KAMARAJ
COLLEGE OF ENGINEERING & TECHNOLOGY
(An Autonomous Institution - AFFILIATED TO ANNA UNIVERSITY, CHENNAI)
S.P.G.Chidambara Nadar - C.Nagammal Campus
S.P.G.C. Nagar, K.Vellakulam – 625 701 (Near VIRUDHUNAGAR).

# B.E. ELECTRCIAL AND ELECTRONICS ENGINEERING

## REGULATIONS – 2021

## AUTONOMOUS SYLLABUS

## CHOICE BASED CREDIT SYSTEM

## III TO IV SEMESTER CURRICULUM AND SYLLABI

**VISION:**

To make the Department of Electrical and Electronics Engineering of this Institution the unique of its kind in the field of Research and Development activities in this part of the world.

**MISSION:**

Department of Electrical and Electronics Engineering is committed to impart highly innovative and technical knowledge in the field of Electrical and Electronics Engineering to the urban and unreachable rural student folks through Total Quality Education

**PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):**

**PEO 1:** **Technical Knowledge:** To provide basic knowledge in Physics, Chemistry, Mathematics and necessary foundation in various concepts of Electrical and Electronics Engineering

**PEO 2:** **Problem Solving:** To impart training to enable the students to envisage the real time problems related to the field of Electrical and Electronics Engineering and allied areas faced by the Industries so as to model, analyze and provide appropriate solutions.

**PEO 3:** **Personality Development:** To provide an academic environment for the students to develop team spirit, leadership qualities, communication skills and soft skills.

**PEO 4:** **Life Long Learning:** To motivate students to prepare for competitive examinations enabling them to pursue higher studies, thereby, promoting Research and Development activities.

**PROGRAM OUTCOMES:**

After going through the four years of study, the Electrical and Electronics Engineering graduates will have the ability to

| POs | Graduate Attribute | Programme Outcome |
|---|---|---|
| 1 | Engineering knowledge | Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems. |
| 2 | 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. |
| 3 | 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. |
| 4 | 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 |
| 5 | 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 |
| 6 | 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 |

| POs | Graduate Attribute | Programme Outcome |
|---|---|---|
| 7 | 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. |
| 8 | Ethics | Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice. |
| 9 | Individual and team work | Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings. |
| 10 | 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. |
| 11 | 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. |
| 12 | Life-long learning | Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change. |

**PROGRAMME SPECIFIC OUTCOMES (PSOs):**

**PSO1 :** Ability to design and solve engineering problems by applying the fundamental knowledge of Engineering Mathematics, Basic Sciences, Electrical and Electronics Engineering.

**PSO2 :** Ability to understand the recent technological developments in Electrical & Electronics Engineering and develop products / software to cater the Societal & Industrial needs.

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**REGULATIONS - 2021**

**CHOICE BASED CREDIT SYSTEM**

**B.E. ELECTRICAL AND ELECTRONICS ENGINEERING**

**CURRICULUM AND SYLLABI FOR SEMESTER III TO IV**

**SEMESTER III**

| S.NO. | COURSE CODE | COURSE TITLE | CATE GORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | | |
| 1 | MA2202 | Transforms and Numerical solution of equations | BS | 4 | 3 | 1 | 0 | 4 |
| 2 | EE2202 | Circuit Theory | PC | 4 | 3 | 1 | 0 | 4 |
| 3 | EE2203 | Electronic Devices and Circuits | ES | 3 | 3 | 0 | 0 | 3 |
| 4 | EE2204 | Measurements and Instrumentation | PC | 3 | 3 | 0 | 0 | 3 |
| 5 | EE2205 | Transmission and Distribution | PC | 3 | 3 | 0 | 0 | 3 |
| 6 | GE2201 | Design Thinking | ES | 3 | 3 | 0 | 0 | 3 |
| 7 | | Audit Course | AU | 3 | 3 | 0 | 0 | 0 |
| **PRACTICALS** | | | | | | | | |
| 8 | EE2206 | Electric Circuits Laboratory | PC | 4 | 0 | 0 | 4 | 2 |
| 9 | EE2207 | Electronic Devices and Circuits Laboratory | ES | 4 | 0 | 0 | 4 | 2 |
| 10 | EM2201 | Practical Course on Electronic Product Development | EM | 2 | 0 | 0 | 2 | 1 |
| | | | **TOTAL** | **33** | **21** | **2** | **10** | **25** |

**SEMESTER IV**

| S.NO. | COURSE CODE | COURSE TITLE | CATE GORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | | |
| 1 | EE2251 | Control Systems | PC | 3 | 3 | 0 | 0 | 3 |
| 2 | EE2252 | DC Machines and Transformers | PC | 3 | 3 | 0 | 0 | 3 |
| 3 | EE2253 | Digital Logic Circuits | PC | 3 | 3 | 0 | 0 | 3 |
| 4 | EE2254 | Linear Integrated Circuits and Applications | PC | 3 | 3 | 0 | 0 | 3 |
| 5 | EE2255 | Power System Analysis | PC | 3 | 3 | 0 | 0 | 3 |
| 6 | GE2251 | Quantitative Aptitude | EM | 1 | 1 | 0 | 0 | 1 |
| 7 | AUD110 | Tamils and Technology | AU | 1 | 1 | 0 | 0 | 0 |
| **PRACTICALS** | | | | | | | | |
| 8 | EE2256 | Control and Instrumentation Laboratory | PC | 4 | 0 | 0 | 4 | 2 |
| 9 | EE2257 | DC Machines and Transformers Laboratory | PC | 4 | 0 | 0 | 4 | 2 |
| 10 | EE2258 | Linear and Digital Integrated Circuits Laboratory | PC | 4 | 0 | 0 | 4 | 2 |
| | | | **TOTAL** | **29** | **17** | **0** | **12** | **22** |

| Course Code | Course Name | L | T | P | C |
|---|---|---|---|---|---|
| MA2202 | TRANSFORMS AND NUMERICAL SOLUTION OF EQUATIONS | 3 | 1 | 0 | 4 |

**Category:** Foundation Courses (Basic Science Courses)

**a. Preamble**

Fourier analysis allows modelling periodic phenomena which appears frequently in engineering, alternating electric currents or the motion of planets. The idea of Fourier analysis is to represent complicated functions in terms of simple periodic functions, namely cosines and sines. This course aims to developing the ability to formulate an engineering problem in a mathematical form by appropriate numerical approach.

**b. Course Outcomes**

After successful completion of the course, the students will be able to

| CO. No. | Course Outcome | Knowledge Level |
|---|---|---|
| CO1 | Construct the Fourier series for periodic functions and for function with discrete data. | K3 |
| CO2 | Classify and solve the initial and boundary value problems such as wave and heat flow equation. | K3 |
| CO3 | Compute the Fourier transforms of standard functions and learn its properties. | K3 |
| CO4 | Apply the techniques of Z - transform to get the solutions of difference equations. | K3 |
| CO5 | Compute numerical solution of algebraic, transcendental equations and system of linear equations. | K3 |

**c. Course Syllabus** **Total: 60 Periods**

**FOURIER SERIES** **12**

Dirichlet's conditions – General Fourier series – Odd and even functions – Half-range sine and cosine series – Complex form of Fourier series – Parseval's identity – Harmonic Analysis.

**APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS** **12**

Classification of partial differential equations - Method of separation of variables - Solutions of one-dimensional wave equation and one-dimensional heat equation - Steady state solution of two-dimensional heat equation - Fourier series solutions in cartesian coordinates.

**FOURIER TRANSFORM** **12**

Fourier integral theorem - Fourier transform pair - Sine and cosine transforms - Properties - Transform of elementary functions - Convolution theorem - Parseval's identity.

**Z-TRANSFORM** **12**

Z-transform – Elementary properties - Initial and final value theorems - Inverse Z–transform - Convolution theorem - Formation of difference equation - Solution of difference equation using Z - transform.

**NUMERICAL SOLUTION OF EQUATIONS** **12**

Solution of Algebraic and Transcendental equations: Bisection Method - Fixed point iteration method - Newton Raphson method – Solution of linear system of equations: Gauss elimination method - pivoting - Gauss Jordan method – Iterative methods: Gauss Jacobi - Gauss Seidel.

