous counters using flip flops and IC 74163.

(A minimum of 5 experiments should be conducted from each Part A & B for the Laboratory Course)