



SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)

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

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School of Electrical & Electronics

Department of Electrical & Electronics Engineering

1.1.3 Courses having focus on Employability / Entrepreneurship / Skill Development

Programme: B.E. – Electrical and Electronics Engineering

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SECA1101	ELECTRONIC DEVICES	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To acquaint the students with the construction, theory and operation of the basic electronic devices such as PN junction diode, Bipolar and Field effect Transistors, Power control devices, LED, LCD and other Opto-electronic devices.
- To understand the mechanisms of current flow in semi-conductors.
- To familiarize on the principle of operation, capabilities and limitation of various advanced semiconductor devices and its practical application.
- To design practical circuits with alternate electronic devices.
- To study about the display devices and power semiconductors.

UNIT 1 SEMICONDUCTOR DIODE

9 Hrs.

PN junction diode- construction and operation, Current equations, Diffusion and drift current densities, forward and reverse bias characteristics, Breakdown in PN Junction Diodes. Applications- Rectifiers, Limiting and Clamping Circuits, Zener diode- construction and VI characteristics.

UNIT 2 BIPOLAR JUNCTION TRANSISTOR

9 Hrs.

Bipolar junction transistors, NPN -PNP, construction, forward and reverse bias characteristics -Early effect, current equations- Input and Output characteristics of CE, CB CC- Ebers Moll Model- Multi Emitter Transistor, Gummel Poon-model.

UNIT 3 FIELD EFFECT TRANSISTORS

9 Hrs.

JFETs – Drain and Transfer characteristics, -Current Equations-Pinch off voltage and its significance- MOSFET- Characteristics- Threshold voltage -Channel length modulation, D-MOSFET, E-MOSFET- Characteristics – Comparison of MOSFET with JFET, DUAL GATE MOSFET.

UNIT 4 SPECIAL SEMICONDUCTOR DEVICES

9 Hrs.

Schottky barrier diode-SCR, DIAC, TRIAC, Varactor diode, Tunnel diode, UJT, LDR, Photo transistor, Gallium Arsenide device.

UNIT 5 POWER DEVICES AND DISPLAY DEVICES

9 Hrs.

Power BJT- Power MOSFET- DMOS-VMOS, CRO, LASER diode, Operation of LCDs, Plasma, LED, Opto-Coupler, Solar cell, CCD.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Apply the knowledge of basic semiconductor materials and understand fabrication processes.
- CO2 - Analyse the characteristics of various electronic devices like diode, transistor etc.,
- CO3 -Examine the various circuit configurations of Transistor and MOSFETs.
- CO4 - Examine the various of Power electronic Devices.
- CO5 - Evaluate the performance of various Display Devices.
- CO6 - Develop power devices for various applications.

TEXT / REFERENCE BOOKS

1. Donald A Neaman, "Semiconductor Physics and Devices", Fourth Edition, Tata Mc GrawHill Inc. 2012.
2. Salivahanan.S, Suresh Kumar. N, Vallavaraj.A, "Electronic Devices and Circuits", Third Edn, Tata McGraw- Hill, 2008.
3. David Bell, "Fundamentals of Electronic Devices and Circuits", 5th Edition, Oxford University Press 2012..
4. Robert Boylestad and Louis Nashelsky, "Electron Devices and Circuit Theory", Pearson Prentice Hall, 10th edition, July 2008.
5. R.S.Sedha, "A Text Book of Applied Electronics", S.Chand Publications, 2006.
6. Edward S.Yang, "Fundamentals of Semiconductor devices", McGraw Hill International Edition, 1978.

SCSA1102	FUNDAMENTALS OF PYTHON PROGRAMMING	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To understand why Python is a useful scripting language for developers.
- To learn how to use lists, tuples, and dictionaries in Python programs.
- To learn how to build and package Python modules for reusability.
- To learn how to read and write files in Python.
- To learn how to use exception handling in Python applications for error handling.
- To learn how to design and program Python applications.

UNIT 1 INTRODUCTION

9 Hrs.

History of Python- Introduction to the IDLE interpreter (shell) -Expressions – Data Types - Built-in function - Conditional statements - Iterative statements- Input/output -Compound Data Types - Nested compound statements – Introduction to Object Oriented Concepts.