**d. Activities:** Students shall be exposed to MATLAB programming to find the Fourier transform of the given functions.

**e. Learning Resources**

**i. TEXT BOOKS**


1. Erwin Kreyszig, *Advanced Engineering Mathematics*, John Wiley & Sons, Tenth Edition, New Delhi, 2015.
2. Grewal, B. S, *Higher Engineering Mathematics*, Khanna Publishers, Forty Fourth Edition, New Delhi, 2017.
3. Sastry, S. S, *Introductory Methods of Numerical Analysis*, PHI Learning, Fifth Edition, 2015.


**ii. REFERENCE BOOKS**


1. Bali, N, Goyal, M, & Watkins, C, *Advanced Engineering Mathematics*, Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.), Seventh Edition, New Delhi, 2009.
2. Peter, V, O'Neil, *Advanced Engineering Mathematics*, Cengage Learning India Pvt., Ltd., Seventh Edition, New Delhi, 2012.
3. Ramana, B.V, *Higher Engineering Mathematics*, Tata McGraw Hill Co. Ltd., New Delhi, Eleventh Reprint, 2010.

| Course Code | Course Name | L | T | P | C |
|---|---|---|---|---|---|
| EE2202 | CIRCUIT THEORY | 3 | 1 | 0 | 4 |

**Category: Professional Core**

**a. Preamble**

This course introduces the basic law related to electrical circuits and various parameters, such as resistance, capacitance, inductance and impedance. It also introduces the hybrid parameters which are useful for the analysis of electronic devices and transmission lines.

**b. Course Outcome**

After successful completion of the course, the students will be able to

| CO. No. | Course Outcome | Knowledge Level |
|---|---|---|
| CO1 | Solve the given DC electric circuit using basic electrical laws / Network theorems. | K3 |
| CO2 | Solve the given AC electric circuit using basic electrical laws / Network theorems. | K3 |
| CO3 | To Determine the frequency response characteristics of resonance circuits & explain the operation of coupled circuits. | K3 |
| CO4 | To Determine the various electrical parameters in three-phase AC circuits under balanced/unbalanced conditions. | K3 |
| CO5 | To Obtain the transient response of RL, RC & RLC circuits using Laplace Transform for both AC and DC inputs | K3 |

**c. Course Syllabus** **Total: 60 Periods**

**BASIC CIRCUITS ANALYSIS - DC** **12**

Ohm's Law , Kirchoff's laws – KVL,KCL, voltage and current division Law, Resistive elements - series and parallel circuits - Mesh current and node voltage - methods of analysis, Network reduction:, source transformation - star delta conversion, Thevenin's and Norton Theorems – Superposition Theorem - Maximum power transfer theorem

**BASIC CIRCUITS ANALYSIS - AC** **12**

Introduction to AC - sine wave, phase relations in R, L and C circuits, complex impedance series and parallel combination of RLC elements. Steady state AC analysis - Mesh, Nodal, Superposition Theorem, star delta conversion, Thevenin's and Norton Theorems -

Maximum power transfer theorem

**RESONANCE AND COUPLED CIRCUITS** **12**

Series and parallel resonance – their frequency response - Quality factor, selectivity and Bandwidth – Self and mutual inductance – Coefficient of coupling – Tuned circuits - Single tuned circuits.

**THREE PHASE CIRCUITS** **12**

A.C. circuit Parameters - Phasor Diagram – Power, Power Factor and Energy- Analysis - three phase 3-wire and 4-wire circuits with star and delta connected loads, balanced & un balanced – phasor diagram of voltages and currents – power measurement in three phase circuits.

**TRANSIENT RESPONSE ANALYSIS** **12**

Transient response of RL, RC and RLC Circuits using Laplace transform for DC input and A.C. sinusoidal input.

**d. Activities**

Students shall be trained to identify and test the various electrical and electronics component used in electrical and electronics circuits and trained to measure the various parameters using appropriate meters, in the field of Electrical Engineering.

**e. Learning Resources**

**i. TEXT BOOKS**


1. Sudhakar A and Shyam Mohan SP, *Circuits and Network Analysis and Synthesis*, McGraw Hill, 2015.
2. William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, *Engineering Circuits and Analysis*, McGraw Hill publishers, edition, New Delhi, 2013.
3. Charles K. Alexander, Mathew N.O. Sadiku, *Fundamentals of Electric Circuits*, Second Edition, McGraw Hill, 2013.


**ii. REFERENCE BOOKS**


1. Paranjothi, S.R., 2010. *Electric circuit analysis,* New Age Science.
2. Nahvi, M. and Edminister, J.A., 2018. *Schaum's outline of Electric Circuits,* McGraw-Hill Education.
3. Kuo, F., 2006. *Network analysis and synthesis*, John Wiley & Sons.

| Course Code | Course Name | L | T | P | C |
|---|---|---|---|---|---|
| EE2203 | ELECTRONIC DEVICES AND CIRCUITS | 3 | 0 | 0 | 3 |

**Category: Professional Core**

**a. Preamble**

This course introduces the various semiconductor devices, signal and power amplifiers, and oscillators.

**b. Course Outcome**

After successful completion of the course, the students will be able to

| CO. No. | Course Outcome | Knowledge Level |
|---|---|---|
| CO1 | Explain the Structure, operation, characteristics and applications of PN junction diode and special diodes. | K2 |
| CO2 | Describe the structure and characteristics of various types of transistors and Thyristors. | K3 |
| CO3 | Analyze the operation of simple amplifier circuits in CB, CC, CE, CS and CD configurations. | K3 |
| CO4 | Elucidate the operation of various configurations of multistage and feedback amplifiers. | K3 |
| CO5 | Comprehend the operation of various amplifiers and oscillators circuits. | K3 |

**c. Course Syllabus** **Total: 45 Periods**

**SEMICONDUCTOR DIODES AND ITS APPLICATIONS** **9**

PN junction diode –Structure, operation and V-I characteristics, diffusion and transition capacitance - applications of PN diode –Switch, clipper, clamper & Rectifier– Zener Diode-Characteristics–as a voltage regulator-Introduction to special diodes:Schottky diode, Varactor diode, Tunnel diode.

**BJT AND POWER ELECTRONIC DEVICES** **9**

Different currents and their relations in BJT- CE, CB and CC configuration- Biasing- Fixed bias- Collector to Base bias and Voltage divider Bias- JFET & MOSFET Characteristics - Thyristors: Characteristics and applications of SCR, DIAC and TRIAC. UJT characteristics and application as relaxation oscillator.

**AMPLIFIERS** **9**

Equivalent hybrid model for BJT-BJT small signal model (exact and approximate) – Mid - band Analysis of CE, CB, CC amplifiers - Gain and frequency response - Design of single stage RC coupled amplifier using BJT - Small signal analysis CS and CD configuration of FET amplifier.

**MULTISTAGE AND FEEDBACK AMPLIFIER** **9**

Multistage amplifier: Coupling schemes for cascading amplifier, General analysis of N-stage cascaded amplifier, Darlington pair, Cascade and Bootstrap amplifiers. Feedback amplifier: Advantages of negative feedback, Mixing and Sampling networks - Types and effects, Voltage-Series, Voltage-Shunt, Current-Series and Current-Shunt amplifier circuits. Introduction to Tuned Amplifiers

**OSCILLATORS AND POWER AMPLIFIERS** **9**

Oscillators: Classification, Condition for oscillation - RC oscillators: RC phase shift and Wien Bridge oscillators - Resonant frequency oscillators: Hartley, Colpitts and crystal oscillators. Power amplifiers: Class A, Class B and Class AB amplifiers, Efficiency - Distortion in power amplifiers.

**d. Activities**

Students shall be exposed to do the projects using the electronic components.

**e. Learning Resources**

**i. TEXT BOOKS**


1. Millman, J., 1979. *Microelectronics McGraw-Hill*. New York, p.5.
2. Bell, D.A., 2009. *Fundamentals of electronic devices and circuits*. Oxford University Press, Inc.


