



SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)

Accredited A++ Grade by NAAC | 12B Status by UGC | Approved by AICTE

www.sathyabama.ac.in

School of Electrical & Electronics

Department of Electrical and Electronics Engineering

1.2.1 New Courses Introduced in 2022 - 2023

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School of Electrical & Electronics

Minutes of Board of Studies held on 9th April 2022

Venue: Central for Excellence in Embedded and IoT

- Dr. N.M. Nandhitha, Professor & Dean, School of Electrical and Electronics, commenced the meeting by extending a welcome to both external and internal participants of the Board of Studies meeting held on April 9, 2023, from 10:30 a.m. to 12:00 noon.
- Dr. V. Sivachidambaramanathan, Head of the Department of Electrical and Electronics Engineering, informed the board that core competencies had been identified based on feedback collected from students, faculty, alumni, and employers.
- Dr. Radhika S. explained and provided justification for the changes made to the Principles of Embedded Systems course. She suggested the inclusion of topics such as Intel ARM-based hard processor System on Chip (SoC) with an on-chip FPGA, and an overview of System on Module (SoM) using ARM-based SoC within Unit III. Dr. N. Shivakumaran, Professor, NIT, Tiruchy, the external member, accepted the changes and he additionally proposed the incorporation of content such as assemblers, compilers, cross-compilers, and linker/locators in Unit V.
- Furthermore, Dr. S. Radhika recommended the addition of experiments in the Embedded and DSP Lab, such as Six-pulse fixed PWM generation using the full compare unit, and Six-pulse fixed PWM generation with dead band using the TMS320X2407 DSP Processor. Dr. M.D. Selvaraj, Associate Professor, IIITDM, external member accepted the changes made in Embedded and DSP lab course.
- Furthermore, Dr. S. Susitraput forth the new courses Programming in MATLAB, Substation Design and Automation for UG. For PG (Power electronics and Industrial Drives) Electric Vehicle and Storage Systems, Smart Grid and Nano Technology for Electrical Engineers before the board members, Dr. N. Shivakumaran Professor, NIT, Tiruchy and Dr. M.D. Selvaraj Associate Professor, IIITDM accepted the new courses.

External Members

Dr. N. Shivakumaran



Professor

Dept of I & C,

NIT, Trichy

Dr, M, D. Selvaraj



Associate Professor, IIITDM, Kancheepuram

The following internal and external members were present in the meeting

Internal Members

1. Dr.N.M.Nandhitha



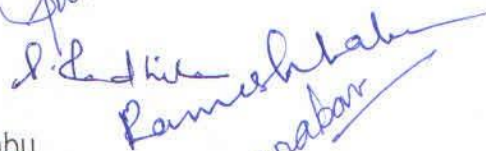
2. Dr.V.Sivachidambaranathan



3. Dr.D.Susitra



3. Dr.S.Radhika



4. Dr.A.Rameshbabu

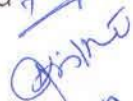


5. Dr.J.Barnabas Paul Glady

6. Mrs.D.Ramya



7. Dr.M.Kavitha



8. Dr.M.Pushpavalli



9. Dr.P. Sivagami



10. Dr.W.AbithaMemella



SEEA7011	Electric Vehicle and Storage System	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To understand the concept of conventional vehicle
- To acquire the knowledge about the electric vehicle
- Apply the control of control techniques for motors
- To understand the transmission system used in electric vehicle
- To acquire the knowledge about the battery charging system

UNIT 1 VEHICLE AND ELECTRIC VEHICLE FUNDAMENTALS

9 Hrs.

General Description of Vehicle Movement, Vehicle Resistance, Dynamic Equation, Tire–Ground Adhesion and Maximum Tractive Effort, Power Train Tractive Effort and Vehicle Speed-Vehicle Power Plant and Transmission Characteristics- Electric Vehicles (EV), Hybrid Electric Vehicles (HEV), Engine ratings, Comparisons of EV with internal combustion Engine vehicles, Fundamentals of vehicle mechanics.

UNIT 2 ARCHITECTURE OF EV

9 Hrs.

Architecture of EV's and HEV's EV Types, EV Configurations, Energy Sources, Power train components and sizing, Gears, Clutches, Transmission and Brakes. Motors Used, Charging Systems, Power Conversion Techniques, Technological Problems, Control Algorithms, Trends and Future Developments

UNIT 3 ELECTRIC PROPULSION SYSTEM

9 Hrs.

DC motor drive-Chopper control of DC motor drive- multi-quadrant control of Chopper fed drive Induction motor drive-constant v/f control-power electronics control-FOC-VSI for FOC. PMBLDC motor drive-basic principle – construction-classification-performance and control of PMBLDC machine. SRM drive-basic magnetic structure-SRM drive converter-modes of operation-generating modes of operation.