UNIT 2 FILES AND EXCEPTIONS HANDLING, MODULES, PACKAGES

9 Hrs.

File Operations –Iterators - Exception handling - Regular Expressions- Creating Modules-Import Statement-Introduction to PIP-Installing Packages via PIP-Using Python Packages.

UNIT 3 GUI PROGRAMMING

9 Hrs.

GUI Programming in Python - Introduction to GUI library - Layout management - Events and bindings - Fonts – Colours - Canvas - Widgets (frame, label, button, check box, entry, listbox, message, radiobutton, text, spinbox).

UNIT 4 DATABASE AND NETWORK

9 Hrs.

Database (using NoSQL):Connector Module –Cursor – Statements - Exceptions in database.Network connectivity: Socket module - Client – Server – Email – URL Access.

UNIT 5 CASE STUDY

9 Hrs.

Web Programming using Python. Image Processing – Facebook Analysis – Twitter Analysis.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, the student will be able to

- CO1 - Develop programs with input, output and conditional statements using Python.
- CO2 - Handle effectively data handling types.
- CO3 - Design GUI Applications in Python.
- CO4 - Develop Client Server network applications using Python.
- CO5 - Connect to database package and manipulate the data.
- CO6 - Develop solution for real life situational problems.

TEXT / REFERENCE BOOKS

1. Y.Daniel Liang, "Introduction to Programming using python", pearson 2013.
2. Paul Gries, Jennifer Campbell, Jason Montojo, "Practical Programming. An Introduction to Computer Science using python 3", pragmatic bookshelf, 21E 2014.
3. Magnus Lie Hetland, "Beginning Python: From Novice to Professional" , Apress.

SEEA1202	DC MACHINES AND TRANSFORMERS	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- To analyze the electromechanical system.
- To impart knowledge in construction details, principle operation and performance characteristics of DC machines and transformer.
- To evaluate the different losses and performance of DC machines and transformer using different testing methods.
- To analyze the performance characteristics of DC machines.
- To impart knowledge in three phase transformer connection.

UNIT 1 MAGNETIC CIRCUITS

9 Hrs.

Definition of MMF, Flux and Reluctance - Leakage Factor - Reluctances in Series and Parallel (Series and Parallel Magnetic Circuits)- Electromagnetic Induction - Fleming's Rule - Lenz's Law - Faraday's laws -statically and dynamically induced EMF- Self and mutual inductance – Analogy of Electric and Magnetic Circuits.

UNIT 2 D.C.GENERATORS

9 Hrs.

Constructional Details - Principle of Operation - E.M.F Equation - Methods of Excitation - Types – losses and efficiency- No load and Load characteristics of Series, Shunt and Compound generators - Armature Reaction, Effects, Methods of Compensation – Commutation - Methods of Improving Commutation – Applications.

UNIT 3 D.C MOTORS

9 Hrs.

Principle of Operation - Back E.M.F and Torque Equation - Characteristics of Series, Shunt & Compound Motors -Starters - Speed Control of DC Series & Shunt Motors - Testing of DC Machines - **Brake Test, Swinburne's Test & Hopkinson's Test.**

UNIT 4 SINGLE PHASE TRANSFORMER

9 Hrs.

Principle of Operation - Constructional Details - E.M.F. Equation - Transformation Ratio - losses and efficiency – Transformer on No Load - Parameters Referred to HV / LV Windings - Equivalent Circuit - Transformer On Load - Phasor diagram - Regulation - **Testing of Transformer - Open Circuit and Short Circuit Test - All day Efficiency - Sumpner's Test.**

UNIT 5 THREE PHASE AND SPECIAL TRANSFORMERS

9 Hrs.

Auto Transformer - Saving of copper in comparison with Two winding Transformer - **Parallel Operation of Single Phase Transformers** - Construction of Three Phase Transformer - **Transformer Connections – Scott connection** - Three Phase to Single Phase Transformer conversion - Elementary Ideas on Instrument Transformers and Toroidal Transformer.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Apply the magnetic circuit concept to electrical machines.
- CO2 - Examine the performance of DC generator.
- CO3 - Analyze the testing methods to determine the performance of DC motor.
- CO4 - Evaluate the performance of a single- phase transformer.
- CO5 - Determine the amount of copper saved in auto transformer.
- CO6 - Investigate the transformer connection for various applications.