**ii. REFERENCE BOOKS**


1. Sedra, A.S. and Smith, K.C., 2015. *Microelectronic circuits* seventh edition..
2. Kumar, B. & Jain, S.B., 2007. *Electronic devices and circuits.* PHI Learning Pvt. Ltd
3. Floyd, T.L. and Buchla, D.M., 2004. *Electric circuits fundamentals*. Pearson/Prentice Hall.
4. Neamen, D.A., 2001. *Electronic circuit analysis and design (Vol. 2).* New York, NY.: McGraw-Hill.
5. Boylestad, R.L., 2009. *Electronic devices and circuit theory*. Pearson Education India

| Course Code | Course Name | L | T | P | C |
|---|---|---|---|---|---|
| EE2204 | MEASUREMENTS AND INSTRUMENTATION | 3 | 0 | 0 | 3 |

**Category: Professional Core**

**a. Preamble**

This course introduces the concepts related to the basic functional elements of a Measurement & Instrumentation System, working fundamentals of Electrical and Electronic Instruments used for measuring Electrical Quantities & Magnetic Parameters, basic Transducers & the Data Acquisition Systems, basic Comparative methods available for the measurement of Resistance, Inductance & Capacitance.

**b. Course Outcome**

After successful completion of the course, the students will be able to

| CO. No. | Course Outcome | Knowledge Level |
|---|---|---|
| CO1 | Calibrate the parameter of a measuring instruments and interpret the measurement data | K3 |
| CO2 | Measure the Electrical Parameters using appropriate Electrical measuring Instruments | K2 |
| CO3 | Choose a specific Electronic Instrument based on needs and Measure Magnetic parameters | K3 |
| CO4 | Apply comparative methods for measurement of resistance, inductance and capacitance | K3 |
| CO5 | Select a transducer for measuring electrical and non-electrical quantities. | K2 |

**c. Course Syllabus** **Total: 45 Periods**

**INTRODUCTION** **9**

Functional elements of a generalized instrument - Static and dynamic characteristics - Errors in measurement - Statistical estimation of measurements data: Arithmetic mean, Average deviation, Standard deviation, Variance and Probable error of mean - Standards and calibration

**ELECTRICAL MEASURING INSTRUMENTS** **9**

Analog ammeters and voltmeters - Moving Iron & Moving Coil Instruments - Torque Equation, Range extension of ammeters and voltmeters - Electrodynamometer Meters - Multi

meters - Single phase and three phase Watt meters and Energy meters - Instrument transformers

**MAGNETIC MEASUREMENT & ELECTRONIC INSTRUMENTS 9**

Magnetic measurements – Determination of B-H curve and measurements of iron loss. Magnetic disk – Recorders, digital plotters and printers, CRT display, digital CRO, LED, LCD & Dot matrix display – Data Loggers.

**COMPARATIVE METHODS OF MEASUREMENTS 9**

D.C potentiometers, D.C (Wheat stone, Kelvin and Kelvin Double bridge) & A.C bridges (Maxwell, Anderson and Schering bridges), transformer ratio bridges, self-balancing bridges. Interference & screening – Multiple earth and earth loops - Electrostatic and electromagnetic Interference – Grounding techniques.

**TRANSDUCERS AND DATA ACQUISITION SYSTEMS 9**

Classification of transducers - Selection of transducers – Resistive, capacitive & inductive Transducers - Piezoelectric, Hall effect, optical and digital transducers - Elements of data acquisition system - Smart sensors-Thermal Imagers.

**d. Activities**

Students shall be exposed to the functioning of various types of Measurement Systems available for measurement of Electrical and Electronic Quantities in an Industry

**e. Learning Resources**

**i. TEXT BOOK**

1. Sawhney, A.K. and Sawhney, P., 2016. *A course in Electrical and Electronic Measurements and Instrumentation.* Dhanpat Rai & Company

**ii. REFERENCE BOOKS**

1. Doebelin, E.O. and Manik, D.N., 2007. *Measurement systems: Application and Design.*
2. Gupta, B.J., 2008. *A Course in Electronics & Electrical Measurements and Instrumentation.* SK Kataria and Sons.
3. Purkait, P., 2013. *Electrical and Electronics Measurements and Instrumentation.* McGraw- Hill Education.

| Course Code | Course Name | L | T | P | C |
|---|---|---|---|---|---|
| EE2205 | TRANSMISSION AND DISTRIBUTION | 3 | 0 | 0 | 3 |

**Category: Professional Core**

**a. Preamble**

This course introduces the concepts related to basic structure of electric power systems, various parameters, modelling, performance and mechanical design aspects of the overhead transmission lines (OHL), the construction and characteristics of underground cable transmission system, different configuration and the challenges in the distribution systems.

**b. Course Outcome**

After successful completion of the course, the students will be able to

| CO. No. | Course Outcome | Knowledge Level |
|---|---|---|
| CO1 | Explain structure of electric power system & determine the transmission line parameters for various conductor configurations. | K2 |
| CO2 | Analyze the performance of different types of transmission lines using suitable model. | K3 |
| CO3 | Describe mechanical design of overhead transmission lines and insulators. | K3 |
| CO4 | Explain construction of UG cables and determine the capacitance of difficult types of cables. | K2 |
| CO5 | Outline AC / DC distribution systems, types of substations and various method of voltage control. | K2 |

**Total: 45 Periods**

**c. Course Syllabus**

**TRANSMISSION LINE PARAMETERS** **9**

Structure of Power System - Parameters of single and three-phase transmission lines with single and double circuits -Resistance, inductance and capacitance of solid, stranded and bundled conductors, Symmetrical and unsymmetrical spacing and transposition - application of self and mutual GMD; skin and proximity effects -Typical configurations, conductor types and electrical parameters of EHV lines - Case study - Commissioned Transmission lines in India.

**MODELLING AND PERFORMANCE OF TRANSMISSION LINES** **9**

Performance of Transmission lines - short line, medium line and long line - equivalent circuits, phasor diagram, attenuation constant, phase constant, surge impedance - transmission efficiency and voltage regulation - Formation of Corona - Critical Voltages - Effect on Line Performance.

**MECHANICAL DESIGN OF LINES** **9**

Mechanical design of OH lines – Line Supports –Types of towers – Stress and Sag Calculation – Effects of Wind and Ice loading. Insulators: Types, voltage distribution in insulator string, improvement of string efficiency, testing of insulators.

**UNDER GROUND CABLES** **9**

Underground cables - Types of cables – Construction of single core and 3 core cables - Insulation Resistance – Potential Gradient - Capacitance of Single-core and 3 core cables - Grading of cables - Power factor and heating of cables.

**DISTRIBUTION SYSTEMS** **9**

Distribution Systems – General Aspects – Kelvin's Law - AC distributions: Power factors referred to receiving end voltage - Power factors referred to respective load voltages - DC distributions: Distributor fed at one end - Distributor fed at both ends - Distributor fed at the centre - Ring distributor. - Techniques of Voltage Control: Excitation control - tap changing transformers - Power factor improvement: Static capacitors - Phase advancers. - Types of Substations - Case study - Commissioned substations of various voltage levels in Tamil Nadu.

**d. Activities**

Students shall be exposed to the different components of transmission system and distribution system in the college premises.

**e. Learning Resources**

**i. TEXT BOOKS**

1. Mehta, V.K. and Mehta, R., 2011. *Principles of power systems*, S. Chand, New Delhi, India.
2. Wadhwa, C.L., 2006. *Electrical power systems*. New Age International.

**ii. REFERENCE BOOKS**

1. Singh, S.N., 2008. *Electric power generation: transmission and distribution*. PHI Learning Pvt. Ltd.

2. Faulkenberry, L.M., 1996. *Electrical power distribution and transmission*. Pearson Education India.
3. Ingole, A., 2017. *Power transmission and distribution*. Pearson Education India.
4. Bayliss, C.R., Bayliss, C. and Hardy, B., 2012. *Transmission and distribution electrical engineering*. Elsevier.
5. Ramamurthy, G., 2004. *Handbook of electrical power distribution*. Universities Press.
6. Gupta, B.R. and Chand, S., 2008. *Power system analysis and design*. New Delhi.

| Course Code | Course Name | L | T | P | C |
|---|---|---|---|---|---|
| GE2201 | DESIGN THINKING | 3 | 0 | 0 | 3 |

**Category: Employability Enhancement Course**

**a. Preamble:**

This course introduces the various principles of design thinking to achieve an effective design and to examine the implementation of the model or process for its successful operation.