UNIT 4 BATTERY ENERGY STORAGE SYSTEM

9 Hrs.

Batteries-Overview-Types of battery, Battery Parameters, Battery modeling, Traction Batteries.

UNIT 5 ALTERNATIVE ENERGY STORAGE SYSTEMS

9 Hrs.

-Fuel Cell- Characteristics- Types – hydrogen Storage Systems and Fuel cell– EV Ultra capacitors, Super capacitor -Flywheel. Charging, standards and infrastructure-Wireless power transfer-Solar charging case study. Case studies-General motor EV-1 and Tesla roadster

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Apply Vehicle concept to electric vehicle
- CO2 - Analyze the power conversion technique of electric vehicle
- CO3 - Select the appropriate electric motor for electric propulsion system
- CO4 - Select a suitable battery for electric vehicle
- CO5 - Examine the performance of EV with alternative energy storage systems.
- CO6 - Analyze the recent technique used in modern electric vehicle

TEXT / REFERENCE BOOKS

- 1.M. Ehsani, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2005 Suggested Reading.
- 2.Tom Denton, Electric and Hybrid vehicle routledge,2016.
- 3.Husain, Electric and Hybrid Electric Vehicles, CRC Press, 2003
4. Un-Noor, F., Padmanaban, S., Mihet-Popa, L., Mollah, M.N. and Hossain, E., 2017. A comprehensive study of key electric vehicle (EV) components, technologies, challenges, impacts, and future direction of development. Energies, 10(8), p.1217.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100

Exam Duration:3 Hrs.

PART A: 6 Question of 5 marks each – No choice

30 Marks

PART B: 2 Questions from each unit of internal choice; each carrying 16 marks

70 Marks

SEEA7012	SMART GRID	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To understand various aspects of smart grid.
- To Study about Smart Grid technologies, different smart meters and advanced metering infrastructure.
- To familiarize the power quality management issues in Smart Grid.
- To familiarize the high performance computing for Smart Grid applications.

UNIT 1 INTRODUCTION TO SMART GRID

9 Hrs.

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

UNIT 2 SMART GRID ARCHITECTURE

9 Hrs.

Components and Architecture of Smart Grid Design –Review of the proposed architectures for Smart Grid. The fundamental components of Smart Grid designs – Transmission Automation – Distribution Automation –Renewable Integration

UNIT 3 SMART METERS AND ADVANCED METERING INFRASTRUCTURE

9 Hrs.

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

UNIT 4 POWER QUALITY MANAGEMENT IN SMART GRID

9 Hrs.

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

UNIT 5 AUTOMATION NETWORK , PROTECTION AND CONTROL

9 Hrs.

Types of networks and their attributes, Different network protocols, ISO-OSI reference model, Automation network security, Energy Management System (EMS), Digital substations, Synchronized Measurement Technology, Cyber Security in an EMS, Cyber security risk assessment, Security index computation, Use of RTDS and simulation tools for analyzing the impact of an attack.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Understand the concepts of Smart Grid and its present developments.
- CO2 - Describe the various Smart Grid technologies.
- CO3 - Knowledge about different smart meters and advanced metering infrastructure.
- CO4 - Realize the power quality management in Smart Grids.
- CO5 - Understand the concepts of various network.
- CO6 - Examine automatic and resilient electrical power grid.

TEXT / REFERENCE BOOKS

1. Stuart Borlase "Smart Grid: Infrastructure, Technology and Solutions",CRCPress2012.
2. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, JianzhongWu, Akihiko Yokoyama, "Smart Grid: Technology and Applications",Wiley, 2012.
3. Vehbi C. Güngör,DilanSahin, TaskinKocak, SalihErgüt, Concettina Buccella, Carlo Cecati, and GerhardP. Hancke, "Smart Grid Technologies: Communication Technologies and Standards", IEEE Transactions On Industrial Informatics, Vol. 7, No. 4, November 2011.
4. Xi Fang, Satyajayant Misra, Guoliang Xue, and Dejun Yang "Smart Grid – The New and Improved Power Grid: A Survey", IEEE Transaction on Smart Grids,Vol.14,No.4,pp.944-980,2012.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100

Exam Duration:3 Hrs.