TEXT / REFERENCE BOOKS

1. A K Theraja & B L Thereja, "A Text book of Electrical Technology (Vol II)", S Chand & Co- 23rd Edition 2008.
2. I J Nagrath and D P Kothari, "Electrical Machines", Tata McGraw Hill Publishing Company Limited New Delhi, 3rd Edition, 2007.
3. R.K.Rajput, "Electrical Machine", Laxmi Publications, 5th Edition 2008.
4. S K Sen, "Electrical Machinery", Khanna Publishers, New Delhi, Reprint 2002.
5. John Hindmarsh, U.M.I.S.T England, "Electrical Machines & their applications", Pergamon, 4th edition 2014.

SECA1305	ELECTRONIC CIRCUITS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To familiarize the student with the design and analysis of Rectifiers and power supplies.
- To understand different Transistor biasing circuits.
- To understand Small signal analysis of FET and MOSFET amplifiers.
- To understand working of feedback amplifiers, oscillators, tuned amplifiers and multivibrators.

UNIT 1 RECTIFIERS AND POWER SUPPLIES

9 Hrs.

Half Wave Rectifier - Full Wave Rectifier - Bridge Rectifier - Performance of Rectifiers - Filters - Types of Filters - L, C, LC and π Filters - Ripple Factor Calculation for C, L, LC and π Filter - **Regulators - Shunt and Series Voltage Regulator - SMPS.**

UNIT 2 SMALL SIGNAL AMPLIFIERS

9 Hrs.

Biasing circuit of BJT, DC equivalent circuit of BJT, DC and AC Load Lines, Stability factor analysis, Two port devices and hybrid model - transistor hybrid model and h parameters - determination of h-parameters from the characteristics - Analysis of transistor amplifier using h -parameters - Low frequency FET model -Common Source and Common drain amplifiers.

UNIT 3 MULTI STAGE AMPLIFIERS AND LARGE SIGNAL AMPLIFIERS

9 Hrs.

Cascading amplifiers - direct coupled and capacitor coupled two stage CE amplifiers - Darlington Pair - Cascode Amplifier- Bootstrap amplifier- Classification of Power amplifiers - Class A Power Amplifier- direct and Transformer coupled amplifiers - Class B Push-pull arrangements and Complementary symmetry amplifiers - efficiency calculations, Amplifier distortion, power dissipation - Class AB amplifier - Power transistor heat sinking - Class C and D amplifiers.

UNIT 4 FEEDBACK AMPLIFIERS AND OSCILLATORS

9 Hrs.

Feedback Amplifiers: Feedback concept - General characteristics of negative feedback amplifiers - Four basic types of feedback topologies - Voltage and current feedback amplifiers. Oscillators: Barkhausen criterion - LC oscillators - Analysis of Hartley, colpitts - RC oscillators - Phase shift and wein bridge types and analysis - Crystal oscillators and frequency stability.

UNIT 5 TUNED AMPLIFIERS AND MULTI VIBRATORS

9 Hrs.

Tuned Amplifiers - single tuned -double tuned -stagger tuned amplifiers - Instability of Tuned Amplifier - Neutralization and Unilateralization - Multivibrators - Collector coupled Astable, Monostable and Bistable Multivibrators.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Analyze the equivalent circuits and characteristics of basic electronics devices.

CO2 - Analyze basic linear electronics circuits and their working principle.

CO3 - Design suitable DC Power supplies for world.

CO4 - Design suitable multistage amplifiers for real world.

CO5 - Design negative feedback amplifier circuits and oscillators.

CO6 - Analyze various solid state power amplifier circuits.