**b. Course Outcomes**

After successful completion of the course, students will be able to

| CO.No | Course Outcome | Knowledge Level |
|---|---|---|
| CO1 | Describe the basic principles of design and various stages of design thinking for better conceiving of idea and refinement | K2 |
| CO2 | Elucidate the concepts of idea generation and refinement | K3 |
| CO3 | Apply various prototype models for solving complex problems | K3 |
| CO4 | Analyze real-time problems for effective design, implementation and operation | K3 |
| CO5 | Device idea/solution towards development of a prototype for a chosen problem of interest | K4 |

**c. Course Syllabus** **Total: 45 Periods**

**INTRODUCTION TO DESIGN THINKING** **9**

Introduction - Product life cycle – Design Ethics – Design Process – Stages in design thinking: Immersion, Analysis and synthesis, Ideation, Prototyping.

**IDEA GENERATION AND REFINEMENT** **9**

Basic design - directions - Themes of thinking - Inspiration and references - Brainstorming - Value - Inclusion – Sketching - Presenting ideas - Thinking in images - Thinking in signs - Appropriation - Personification - Visual metaphors - Modification - Thinking in words – Words and language - Thinking in shapes - Thinking in proportions - Thinking in color - Outside the Box.

**PROTOTYPING** **9**

Developing designs - Types of prototype - Prototyping for Designing Complex Systems – The Efficacy of Prototyping under Time Constraints.

**IMPLEMENTATION** **9**

Format - Materials - Finishing - Media - Scale - Series/Continuity - Emerging Landscapes of Design - Real-Time Design Interaction Capture and Analysis - Enabling Efficient Collaboration in Digital Design - Spaces Across Time and Distance - Software used in Developing in Virtual Environments.

**DESIGN THINKING IN VARIOUS SECTORS** **9**

Design & Development of Prototypes for Wall Plastering, Rubber shredding, Separation of Corn seeds, Electric vehicles, Smart gates, Burglar alarm, Tyre pressure monitor, Development of Online Voting System, Online Proctoring System, Online Health Monitoring System, IoT based Home Automation and any other problem of interest in your domain.

**d. Learning Resources**

**i. TEXT BOOKS:**


1. Binder, T., De Michelis, G., Ehn, P., Jacucci, G., Linde, P., and Wagner, I., 2011. *Design things*, MIT press
2. Ambrose, G., and Harris, P., 2009. *Basics Design: Design thinking*, Bloomsbury Publishing


**ii. REFERENCE BOOKS:**


1. Meinel, C., and Leifer, L. (Eds.)., 2011. *Understanding Innovation*, Springer.
2. Plattner, H., Meinel, C., and Leifer, L. (Eds.)., 2010. *Design thinking: understand – improve–apply*, Springer Science & Business Media
3. Moran, T. P., and Carroll, J. M., 1996. *Design Rationale: Concepts, Techniques, and Use*, L. Erlbaum Associates Inc.
4. Cross, N., 1984. *Developments in Design Methodology*, Chichester: Wiley.


**WEB RESOURCES**:

1. https://www.designsociety.org/download-publication/39626/Design+prototyping+of+systems
2. https://www.interaction-design.org/literature/article/5-stages-in-the-design-thinking-process

**VIDEO LECTURES: (NPTEL OR ANY OTHER VIDEO LECTURES)**

https://nptel.ac.in/courses/110/106/110106124/#

| Course Code | Course Name | L | T | P | C |
|---|---|---|---|---|---|
| EE2206 | ELECTRIC CIRCUITS LABORATORY | 0 | 0 | 4 | 2 |

**Category: Foundation Course (Engineering Science)**

**a. Preamble**

This course introduces the experiments related to basic electrical circuit laws, theorems, three phase power and networks.

**b. Course Outcome**

After successful completion of the course, the students will be able to

| CO. No. | Course Outcome | Knowledge Level |
|---|---|---|
| CO1 | Apply basic electrical laws for solution of simple DC & AC circuits. | K3 |
| CO2 | Apply network theorems for solution of simple DC & AC circuits. | K3 |
| CO3 | Determine transient response and frequency response of given AC circuits | K3 |
| CO4 | Determine network parameters of the given of two port network. | K3 |
| CO5 | Simulate three phase balanced / unbalanced star / delta network | K3 |

**Total: 60 Periods**

**c. Course Syllabus**

1. Simulation and experimental verification of Kirchhoff's voltage and current laws for the given DC circuit.
2. Simulation and experimental verification of Thevenin and Norton's theorem for the given DC & AC circuits.
3. Simulation and experimental verification of Superposition theorem for the given DC circuit.
4. Simulation and experimental verification of Maximum Power transfer Theorem for the given DC circuit.
5. Study of oscilloscopes and measurement of sinusoidal voltage, frequency and power factor using CRO.
6. Simulation and Experimental validation of frequency response of RLC electric circuit.

7. Measurement of self and mutual inductance of a coil and study of magnetically coupled coils.
8. Simulation and Experimental validation of transient behavior of R-C circuit under DC input.
9. Determination of Z and Y parameters of two-port networks.
10. Analysis of three-phase balanced and unbalanced Star/Delta network.
11. Measurement of 3-Phase Power by two wattmeter method under balanced & unbalanced load conditions.

**d. Activities**

Students shall be exposed to the basic electric engineering projects.

**e. Learning Resources**

**i. REFERENCE BOOK**

1. Sudhakar A and Shyam Mohan SP, *Circuits and Network Analysis and Synthesis*, McGraw Hill, 2015.

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:**

| S. No. | Description of Equipment | Quantity Required |
|---|---|---|
| 1 | Regulated Power Supply: 0 – 15 V D.C | 10 Nos. |
| 2 | Function Generator (1 MHz) | 10 Nos. |
| 3 | Single Phase Energy Meter | 1 No. |
| 4 | Oscilloscope (20 MHz) | 10 Nos. |
| 5 | Digital Storage Oscilloscope (20 MHz) | 1 No. |
| 6 | Storage Oscilloscope | 1 No. |
| 7 | PC with Circuit Simulation Software ( e-Sim / Scilab/ Pspice / MATLAB /other Equivalent software Package) (min 10 Users) | 10 No. |
| 8 | Printer | 1 No |
| 9 | AC/DC - Voltmeters , Ammeters, Multimeters | 10 Nos each |
| 10 | Single Phase Wattmeter | 3 Nos. |

| | | |
|---|---|---|
| 11 | Decade Resistance Box, Decade Inductance Box, Decade Capacitance Box | 6 Nos. each |
| 12 | Circuit Connection Boards | 10 Nos. |
| 13 | Resistors, Inductors, Capacitors of various capacities (Quarter Watt to 10 Watt) | Adequate |

| Course Code | Course Name | L | T | P | C |
|---|---|---|---|---|---|
| EE2207 | ELECTRONIC DEVICES AND CIRCUITS LABORATORY | 0 | 0 | 4 | 2 |

**Category: Foundation Course (Engineering Science)**

**a. Preamble**

This course introduces the basic characteristics rated to various electronic circuits, such as PN junction diode, BJT, JFET & UJT. It also introduces the hybrid parameters which are useful for the analysis of electronic devices

**b. Course Outcome**

After successful completion of the course, the students will be able to

| CO. No. | Course Outcome | Knowledge Level |
|---|---|---|
| CO1 | To obtain the characteristics of various semiconductor devices such as PN junction diode and Zener diode | K3 |
| CO2 | To obtain the characteristics of various semiconductor BJT, JFET & UJT. | K3 |
| CO3 | To design rectifiers and voltage regulators for simple applications. | K3 |
| CO4 | To demonstrate working of amplifier using BJT/FET | K3 |
| CO5 | To demonstrate working of differential amplifier and oscillator. | K3 |

**c. Course Syllabus** **Total: 60 Periods**

1. Characteristics of PN junction diode.
2. Characteristics of a NPN Transistor under common emitter configuration
3. Characteristics of JFET.
4. Characteristics of UJT and generation of saw tooth waveforms.
5. Frequency response characteristics of a Common Emitter amplifier.
6. Characteristics of photo diode & photo transistor.
7. Design and testing of RC phase shift oscillator.
8. Single Phase half-wave and full wave rectifiers with inductive and capacitive filters.
9. Differential amplifiers using FET.
10. Study of CRO for frequency and phase measurements.

**d. Activities**

Students shall be exposed to the basic electric engineering projects.