PART A: 6 Question of 5 marks each – No choice

30 Marks

PART B: 2 Questions from each unit of internal choice; each carrying 14 marks

70 Marks

SEEA7013	Nano Technology for Electrical Engineers	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To understand the concept of conventional vehicle
- To acquire the knowledge about the electric vehicle
- Apply the control of control techniques for motors
- To understand the transmission system used in electric vehicle
- To acquire the knowledge about the battery charging system

UNIT 1 INTRODUCTION TO MICROENGINEERING AND MICROTECHNOLOGIES

9 Hrs.

Introduction - Biological Analogies - Nano and Micro electromechanical Systems - Applications of Nano and Micro electro mechanical Systems - Nano and Micro electromechanical Systems - Introduction to MEMS Fabrication, Assembling, and Packaging.

UNIT 2 MATHEMATICAL MODELS AND DESIGN OF NANO AND MICROELECTROMECHANICAL SYSTEMS 9 Hrs.

Nano and Micro electromechanical Systems Architecture - Electromagnetics and its Application for Nano and Micro scale Electromechanical Motion Devices - Classical Mechanics and its Application - Newtonian Mechanics - Lagrange Equations of Motion - Hamilton Equations of Motion Atomic Structures and Quantum Mechanics - Molecular and Nanostructure Dynamics. Schrödinger Equation and Wave function Theory - Density Functional Theory - Nanostructures and Molecular Dynamics - Molecular Wires and Molecular Circuits – Thermo analysis and Heat Equation

UNIT 3 STRUCTURAL DESIGN, MODELING, AND SIMULATION - I

9 Hrs.

Nano and Micro-electromechanical Systems - Carbon Nanotubes and Nano devices Micro-electromechanical Systems and Micro-devices - Structural Synthesis of Nano and Micro-electromechanical Actuators and Sensors - Configurations and Structural Synthesis of Motion Nano and Microstructures (actuators and Sensors) - Algebra of Sets -Direct Current Micro machines

UNIT 4 STRUCTURAL DESIGN, MODELING AND SIMULATION - II

9 Hrs.

Induction Motors -Two-Phase Induction Motors - Three Phase Induction Motors Microscale Synchronous Machines –Single Phase Reluctance Motors - Permanent-Magnet Synchronous Machines - Microscale Permanent - Magnet Stepper Motors - Mathematical Model in the Machine Variables - Mathematical Models of Permanent - Magnet Stepper Motors in the Rotor and Synchronous Reference Frames - Nanomachines: Nanomotors and Nanogenerators

UNIT 5 CONTROL OF NANO AND MICROELECTRO MECHANICAL SYSTEMS

9 Hrs.

Nanomaterials for Batteries and Supercapacitors-Nanogenerators and Energy Harvesting-Nanotechnology in Solar Cells-Nanotechnology in Power Electronics Nano sensors for Electrical and Environmental Monitoring-Nanoscale Imaging Techniques-Lab- on-a-Chip and Biosensors-Applications in Electrical Systems Nanotechnology in Quantum Computing-Nanotechnology in Space and Aerospace-Case study on Emerging Nanotechnology Applications. Ethical Issues in Nanotechnology-Environmental Impact of Nanomaterials-Safety Practices in Nanotechnology.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Apply fundamental principles of micro engineering and micro technologies.
- CO2 - Analyze, design, and model nano and micro electromechanical systems, incorporating principles from classical mechanics, electromagnetics, quantum mechanics, and thermodynamics, for various applications in the field.
- CO3 - Proficient in designing and modeling nano and micro electro mechanical systems, with a focus on structural synthesis.
- CO4 - Design, modeling, and simulation of various microscale electrical machines and motors with a deep understanding of their mathematical models and operation.
- CO5 - Skills to understand, analyze, and apply nanotechnology in various energy systems, including batteries, supercapacitors, nanogenerators, solar cells, and power electronics.
- CO6 - An awareness of ethical considerations and environmental impact in nanotechnology.

TEXT / REFERENCE BOOKS

1. Krause P. C. and Wasynczuk O., "Electromechanical Motion Devices", McGraw-Hill, New York, 1989. Lyshevski S. E., Electromechanical Systems, Electric Machines, and Applied Mechatronics, CRC Press, FL, 2017
2. Rogers, B., Adams, J., Pennathur, S. (2015). Nanotechnology: Understanding Small Systems, Third Edition. United Kingdom: Taylor & Francis.
3. Kulkarni, S. K. (2014). Nanotechnology: Principles and Practices. Germany: Springer International Publishing.
3. Maluf, Nadim, and Williams, Kirt. An Introduction to Microelectromechanical Systems Engineering. United Kingdom, Artech House, 2004.
4. Madou, M. J. (2018). Fundamentals of Microfabrication and Nanotechnology, Three-Volume Set. United States: CRC Press.
5. Poole, C. P., Owens, F. J. (2003). Introduction to Nanotechnology. United Kingdom: Wiley..

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100

Exam Duration:3 Hrs.

PART A: 6 Question of 5 marks each – No choice

30 Marks

PART B: 2 Questions from each unit of internal choice; each carrying 16 marks

70 Marks

SEEA3029	Design And Automation of Substation	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To enhance the knowledge and provide practical guidelines about substation components, protection circuits.
- To enhance the knowledge about substation design and automation.

UNIT 1 INTRODUCTION

9 Hrs.

Substation Introduction, their purpose, and the various classifications based on their functions and voltage levels., Different bus bar switching schemes for controlling electrical distribution. Standards and Practices- industry standards and best practices for substation design to ensure safety, reliability, and compliance with regulations Factors Influencing Substation Design - Altitude, Ambient Temperature, Earthquake and seismic zones, pollution and corrosion etc., Testing of Electrical Equipment, Concept and development of Single Line Diagram. Requirement of substation calculation.

UNIT 2 ESSENTIAL AND AUXILIARY SUBSTATION EQUIPMENT

9 Hrs.

Substation equipment: Transformer, Isolator, Circuit Breaker, surge arrester, Instrument transformers -Selection and sizing Classifications of MV Switchgear and Key Design Parameters, MV/LV Switchgear construction and control scheme design. Station Auxiliary equipment: basics, design and sizing . Transformer, DC System, Components, Battery Sizing & charger Sizing, DG Set Classification, and sizing. Gas insulated substation: Operating principle, construction, advantages

UNIT 3 PROTECTION AND SUBSTATION AUTOMATION

9 Hrs.

Power System protection, Fault protection and coordination. Distribution Feeder Protection, Transformer –Protection, Relays, protection for transmission line. Substation Automation: Evolution of Substation Automation, Communication System Fundamentals-Protocol fundamental and choosing the right protocol. Substation integration and automation functional architecture, Substation signal list - DI, DO, AI, AO– Bay Control Unit (BCU), Remote Terminal Unit RTU.

UNIT 4 SUBSTATION LAYOUT ENGINEERING

9 Hrs.

Layout aspects of Outdoor Air Insulated Substation and GIS: Statutory Clearances, Equipment Layout engineering aspects for Outdoor Substation/GIS and related calculations, and guide lines,

UNIT 5 SUBSTATION DESIGN ENGINEERING

9 Hrs.

Cable routing layout, Erection Key Diagram (EKD), switchyard earthing design as per IEEE80, Importance and Types of Earthing, Earthing Design, Types of Earthing Material, Direct stroke Lightning Protection for switchyard with IS/ IEC 62305. LV Cables - Power & Control, MV Cables, Methods for Cable Installation, Practical aspects of Cable Sizing, Cable accessories, Illumination System Design

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Examine the deciding factors involved in substation design
- CO2 - Analyze the sizing and selection of equipment
- CO3 - Analyze the protection circuit for substation design
- CO4 - Analyze the composite layout design.
- CO5 - Examine earthing design for substation CO6
- Develop substation automation system. TEXT /

REFERENCE BOOKS

- McDonald John D, "Electric Power Substations Engineering", CRC Press, 3rd Edition, 2012
- Partap Singh Satnam, P.V. Gupta, "Sub-station Design and Equipment", Dhanpat Rai Publications, 1st Edition, 2013
- Sunil S. Rao, "Switchgear Protection and Power Systems (Theory, Practice & Solved Problems)", Khanna Publications, 14th Edition, 2019.
- Electrical substation and engineering & practice by S.Rao, 3rd Edition, Khanna Publishers 2015
- Manual on Substation by Central Board of irrigation and Power (CBIP) Publication No 342., 2006.
- Substation automation system Design and implementation by Evelio Padilla by Wiley Publications, 1st Edition, 2015 November.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100

Exam Duration:3 Hrs.

PART A: 10 Question of 2marks each – No choice

20 Marks

PART B: 2 Questions from each unit of internal choice; each carrying 16 marks

80 Marks

SEEA3030	PROGRAMMING IN MATLAB	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- Implement and understand numerical methods using MATLAB..
- To enhance the knowledge on MATLAB functions for linear algebra operations.

UNIT 1 MATLAB ENVIRONMENT

9 hrs.

Defining Variables – functions – Matrices and Vectors –Strings – Input and Output statements -Script files – Arrays in Mat lab – Addressing Arrays – Dynamic Array – Cell Array – Structure Array – File input and output – Opening & Closing – Writing & Reading data from files.

UNIT 2 PROGRAMMING IN MATLAB

9 hrs.

Relational and logical operators – Control statements IF-END, IF-ELSE – END, ELSEIF, SWITCH CASE – FOR loop – While loop – Debugging – Applications to Simulation – miscellaneous MAT lab functions & Variables.

UNIT 3 PLOTTING IN MATLAB

9 hrs.