**e. Learning Resources**

**i. REFERENCE BOOKS**

1. Bell, D.A., 2009. *Fundamentals of electronic devices and circuits*. Oxford University Press, Inc

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:**

| S. No. | Description of Equipment | Quantity Required |
|---|---|---|
| 1 | Semiconducter devices like Diode, Zener Diode, NPN Transistors, JFET, UJT, Photo diode, Photo Transistor | 15 each |
| 2 | Resistors, Capacitors and inductors | 15 each |
| 3 | Necessary digital IC 8 | 15 each |
| 4 | Function Generators | 10 |
| 5 | Regulated 3 output Power Supply 5, ± 15V | 10 |
| 6 | Storage Oscilloscope | 1 |
| 7 | CRO | 10 |
| 8 | Bread boards | 10 |

| Course Code | Course Name | L | T | P | C |
|---|---|---|---|---|---|
| EM2201 | PRACTICAL COURSE ON ELECTRONIC PRODUCT DEVELOPMENT | 0 | 0 | 2 | 1 |

**Category: Emplayability Enhancement Course**

**a. Preamble**

All the electrical and electronics engineers should have knowledge in PCB Design, Layout and printing. This course will give practical exposer to the students in the operation of PCB Machine, Arduino Controller & Various Sensors.

**b. Course Outcome**

After successful completion of the course, the students will be able to

| CO. No. | Course Outcome | Knowledge Level |
|---|---|---|
| CO1 | Understand and develop the basic PCB design | K3 |
| CO2 | Develop basic PCB design in the PCB Board by using manual and using PCB machine. | K3 |
| CO3 | Model and analyze Arduino Controller and their application to Real time | K3 |
| CO4 | Implement the simple applications using Sensors. | K3 |
| CO5 | Implement simple applications for controlling PWM pulses | K3 |

**c. Course Syllabus** **Total: 30 Periods**

Design and Development of:

1. PCB Board for 5V DC Power Supply - using Manual method
2. PCB Board for 5V DC Power Supply - using PCB Machine
3. Product for water level indication
4. Product for protect the motor/electrical equipment
5. 12V DC – 12V AC Square Wave Inverter
6. 12V DC Step Down DC Chopper

**d. Activities**

Students will develop electronic products.

## e. Learning Resources

### i. REFERENCE BOOKS


1. Archambeault, B.R. and Drewniak, J., 2013. *PCB design for real-world EMI control* (Vol. 696). Springer Science & Business Media.
2. Norris, D., 2015. *The Internet of things: do-it-yourself projects with Arduino, Raspberry Pi, and BeagleBone Black*. McGraw-Hill Education TAB.
3. Fraden, J. and Fraden, J., 2004. *Handbook of modern sensors: physics, designs, and applications* (Vol. 3). New York, NY, USA: springer.

| Course Code | Course Name | L | T | P | C |
|---|---|---|---|---|---|
| EE2251 | CONTROL SYSTEMS | 3 | 0 | 0 | 3 |

**Category: Professional Core**

**a. Preamble**

After the completion of the course the student will be able to derive the Transfer function for simple systems, correlate between frequency domain and time domain specifications, design controllers to meet the desired specifications

**b. Course Outcome**

After successful completion of the course, the students will be able to

| CO. No. | Course Outcome | Knowledge Level |
|---|---|---|
| CO1 | Develop mathematical model for various physical systems and deduce the transfer functions | K3 |
| CO2 | Determine time-domain specifications of given linear system and discuss on effects of conventional controllers | K3 |
| CO3 | Obtain the frequency response analysis of given linear system using bode and polar plot. | K3 |
| CO4 | Determine the stability of control system using suitable methods and design compensator s for the given specifications. | K3 |
| CO5 | Develop state space model for a LTI system and obtains its solution. | K3 |

**c. Course Syllabus** **Total: 45 Periods**

**SYSTEMS AND REPRESENTATION** **9**

Basic elements in control systems: Open and closed loop systems – Mathematical Models – Differential Equations - Electrical analogy of mechanical and thermal systems – Transfer function – Block diagram reduction techniques – Signal flow graphs- Case Study: AC and DC servomotors

**TIME RESPONSE ANALYSIS** **9**

Time response: Time domain specifications – Standard Test Signals – Time domain analysis of I and II order system – Error coefficients – Generalized error series – Steady state error – Root locus construction- Effect of addition of poles and Zeros - Effects of P, PI, PID modes of

feedback control.

**FREQUENCY RESPONSE ANALYSIS** **9**

Frequency response: Bode plot – Polar plot – Determination of Gain & Phase Margin - Correlation between frequency domain and time domain specifications

**STABILITY AND COMPENSATOR DESIGN** **9**

Characteristic equation – Routh Hurwitz criterion – Nyquist stability criterion- Performance criteria –Design of Lag, Lead and Lag Lead compensator using bode plots.

**STATE VARIABLE ANALYSIS** **9**

Concepts of state variables – State models for linear and time invariant Systems (Controllable, Observable and Jordan Models) – Equivalence between transfer function and state variable representations - Solution of state and output equation – Concepts of controllability and observability

**d. Activities**

Students will be exposed to the Controllers and will be able to design their own basic controller for simple applications

**e. Learning Resources**

**i. TEXT BOOKS**


1. Salivahanan, S., Rengaraj, R. and Venkatakrishnan, G.R., 2018. *Control systems engineering*. Pearson.
2. Ogata, K. and Yang, Y., 2015. *Modern control engineering,* 5th Edition, India: Prentice hall.
3. Nagrath, I.J., 2018. *Control systems engineering*. New Age International, Sixth Edition


**ii. REFERENCE BOOKS**


1. Gopal, M., 2012. *Control systems: Principles and Design*. Tata McGraw-Hill Education.
2. Kuo, B.C., 2018. *Automatic control systems*. Wiley
3. Dorf, R.C. and Bishop, R.H., 2014. *Modern control systems*. Pearson.
4. Houpis, C.H. and Sheldon, S.N., 2013. *Linear Control System Analysis and Design with MATLAB®*. CRC Press.

| Course Code | Course Name | L | T | P | C |
|---|---|---|---|---|---|
| EE2252 | DC MACHINES AND TRANSFORMERS | 3 | 0 | 0 | 3 |

**Category: Professional Core**

**a. Preamble**

This course introduces the concepts related to the Magneto statics, Magnetic-circuit and electromechanical energy conversion principles. The course will also include the principle of operation, speed control and Testing of transformers and DC machines.

**b. Course Outcome**

After successful completion of the course, the students will be able to

| CO. No. | Course Outcome | Knowledge Level |
|---|---|---|
| CO1 | \Acquaint with the basic laws of magnetic-circuits and characteristics of magnetic materials | K2 |
| CO2 | Examine the principle of electromechanical energy conversion used in electrical machines | K2 |
| CO3 | Discuss the construction, working, testing of single-phase transformer and three-phase transformer connections | K3 |
| CO4 | Describe the working principle, types, characteristics, starting, speed control and testing of DC motors | K3 |
| CO5 | Elucidate the construction, working, types, and characteristics of DC generator | K3 |

**c. Course Syllabus** **Total: 45 Periods**

**MAGNETOSTATICS** **9**

Introduction Lorentz force, magnetic field intensity (H) – Biot – Savart's Law - Ampere's Circuit Law - Magnetic flux density (B) – B in free space, conductor, magnetic materials – Magnetization, Magnetic force, Torque Equation, Inductance, Energy density, Applications, Magnetic circuits Hysteresis and Eddy Current losses.

**ELECTROMECHANICAL ENERGY CONVERSION** **9**

Electromechanical energy conversion principles; Singly and multiply excited magnetic field systems - rotating mmf waves.

**TRANSFORMERS** **9**

Transformers - Construction – Principle of Operation – Equivalent Circuit Parameters-Losses. Testing of Transformers – Efficiency and Voltage Regulation- All Day Efficiency-Sumpner's Test. Auto Transformer – Three Phase Transformers - Connections – Scott Connection – Vector Groups – Parallel Operation - Applications of Transformers.

**DC MOTORS** **9**

Principle and Operations – Types – Characteristics of DC Motors - Starting and Speed control of DC Motors – Testing and Efficiency – Retardation Test - Swinburne's Test and Hopkinson's Test – Applications of DC Motor.

**DC GENERATORS** **9**

Construction of DC Machine - Principle of Operation - Lap and Wave Windings - EMF Equation– Equivalent Circuit Model - Armature Reaction - Commutation - Interpoles and Compensating Winding - Types - Characteristics of DC Generators- Applications of DC Generators.

**d. Activities**

Students shall be exposed to the different types of transformers and DC motors in the various department laboratories and in college premises.