Basic 2D plots – modifying line styles – markers and colors – grids – placing text on a plot – Various / Special Mat Lab 2D plot types – SEMILOGX – SEMILOGY – LOG- LOG – POLAR – COMET – Example frequency response of filter circuits.

UNIT 4 APPLICATION OF MATLAB

9 hrs.

Linear algebraic equations – elementary solution method – matrix method for linear equation – Cramer's method – Statistics, Histogram and probability – normal distribution – random number generation – Interpolation – Analytical solution to differential equations – Numerical methods for differential equations.

UNIT 5 TOOL BOXES

9 hrs.

Simulink – Simulink model for a dead zone system, nonlinear system – Applications in DSP – Computation of DFT & FFT – Filter structure –IIR & FIR filter design – Applications in Communication PCM, DPCM, DM, DTMF- Interfacing of Matlab with event driven simulators.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Examine the MATLAB environment
- CO2 - Develop basic programming skills in MATLAB
- CO3 - Implement numerical methods using MATLAB.
- CO4 - Solve mathematical problems using built-in functions and algorithms.
- CO5 - Develop MATLAB for signal processing and analysis
- CO6 - Design MATLAB to solve real-world engineering and scientific problems.

TEXTBOOKS/ REFERENCE BOOKS:

1. Rudra Pratap, Getting Started with MATLAB6.0, 1st Edition, Oxford University Press, 2004.
2. William J.Palm, Introduction to MATLAB 6.0 for Engineers, Mc Graw Hill & Co
3. M.Herniter, Programming in MATLAB, Thomson earning.
4. John G.Proakis, Digital Signal Processing using MATLAB, Thomson earning.



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School of Electrical & Electronics
Minutes of Board of Studies held on 25th November 2022
Venue: Central for Excellence in Embedded and IoT

- Dr.N.M.Nandhitha, Prof. and Dean School of Electrical and Electronics started the meeting by welcoming both the external and the internal members to the Board of Studies meeting.
- Dr.Sivachidambaranathan, Prof. and Head, Dept. of Electrical and Electronics Engineering requested Dr. S. Radhika and Dr. A. Rameshbabu Faculty/EEE to put forth revision of the courses namely Industry 4.0 or Electrical Engineers, Industry 4.0 and Power Electronics Lab.
- Dr.S.Radhika, Associate Professor, Department of EEE informed the panel that the content of syllabus Industry 4.0- SCCA9501 and Industry 4.0 for Electrical Engineers SEEA1403 were revised specifically as PBLA for PG and UG students.
- Dr.A.Rameshbabu, Associate Professor, Department of EEE presented the new syllabus for Power Electronics Lab-SEEA2401 before the board and discussed the valid additions made in the syllabus. The syllabus included the experiments related to Electric vehicle Henceforth, the title of the lab was reframed as Power Electronics and Electric Vehicle Lab
- The new courses Static Relays, Power System Dynamics and Computer Aided Design for UG and for PG (Power electronics and Industrial Drives) Digital Simulation in Power Electronics, Computer Aided Electrical Apparatus for Electrical Engineers was presented before the board members by Dr. J.Barnabas Paul Gladly .
- Dr. N. Shivakumaran Professor, NIT, Tiruchy and Dr.M.D. Selvaraj Associate Professor, IIITDM accepted the new courses.

- The board members suggested to substitute the professional elective courses with a list of NPTEL courses in the final semester.
- The board members advised to identify the theory cum practical subject for each semester for the upcoming Curriculum revision 2023

External Members

Dr. N. Shivakumaran



Professor

Dept of I & C

NIT, Trichy

Dr, M, D. Selvaraj



Associate Professor, IIITDM, Kancheepuram

The following internal and external members were present in the meeting

Internal Members

1. Dr.N.M.Nandhitha



2. Dr.V.Sivachidambaranathan



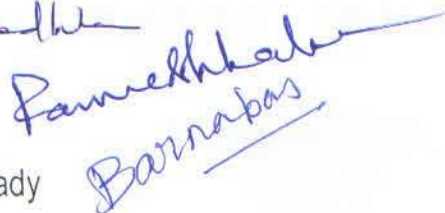
3. Dr.D.Susitra



3. Dr.S.Radhika



4. Dr.A.Rameshbabu



5. Dr.J.Barnabas Paul Gladly



6. Mrs.D.Ramya



7. Dr.M.Kavitha



8. Dr.M.Pushpavalli



9. Dr.P. Sivagami



SEEA7014	DIGITAL SIMULATION IN POWER ELECTRONICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- Explore the modeling of firing circuits for thyristors, enabling a deeper comprehension of power electronics components and their behavior.
- Learn the systematic methods for formulating state equations
- Gain knowledge of modeling both DC and AC machines in power electronics.

UNIT 1 INTRODUCTION AND MODELLING OF POWER ELECTRONICS ELEMENT

9 Hrs.

Importance of simulation – Semiconductor device modeled as resistor – RL combination – RLC combination – Analog hybrid model for thyristor – Modelling of firing circuits for thyristor.

UNIT 2 SYSTEMATIC METHOD OF FORMULATION & SOLVING STATE EQUATION

9 Hrs.

Network topology – Incidence matrix – Fundamental cutset & loop matrices – Proper tree algorithm – Algorithm for the formulation of fundamental cutset matrix – Welsh Algorithm – Computer solution of state equation – Explicit & Implicit integration method.

UNIT 3 MACHINE MODELLING

9 Hrs.

DC machine modeling – Equivalent circuit & electromagnetic torque – Electromechanical modeling – State space modeling – AC machine modeling for three phase induction motors – Squirrel cage type..

UNIT 4 PHASE CONTROLLED DC MOTOR DRIVES

9 Hrs.

Introduction to phase controlled converters – Single phase & three phase controlled converters – Control circuited–Control modeling – Steady state analysis of three phase converter controlled DC motor drive – Transfer function – Design of controllers.

UNIT 5 CASE STUDIES

9 Hrs.

Few case studies of DSP based controllers of induction motors & switched reluctance motors – Case studies using P Spice simulator.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Understand the power electronics components and their behavior and model thyristors using analog hybrid models
- CO2 - Analyze and simulate complex power electronic systems efficiently
- CO3 - Develop a strong foundation in machine behavior for power electronic applications.
- CO4 - Design controller for three-phase converter-controlled DC motor drives.
- CO5 - Examine practical case studies using DSP-based controllers
- CO6 - Design practical case studies using P Spice simulator simulation tool.

TEXT / REFERENCE BOOKS

- Power Electronics: Essentials; Applications by L. Umanand , Publisher: Wiley Year: 2015
- Power Electronics Handbook by Muhammad H. Rashid Publisher: Academic Press Year: 2017.
- Power Electronics: A First Course; by Ned Mohan Publisher: Wiley Year: 2006
- Power Electronics and Motor Drives; by Bimal K. Bose Publisher: Academic Press Year: 2005

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100

Exam Duration:3 Hrs.

PART A: 6 Question of 5 marks each – No choice

30 Marks

PART B: 2 Questions from each unit of internal choice; each carrying 14 marks

70 Marks

SEEA7015	COMPUTER AIDED DESIGN OF ELECTRICAL APPARATUS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To create and modify electrical circuit diagrams and schematics using CAD software, considering safety and efficiency principles.
- Gain the ability to identify and resolve design issues, troubleshoot problems, and make improvements to existing electrical apparatus designs.

UNIT 1 INTRODUCTION

9 Hrs.

Conventional design procedures – Limitations – Need for field analysis based design.

UNIT 2 MATHEMATICAL FORMULATION OF FIELD PROBLEMS

9 Hrs.

Electromagnetic Field Equations – Magnetic Vector/Scalar potential – Electrical vector /Scalar potential – Stored energy in field problems – Inductance - Development of torque/force - Laplace and Poisson's Equations – Energy functional - Principle of energy conversion.

UNIT 3 PHILOSOPHY OF FEM

9 Hrs.

Mathematical models – Differential/Integral equations – Finite Difference method – Finite element method – Energy minimization – Variational method - 2D field problems – Discretisation – Shape functions – Stiffness matrix – Solution techniques.

UNIT 4 CAD PACKAGES

9 Hrs.

Elements of a CAD System – Pre-processing – Modelling – Meshing – Material properties - Boundary Conditions – Setting up solution – Post processing.

UNIT 5 CASE STUDIES

9 Hrs.

Design of Solenoid Actuator – Induction Motor – Insulators – Power transformer.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Examine the need for analysis based design
- CO2 - Analyze the mathematical modelling for field problems
- CO3 - Analyze the mathematical modelling for finite element method.
- CO4 - Apply CAD tools to practical design projects.
- CO5 - Examine practical case studies using CAD
- CO6 - Design practical case studies for machines.

TEXT / REFERENCE BOOKS

1. AutoCAD Electrical 2023 For Electrical Control Designers by Prof. Sham Tickoo Purdue Univ. and CAD/CIM Technologies
2. SOLIDWORKS Electrical 2023 Black Book by Gaurav Verma.
3. Electromagnetic Modeling by Finite Element Methods by João Pedro A. Bastos
4. Electric Machines and Drives: A First Course" by Ned Mohan, Tore M. Undeland, and William P. Robbins

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100

Exam Duration:3 Hrs.