**e. Learning Resources**

**i. TEXT BOOKS**


1. Nagrath, I.J. and Kothari.D.P., *Electric Machines*, McGraw-Hill Education, 2017
2. Gupta, J.B., 2020. *Theory&Performance of Electrical Machines*. SK Kataria&Sons.
3. Theraja, B.L. and Theraja, A.K., 2005. *A text Book of Electrical Technology vol 2 AC and DC machines*.


**ii. REFERENCE BOOKS**


1. Stephen J. Chapman, *Electric Machinery Fundamentals* 4th edition, McGraw Hill Education Pvt. Ltd, 2010
2. B.R. Gupta ,*Fundamental of Electric Machines* New age International Publishers, 3rd Edition, Reprint 2015
3. S.K. Bhattacharya, *Electrical Machines* McGraw - Hill Education, New Delhi, 3rd Edition, 2017
4. Fitzgerald. A.E., Charles Kingsely Jr, Stephen D.Umans, *Electric Machiner*, Sixth edition, McGraw Hill Books Company, 2017
5. P. S. Bimbhra, *Electric Machinery*, Khanna Publishers, 2nd Edition, 2021

| Course Code | Course Name | L | T | P | C |
|---|---|---|---|---|---|
| EE2253 | DIGITAL LOGIC CIRCUITS | 3 | 0 | 0 | 3 |

**Category: Professional Core**

**a. Preamble**

This course introduces the basic concepts related to digital circuits , design of different combinational circuits, and various synchronous and asynchronous circuits.

**b. Course Outcome**

After successful completion of the course, the students will be able to

| CO. No. | Course Outcome | Knowledge Level |
|---|---|---|
| CO1 | Explain various number systems and characteristics of digital logic families | K2 |
| CO2 | Apply minimization methods to simplify the given Boolean expressions and implementation of combinational circuit | K3 |
| CO3 | Design various synchronous sequential circuits using Flip Flops | K3 |
| CO4 | Explain asynchronous sequential logic circuits and Programmable Logic Devices. | K2 |
| CO5 | Apply VHDL for simulating and testing RTL, combinational and sequential circuits | K3 |

**c. Course Syllabus** **Total : 45 Periods**

**NUMBER SYSTEMS AND DIGITAL LOGIC FAMILIES** **9**

Number system, error detection, corrections & codes conversions, (Parity and Hamming code) - Digital Logic Families -comparison of RTL, DTL, TTL, ECL and MOS families - operation, characteristics of digital logic family.

**COMBINATIONAL CIRCUITS** **9**

Combinational logic - representation of logic functions-SOP and POS forms, K-map representations - minimization using K maps - simplification and implementation of combinational logic – multiplexers and de multiplexers - code converters, adders, subtractors, Encoders and Decoders.

**SYNCHRONOUS SEQUENTIAL CIRCUITS** **9**

Sequential logic- SR, JK, D and T flip flops - level triggering and edge triggering - counters - asynchronous and synchronous type - Modulo counters - Shift registers - design of synchronous sequential circuits – Moore and Mealy models- Counters, state diagram; state reduction; state assignment.

**ASYNCHRONOUS SEQUENTIAL CIRCUITS AND PROGRAMMABLE LOGIC DEVICES** **9**

Asynchronous sequential logic Circuits-Transition stability, flow stability-race conditions, hazards &errors in digital circuits; analysis of asynchronous sequential logic circuits. Introduction to Programmable Logic Devices: PROM – PLA –PAL, CPLD - FPGA.

**VHDL** **9**

RTL Design – combinational logic – Sequential circuit – Operators – Introduction to Packages – Subprograms – Test bench. (Simulation /Tutorial Examples: adders, flip flops, Multiplexers & De multiplexers).

**d. Activities**

Students shall be exposed to the different circuits using Digital ICs.

**e. Learning Resources**

**i. TEXT BOOKS**


1. Mano, M.M., 2017. *Digital logic and computer design*. Pearson Education India
2. Mandal, *Digital Electronics Principles & Application*, McGraw Hill Edu, 2013.


**ii. REFERENCE BOOKS**


1. Tocci R.J., Neal S. Widmer, *Digital Systems: Principles and Applications*, PearsonEducation Asia, 12th Edition, 2017.
2. Thomas L Floyd, *Digital fundamentals*, Pearson Education Limited, 11th Edition, 2018

| Course Code | Course Name | L | T | P | C |
|---|---|---|---|---|---|
| EE2254 | LINEAR INTEGRATED CIRCUITS AND APPLICATIONS | 3 | 0 | 0 | 3 |

**Category: Professional Core**

**a. Preamble**

This course introduces the basic concepts related to linear circuits , design of amplifier, summer, differentiator, integrator,using OP-AMPs, and applications of op-amp based instrumentation amplifier,waveform generators, A/D and D/A converters.

**b. Course Outcome**

After successful completion of the course, the students will be able to

| CO. No. | Course Outcome | Knowledge Level |
|---|---|---|
| CO1 | Explain monolithic IC fabrication process. | K2 |
| CO2 | Describe the characteristics and basic applications of Op-Amp. | K2 |
| CO3 | Design circuits using op-amp for various applications. | K3 |
| CO4 | Explain Functional blocks, characteristics and applications of Timer, PLL, analog multiplier ICs. | K2 |
| CO5 | Explain Functional blocks, characteristics and applications of Voltage regulator ICs. | K2 |

**c. Course Syllabus** **Total : 45 Periods**

**IC FABRICATION** **9**

IC classification, fundamental of monolithic IC technology, epitaxial growth, masking and etching, diffusion of impurities. Realization of monolithic ICs and packaging. Fabrication of diodes, capacitance, resistance, transistors and PV Cell.

**CHARACTERISTICS OF OP-AMP** **9**

Ideal OP-AMP characteristics, DC characteristics, AC characteristics, differential amplifier; frequency response of OP-AMP; Basic applications of op-amp - inverting amplifier and Non-Inverting Amplifiers, summer, differentiator and Integrator-V/I & I/V converters.

**APPLICATIONS OF OP-AMP** **9**

Instrumentation amplifier and its applications , Log and Antilog Amplifiers- Analog multiplier & Divider, first and second order active filters, comparators, multi vibrators, waveform generators, clippers, clampers, peak detector, S/H circuit, D/A converter (R- 2R

ladder and weighted resistor types), A/D converters using OP-AMPs.

**SPECIAL ICs** **9**

Functional block, characteristics of 555 Timer and its application as astable and monostable multivibrator - IC-566 voltage controlled oscillator, IC - 565-phase locked loop , AD633 Analog multiplier ICs.

**APPLICATION ICs** **9**

AD623 Instrumentation Amplifier and its application as load cell weight measurement - IC voltage regulators –LM78XX, LM79XX; Fixed voltage regulators its application as Linear power supply - LM317, 723 Variability voltage regulators, switching regulator- SMPS - ICL 8038 function generator IC.

**d. Activities**

Students shall be exposed to the different circuits using Linear ICs.

**e. Learning Resources**

**i. TEXT BOOK**

1. D. Roy Choudhary, Sheil B. Jani, *Linear Integrated Circuits*, New Age, Fourth Edition, 2018.

**ii. REFERENCE BOOKS**

1. Fiore,*Opamps& Linear Integrated Circuits Concepts & applications*, Cengage, 2010.
2. Jacob Millman, Christos C.Halkias, *Integrated Electronics - Analog and Digital circuits system*, McGraw Hill, 2nd Edition, 2017.

| Course Code | Course Name | L | T | P | C |
|---|---|---|---|---|---|
| EE2255 | POWER SYSTEM ANALYSIS | 3 | 0 | 0 | 3 |

**Category: Professional Core**

**a. Preamble**

This course introduces the concepts related to power system under steady state operating condition, load flow studies, short circuit studies on power system and stability problems in power system.

**b. Course Outcome**

After successful completion of the course, the students will be able to

| CO. No. | Course Outcome | Knowledge Level |
|---|---|---|
| CO1 | Model and develop the per unit equivalent circuit of power system network and to determine the various network matrices by suitable method. | K2 |
| CO2 | Formulate the power flow problem and solve using numerical iterative methods | K3 |
| CO3 | Solve the given power system network under symmetrical faults using appropriate technique | K3 |
| CO4 | Determine the fault current and post fault voltage when subjected to unsymmetrical faults. | K3 |
| CO5 | Classify power system stability and derive the swing equation for SMIB system and to assess the transient stability of given SMIB system by appropriate technique | K3 |

**c. Course Syllabus** **Total: 45 Periods**

**INTRODUCTION TO POWER SYSTEM** **9**

Power scenario in India – Representation of Power system components (Synchronous generator, Synchronous motor, Transmission line, off-nominal transformer & load) – Single line diagram - per unit quantities - p.u. impedance diagram and reactance diagram - Formation of bus admittance matrix using Two rule method and Singular Transformation method.