PART A: 6 Question of 5 marks each – No choice

30 Marks

PART B: 2 Questions from each unit of internal choice; each carrying 14 marks

70 Marks

SEEA3031	STATIC RELAYS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To study and understand the working of comparators Relays in power system protection.
- To study and implement the advance microprocessor relays in power system protection

UNIT 1 PHASE AND AMPLITUDE COMPARATORS

9 Hrs.

Phase and Amplitude Comparators – Duality between them – Types – Direct and Integrating Rectifier Bridge, Circulating Current Opposed Voltage Coincident type Phase Comparator, Direct or Block Spike Phase comparator, Phase Splitting Techniques, Integrating type Phase Comparator with Transistor AND Gate – Hybrid comparator – Hall Effect type and magneto resistivity type, Vector Product type – Zener Diode Phase Comparator – Multi Input – Three Input Coincident Comparator/Phase Sequence Detector.

UNIT 2 SOLID STATE PROTECTIVE RELAYS

9 Hrs.

Static relay circuits using analog and digital ICs for over current, Differential and Directional Relays

UNIT 3 SOLID STATE POWER SYSTEM ELEMENT PROTECTION

9 Hrs.

Static Relay Circuits for Generator Loss of Field, Under Frequency, Distance, Impedance, Reactance, Mho and Reverse power Relays - Static Relay Circuits for Carrier Current Protection.

UNIT 4 ANALYSIS OF SOLID STATE RELAYS

9 Hrs.

Steady State and Transient Behavior of Static Relays – Testing and Maintenance of Relays – Tripping Circuits Using thyristors

UNIT 5 MICROPROCESSOR BASED RELAYS

9 Hrs.

Microprocessor Based Relays – Hardware and Software for the Measurement of Voltage, Current, Frequency and Phase Angle – Microprocessor Based Implementation of Over Current, Directional, Impedance and Mho Relays.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Apply various types of phase and amplitude comparators on static relay
- CO2 - Identify static relay circuit using analog and digital ICs for different protection
- CO3 - Analyse the usage of static relays for various fault conditions.
- CO4 - Examine the behavior of static relay under steady state and transient conditions.
- CO5 - Develop Hardware and software for different electrical parameter.
- CO6 - Propose microprocessor based relay for over current, differential and distance relay.

TEXT / REFERENCE BOOKS

1. Van.C.Warinton, "Protective Relays-their Theory and Practice", Vol I & II, Champ Man and Hall Ltd, London, 2014.
2. T.S.Madhava Rao, "Power System Protection, Static Relays with Microprocessor Applications", Tata Mc- Graw Hill, New Delhi, 2017.
3. Ram.B, "Fundamental of Microprocessors and Micro computers", Reprint 2018.
4. Sunil S.Rao, "Switchgear Protection & Power Systems", Khanna Publishers, New Delhi 2015.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration: 3 Hrs.

PART A: 10 questions of 2 marks each - No choice

20 Marks

PART B: 2 questions from each unit of internal choice, each carrying 16 marks

80 Marks

SEEA3032	POWER SYSTEM DYNAMICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

To impart knowledge on modeling of machines, excitation system and stability analysis.

UNIT 1 SYNCHRONOUS MACHINE MODELING

9 Hrs.

Mathematical description of a synchronous machine; Review of magnetic circuit equations, basic equations of a synchronous machine, per unit (pu) representation: pu system for the stator quantities, pu stator voltage equations, pu rotor voltage equations, stator flux linkage equations, rotor flux linkage equations, pu system for the rotor, pu power and torque, Alternative per unit systems and transformations- Equivalent circuits for direct and Quadrature axes-constant flux linkage model, classical model, constant flux linkage model including the effects of sub transient circuits.

UNIT 2 INDUCTION MOTOR AND SYNCHRONOUS MOTOR MODELING

9 Hrs.

Modeling of Induction motors: Equations of an induction machine - steady state characteristics - Alternative rotor constructions- Representation of saturation - per unit Representation – Representation in stability studies - Synchronous motor model.

UNIT 3 EXCITATION SYSTEM

9 Hrs.

Excitation system requirements - Elements of an excitation system - Types of excitation system: DC Excitation systems, AC excitation systems, static excitation systems - Control and protective functions: AC and DC regulators, Excitation system stabilizing circuits, power system stabilizer(PSS), load compensation, Under excitation limiter, over excitation limiter, volts-per-hertz limiter and protection, Field shorting systems - Modeling of excitation systems.

UNIT 4 SMALL-SIGNAL STABILITY

9 Hrs.

Fundamental concept of stability of dynamic systems - small-signal stability of a single-machine infinite bus system - Effects of excitation system - power system stabilizer - small signal stability of multi machine systems.