**POWER FLOW ANALYSIS** **9**

Significance of power flow analysis- Bus classification (PV, PQ and SB) - Power Flow equations in polar coordinates - Power flow solution using Gauss Seidel method - Handling of Voltage controlled buses - Power Flow Solution by Newton Raphson method.

**SYMMETRICAL FAULT ANALYSIS** **9**

Importance of short circuit studies- Assumptions in short circuit analysis - Symmetrical short circuit analysis using Thevenin's theorem - Bus Impedance matrix building algorithm (without mutual coupling) - Symmetrical fault analysis using bus impedance matrix - Current limiting reactors.

**UNSYMMETRICAL FAULT ANALYSIS** **9**

Symmetrical components - Sequence impedances - Sequence networks - Analysis of unsymmetrical faults at generator terminals: Single line to ground fault (LG), Line to Line fault (LL) and Double Line to Ground fault (DLG).

**STABILITY ANALYSIS** **9**

Importance of stability studies-Assumptions-Classification of power system stability – Rotor angle stability - Swing equation - Swing curve - Power-Angle equation –Transient stability analysis of SMIB system using Equal area criterion - Critical clearing angle and time - Classical step-by-step solution of the swing equation – fourth order Runge Kutta method and Modified Euler's method (Algorithm and flow chart)- Factors influencing transient stability and methods of improving transient stability.

**d. Activities**

Students shall be exposed to the behavior of power system, when it is subjected to steady state and faulted state.

**e. Learning Resources**

**i. TEXT BOOKS**


1. John J. Grainger, William D. Stevenson, Jr, 2017. *Power System Analysis,* McGraw Hill Education (India) Private Limited, New Delhi.
2. Kothari, D.P. and Nagrath, I.J., 2022. *Modern power system analysis*. Tata McGraw-Hill Publishing Company.


**ii. REFERENCE BOOKS**


1. Hadi Saadat, 2010. *Power System Analysis*, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 21st reprint.

2. Pai M A, 2017. *Computer Techniques in Power System Analysis*, Tata McGraw-Hill Publishing Company Ltd., New Delhi, Third Edition.
3. Glover, J.D., Sarma, M.S. and Overbye, T., 2012. *Power system analysis & design, SI version*. Cengage Learning.
4. Gupta, B.R., 2011. *Power System Analysis and Design*. S. Chand publishing, Sixth Edition.
5. Kundur, P.S. and Malik, O.P., 2022. *Power system stability and control*. McGraw-Hill Education.

| Course Code | Course Name | L | T | P | C |
|---|---|---|---|---|---|
| GE2251 | QUANTITATIVE APTITUDE | 1 | 0 | 0 | 1 |

**Category: Employability Enhancement Course**

**a. Preamble**

To develop the thinking ability and problem solving skills of students to compete themselves in placement and competitive examinations.

**b. Course Outcome**

After successful completion of the course, the students will be able to

| CO. No. | Course Outcome | Knowledge Level |
|---|---|---|
| CO1 | Apply the concept of profit in real life problems | K3 |
| CO2 | Solve the problems by using proportion | K3 |
| CO3 | Compute accurate speed, time and distance | K3 |
| CO4 | Apply the concept of Time & Speed | K3 |
| CO5 | Calculate the work done based on various methods | K3 |

**c. Course Syllabus** **Total : 15 Periods**

**PROFIT AND LOSS** **3**

Profit and Loss - Cost Price, Selling Price, Profit and Loss %, Marked Price, Discount.

**RATIO AND PROPORTION** **3**

Ratio and Proportion - Ratio, Proportion, Comparison of Ratios, Duplicate, Triplcate Ratio.

**TIME, SPEED AND DISTANCE** **3**

Time, Speed and Distance - Concept of time, speed and distance, Conversion of units and proportionality, Avearge speed concept.

**APPLICATIONS ON TIME, SPEED AND DISTANCE** **3**

Problems on trains - Relative speed concept and application. Boats and Streams - Upstream speed, Downstream speed, Speed of stream, Speed of boat.

**TIME AND WORK** **3**

Time & work - Problems based on time and work, Formulae, Computation of work together, Wages based work problems. Pipes & Cisterns - Inlet-outlet, Part of tank filled, Time based problems.

**d. Learning Resources**

**i. TEXT BOOK**

1. Dinesh Khattar, *Quantitative Aptitude for Competitive Examinations*, Pearson India Education services Pvt Ltd, Fourth Edition, Uttar Pradesh, 2019.

**ii. REFERENCE BOOKS**

1. TCY online, *Reasoning ability and Quantitative Aptitude*, Wiley India Pvt. Ltd, First Edition, New Delhi, 2016.
2. Agarwal.R.S, *Quantitative Aptitude for Competitive Examinations*, S.Chand Limited, 2011.
3. Abhijit Guha, *Quantitative Aptitude for Competitive Examinations*, Tata McGraw Hill, 3rd Edition, 2011

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| Course Code | Course Name | L | T | P | C |
|---|---|---|---|---|---|
| EE2256 | CONTROL AND INSTRUMENTATION LABORATORY | 0 | 0 | 4 | 2 |

**Category: Foundation Course (Engineering Science)**

**a. Preamble**

The student will be imparted with the knowledge on the analysis and design of control system concepts along with basics of instrumentation

**b. Course Outcome**

After successful completion of the course, the students will be able to

| CO. No. | Course Outcome | Knowledge Level |
|---|---|---|
| CO1 | Demonstrate the concepts of control theory to perform stability analysis on linear systems | K2 |
| CO2 | Design simulation models for controllers/compensators for simple electrical applications. | K3 |
| CO3 | Implement bridge circuits to measure various electrical quantities | K3 |
| CO4 | Calibrate energy meter and perform signal conditioning of instruments | K3 |
| CO5 | Calibrate and interface basic sensors for simple applications | K3 |

**Total: 60 Periods**

**c. Course Syllabus**

**Control Systems Experiment**

1. Estimate the effects of P, PI, PD and PID controllers on the Second-order linear system using suitable software package.
2. Perform stability analysis of linear systems using Bode, Root locus & Nyquist plots method using suitable software package.
3. Derive the mathematical modelling of a DC machine and Thermistor.
4. Design of Lag, Lead and Lag-Lead Compensators using suitable software package.
5. DC Position Control Systems.
6. AC Synchro: Transmitter- Receiver and Characteristics.

**Instrumentation Experiment**

7. AC bridges (Anderson bridge) and (Schering bridge), DC bridges (Wheat stone bridge)
8. Study of Displacement Transducer – LVDT, Study of Pressure Transducer, Study of Flow sensor, Study of RDT
9. Calibration of Three Phase Energy meter by direct loading, Measurement of Three Phase power and power factor, Calibration of Single-Phase energy meter
10. Instrumentation Amplifier
11. D/A and A/D converters
12. Real time interfacing of Sensors with Microcontrollers

**d. Activities**

Students shall be exposed to the basic control systems.

**e. Learning Resources**

**i. TEXT BOOKS**


1. Gopal, M., 2015. *Control systems: Principles and Design*. Tata McGraw-Hill Education.
2. Houpis, C.H. and Sheldon, S.N., 2013. *Linear Control System Analysis and Design with MATLAB®*. CRC Press.
3. Sawhney, A.K. and Sawhney, P., 2016. *A course in Electrical and Electronic Measurements and Instrumentation*. Dhanpat Rai & Company.


**ii. REFERENCE BOOKS**


1. Nagrath, I.J., 2018. *Control systems engineering*. New Age International
2. Kuo, B.C., 2018. *Automatic control systems*. Wiley.
3. Al Morris, A.S. and Langari, R., 2012. *Measurement and instrumentation: theory and application*. Academic Press.


**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:**

| S.No. | Description of Equipment | Quantity Required |
|---|---|---|
| 1. | PID controller simulation and learner kit | 1 |
| 2. | Digital storage Oscilloscope for capturing transience | 1 |
| 3. | Personal Computer with control system simulation packages | 10 |
| 4. | DC motor –Generator test set-up for evaluation of motor parameters | 1 |
| 5. | CRO 30MHz | 4 |

| S.No. | Description of Equipment | Quantity Required |
|---|---|---|
| 6. | 2MHz Function Generator | 4 |
| 7. | Position Control Systems Kit | 1 |
| 8. | AC Synchro transmitter& receiver | 1 |
| 9. | Digital multimeter | 5 |
| 10. | R, L, C Bridge kit | 1 |
| 11. | LM723 | 5 |
| 12. | Electric heater, Thermometer, Thermistor (silicon type) RTD nickel type | 1 each |
| 13. | 30 psi Pressure chamber (complete set) – 1No. Current generator (0 – 20mA) Air foot pump | 1 |
| 14. | LVDT20mm core length movability type | 1 |
| 15. | Optical sensor | 1 |
| 16. | Strain Gauge Kit with Handy lever beam | 1 |
| 17. | Flow measurement Trainer kit | 1 |
| 18. | Single phase Auto transformer | 1 |
| 19. | Watt-hour meter (energy meter) | 1 |
| 20. | IC Transistor kit | 1 |
| 21. | Instrumentation Amplifier kit | 1 |
| 22. | Analog – Digital and Digital –Analog converters | 1 |

| Course Code | Course Name | L | T | P | C |
|---|---|---|---|---|---|
| EE2257 | DC MACHINES AND TRANSFORMERS LABORATORY | 0 | 0 | 4 | 2 |

**Category: Professional Core**

**a. Preamble**

This course introduces the gives the practical exposure to understand the load characteristics of DC machines and transformers, the performance characteristics of DC machines and transformers. The course will give hands on experience to familiarize about speed control methods, need for starters and various three Phase transformers connections.

**b. Course Outcome**

After successful completion of the course, the students will be able to

| CO. No. | Course Outcome | Knowledge Level |
|---|---|---|
| CO1 | Interpret the working of three phase transformers connections | K3 |
| CO2 | Analyze the performance characteristics of Transformers by conducting the load test | K4 |
| CO3 | Apply the various speed control of DC shunt motor and understand the working of various starters used in DC motors. | K4 |
| CO4 | Conduct various tests on DC generators and analyze its performance characteristics. | K4 |
| CO5 | Obtain the steady state characteristics of various types of DC Machines by performing the load test. | K4 |

**c. Course Syllabus** **Total: 60 Periods**

1. Study of 3-phase transformers connections.
2. Open circuit and short circuit tests on single phase transformer.
3. Load test on single-phase transformer and three phase transformers.
4. Separation of no-load losses in single phase transformer.
5. Sumpner's test on single phase transformers.
6. Study of starters
7. Load test on DC shunt motor.
8. Load test on DC series motor.
9. Load test on DC compound motor.

10. Swinburne's test and speed control of DC shunt motor.
11. Open circuit and load characteristics of DC shunt generator- critical resistance and critical speed.
12. Load characteristics of DC compound generator with differential and cumulative connections.
13. Hopkinson's test on DC motor – generator set.

**d. Activities**

Students shall be exposed to the machine related engineering projects.

**e. Learning Resources**

**i. TEXT BOOKS**


1. Nagrath, I.J. and Kothari.D.P., *Electric Machines*, McGraw-Hill Education, 2017
2. Gupta, J.B., 2020. *Theory & Performance of Electrical Machines*. SK Kataria and Sons.
3. Theraja, B.L. and Theraja, A.K., 2005. *A text Book of Electrical Technology* vol 2 AC and DC machines.


**ii. REFERENCE BOOKS**


1. Stephen J. Chapman, *Electric Machinery Fundamentals,* 4th edition, McGraw Hill Education Pvt. Ltd, 2010
2. B.R. Gupta , *Fundamental of Electric Machines,* New age International Publishers, 3rd Edition, Reprint 2015
3. S.K. Bhattacharya, *Electrical Machines,* McGraw - Hill Education, New Delhi, 3rd Edition, 2017
4. Fitzgerald. A.E., Charles Kingsely Jr, Stephen D.Umans, *Electric Machinery*, Sixth edition, McGraw Hill Books Company, 2017
5. P. S. Bimbhra, *Electric Machinery*, Khanna Publishers, 2nd Edition, 2021


**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:**

| S.No. | Description of Equipment | Quantity Required |
|---|---|---|
| 1. | DC Shunt Motor with Loading Arrangement | 3 |
| 2. | DC Shunt Motor Coupled with Three phase Alternator | 1 |
| 3. | Single Phase Transformer | 4 |
| 4. | DC Series Motor with Loading Arrangement | 1 |
| 5. | DC compound Motor with Loading Arrangement | 1 |

| S.No. | Description of Equipment | Quantity Required |
|---|---|---|
| 6. | Three Phase Induction Motor with Loading Arrangement | 2 |
| 7. | Single Phase Induction Motor with Loading Arrangement | 1 |
| 8. | DC Shunt Motor Coupled With DC Compound Generator | 2 |
| 9. | DC Shunt Motor Coupled With DC Shunt Motor | 1 |
| 10. | Tachometer -Digital/Analog | 8 |
| 11. | Single Phase Auto Transformer | 2 |
| 12. | Three Phase Auto Transformer | 1 |
| 13. | Single Phase Resistive Loading Bank | 2 |
| 14. | Three Phase Resistive Loading Bank | 2 |

| Course Code | Course Name | L | T | P | C |
|---|---|---|---|---|---|
| EE2258 | LINEAR AND DIGITAL INTEGRATED CIRCUITS LAB | 0 | 0 | 4 | 2 |

**Category: Professional Core**

**a. Preamble**

Basic Knowledge in Electronic components like, diode, transistor, different integrated and digital ICs and knowledge of output parameters using measuring instruments and wave form generators.

**b. Course Outcome**

After successful completion of the course, the students will be able to

| CO. No. | Course Outcome | Knowledge Level |
|---|---|---|
| CO1 | Design and analyze simple electronic circuits (Adder, Comparator, Clipper, and Clamper) using OP-AMP | K4 |
| CO2 | Design and analyze astable multivibrator using timer 555 timer. | K4 |
| CO3 | Design and analyze digital circuits involving Boolean functions using basic logic gates. | K4 |
| CO4 | Design and analyze combinational circuits such as adder, subtractor, code converters, encoders and decoders. | K4 |
| CO5 | Design and demonstrate sequential logic circuits such as Flip-Flops, Counters (synchronous and asynchronous), and Shift Registers. | K3 |

**c. Course Syllabus** **Total : 60 Periods**

**Analog circuits:**

1. Design and Implementation of various circuits using OP-AMP – Inverting, Non-inverting, Adder, Subtractor & Comparator.
2. Design and Implementation of Integrator and Differentiator circuit
3. Design and Implementation of OP-AMP based Clamper circuit/ clipper circuits.
4. Design and Implementation of Astable multi-vibrator using 555 – Timer IC
5. Study of Voltage Controlled Oscillator to generate waveforms (Sine, triangular and square wave)

**Digital Circuits**

6. Implementation of Boolean Functions using logic gates and Karnaugh Map
7. Design and Implementation of Adder, Subtractor, Parity Checker and code converter using basic logic gates and special IC's
8. Design and Implementation of MUX, DEMUX, Encoder and Decoder using special IC's
9. Design of Synchronous and Asynchronous counter using Flip flops and special IC's
10. Design of Shift registers using Flip flops.

**d. Activities**

Students shall be exposed to the various electrical and electronics engineering projects.

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:**

| S.No. | Description of Equipment | Quantity Required |
|---|---|---|
| 1. | Dual ,(0-30V) variability Power Supply | 10 |
| 2. | CRO, 30MHz | 5 |
| 3. | Digital Multimeter | 5 |
| 4. | Function Generator, 1MHz | 5 |
| 5. | IC Tester (Analog) | 1 |
| 6. | Bread board | 10 |
| 7. | IC 741/ IC NE555/566/565 | 5 |
| 8. | Digital IC trainer kit | 5 set |
| 9. | Digital IC tester | 1 |
| 10. | LM317 | 5 |
| 11. | LM723 | 5 |
| 12. | Resistors 1/4 Watt Assorted | Adequate |
| 13. | Single Strand Wire | Adequate |