UNIT 5 TRANSIENT STABILITY

9 Hrs.

Elementary view of transient stability - Simulation of power system dynamic response - Direct method of transient stability analysis: Description of the transient energy function approach, Analysis of practical power systems - Limitations of the direct methods.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Apply the basic equations for Synchronous Machine Modeling
- CO2 - Analyze the per unit representation and characteristics of Induction motor
- CO3 - Design the excitation model for AC and DC system
- CO4 - Investigate the small signal stability of a single machine infinite bus system
- CO5 - Evaluate the dynamic response of power system in transient stability analysis.
- CO6 - Examine the transient energy function approach

TEXT / REFERENCE BOOKS

1. P.Kundur, "Power system stability and control", McGraw Hill Inc:USA, 2006
2. R.Ramanujam, " Power System Dynamics",Phi learning, 2010.
3. M.A.Pai and W.Saueer, " Power system dynamics and stabilities", Pearson Education Asia,India,2002.
4. Edward Wilson kimbark, " Power systems stability", volume III, John Wiley &Sons,Inc,2004.
5. K.R.Padiyar, "Power System Dynamics", Anshan Pvt Ltd, 2004.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration: 3 Hrs.

PART A: 10 questions of 2 marks each - No choice

20 Marks

PART B: 2 questions from each unit of internal choice, each carrying 16 marks

80 Marks

SEEA3033	COMPUTER AIDED DESIGN	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To give an exposure to basic concepts of PSPICE and MATLAB.
- To make the students to design and simulate circuits using the above software.

UNIT 1 INTRODUCTION TO PSPICE

9 Hrs.

Description of Spice- Limitations- Circuit Descriptions- DC Circuit Analysis- Transient Analysis- AC Analysis-Parametric - Sub circuit - Fourier analysis - programs based on DC, AC and Transient Analysis.

UNIT 2 DEVICE MODELLING

9 Hrs.

Analysis of Diode, Bipolar Junction transistor, Field Effect transistor - Op Amp Circuits - Spice AC and DC models – Parameters - Examples circuits

UNIT 3 MATLAB INTRODUCTION

9 Hrs.

Basic features – Script m files – Array and array operations – Data types – Cell array and structures – Relational and logical operations – Control flow – Functions – Plotting commands – Matlab toolbox – Simulink.

UNIT 4 MATLAB ANALYSIS

9 Hrs.

DC Analysis – Nodal Analysis, Loop Analysis, Maximum power Transfer. Transient Analysis - RC, RL, RLC circuit, State Variable Approach. AC Analysis and Network Functions – Steady State AC Circuit, Single and Three Phase AC Circuit, Network Characteristics – Frequency Response. Two port Network – Z, Y, H Parameter Analysis, Transmission parameters.

UNIT 5 MATLAB APPLICATIONS

9 Hrs.

Characteristics Realization of Diodes – I-V curve, operating point, full wave rectifier. Characteristics realization of Op-Amps – open loop gain, closed loop gain, Transfer function, poles and zeros- Characteristic realization of transistor, BJT, MOSFET

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Evaluate the performance of electronic circuits using PSpice.
- CO2 - Determine the parameters of various electronic devices using PSpice.
- CO3 - Develop MATLAB codes for various array related relational, logical operations.
- CO4 - Develop MATLAB codes for DC and AC analysis of various electronic circuits.
- CO5 - Evaluate the characteristics of open loop and closed loop systems using MATLAB.
- CO6 - Design an electronic circuit using MATLAB and Pspice.

TEXT / REFERENCE BOOKS

1. John Okyere Attia, "Electronic and Circuit Analysis Using MATLAB" CRC Press, 2004.
2. Muhammad H.Rashid, "Introduction to PSPICE using ORCAD for circuits and electronics",3rd Edition, Prentice Hall of india Private Limited,2010.
3. Alok Jain, "Power Electronics: Devices, Circuits & Matlab Simulations", Penram international Publication, 1st Edition
4. Mohammed Rashid, "Power Electronics circuits, Devices and Applications",3rd edition, PHI publishing company,2010
5. Duane Hansel Man, "Mastering Matlab-7",Bruce Little Field,Pearson education Ltd,1st Edition,2009.
6. Cleve B.Moler, "Numerical Computing with Matlab, Society for Industrial & Applied Mathematics ", 2004.
7. John Okyere Attia, "PSPICE and MATLAB for Electronics" CRC Press, 2009.

END SEMESTER EXAM QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration: 3 Hrs.

PART A: 10 questions of 2 marks each - No choice

20 Marks

PART B: 2 questions from each unit of internal choice, each carrying 16 marks

80 Marks