TEXT / REFERENCE BOOKS

1. S Millman and Halkias, "Integrated Electronics", Tata McGraw Hill International, 2008.
2. R.L. Boylestad and L. Nashelsky, "Electronic Devices and Circuit Theory", PHI Learning Pvt. Ltd, India, 9th edition, 2008.
3. D.Roy Choudhury & Shail B Jain, "Linear Integrated Circuits", 3rd edition. 2007.
4. David. A. Bell, "Electronic Devices and Circuits", PHI Learning Private Ltd, India, 4th edition 2008.
5. R.A. Gayakwad, "Op-Amps and Linear integrated circuits", PHI, 2008.

SEEA1303	AC MACHINES	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- To impart knowledge on Construction and principle operation of Asynchronous and Synchronous machines.
- To impart knowledge on not self-starting AC machines.
- To convey knowledge on speed control of three-phase induction motors.
- To analyze performance characteristics of Synchronous and Asynchronous machines.
- To convey knowledge on synchronized operation of an Alternator with an Infinite bus bar.

UNIT 1 SYNCHRONOUS GENERATORS

10 Hrs.

Constructional features - EMF Equation - Armature Reaction - Synchronous Reactance - Voltage Regulation - Synchronous Impedance Method - MMF and Potier Methods - Synchronising & Parallel Operation - Two Reaction Theory - Determination of X_d and X_q (Slip test).

UNIT 2 SYNCHRONOUS MOTORS

9 Hrs.

Principle of Operation - Starting Methods - Effect of Increased Load with Constant Excitation - Effect of Changing Excitation on Constant Load - Different Torque - Power flow equation - Phasor diagram - V and inverted V curves - Hunting and suppression methods.

UNIT 3 THREE PHASE INDUCTION MOTORS

9 Hrs.

Construction - Types of 3- Phase Induction Motors - Rotating Magnetic Fields - Torque Equation - Condition for Maximum Torque - Slip, Torque Slip Characteristics - Power Stages in Induction Motors - Losses and Efficiency - Plugging - Cogging and Crawling - Concept of Induction Generator.

UNIT 4 CIRCLE DIAGRAM AND CONTROL METHODS OF 3- PHASE INDUCTION MOTOR

9 Hrs.

No load and Blocked rotor tests - Equivalent circuit - Construction of Circle diagram - Starting methods - Speed control - Double cage Induction motor.

UNIT 5 SINGLE PHASE AC MOTORS

8 Hrs.

Double Field Revolving Theory - Types of Single- Phase Induction Motor - Equivalent Circuit (Qualitative) - Repulsion Motor - Series Motor - Universal motor, AC Servomotor, Linear Induction Motor, Hysteresis motor.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Apply relevant principles to predetermine the regulation of a Synchronous Generator.
- CO2 - Analyze the operation of synchronous motor under various excitation conditions.
- CO3 - Analyze the performance of three phase induction motor.
- CO4 - Realize the various methods of starting and testing of three phase induction motor.
- CO5 - Analyze the equivalent circuit of single- phase induction motor.
- CO6 - Select a suitable AC motor for particular application.

TEXT / REFERENCE BOOKS

1. A K Theraja & B L Thereja, "A Text book of Electrical Technology (Vol II)", S Chand & Co., 23rd Edition 2008.
2. D.P. Kothari and I.J. Nagrath, "Electric Machines", Tata McGraw Hill Publishing Company Ltd, 2002.
3. A.E. Fitzgerald, Charles Kingsley, Stephen. D.Umans, "Electric Machinery", Tata Mc Graw Hill Publishing Company Ltd, 2003.
4. M.N.Bandyopadhyay, "Electrical Machines Theory and Practice", PHI Learning Pvt. Ltd., New Delhi, 2009.
5. Charless A. Gross, "Electric / Machines", CRC Press, 2010.

SCSA1202	PROGRAMMING WITH C AND C++	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- To learn the fundamental programming concepts and methodologies which are essential to building good C/C++ program.
- To demonstrate a thorough understanding of modular programming by designing programs which require the use of programmer-defined functions.
- To impart the knowledge about pointers which is the backbone of effective memory handling.
- To demonstrate adeptness of object oriented programming in developing solutions to problems demonstrating usage of data abstraction, encapsulation, and inheritance.

UNIT 1 BASICS OF C PROGRAMMING

9 Hrs.

Introduction to C: Features of C - Structure of C program-Data Types-'C' Tokens-Input/output statements-Control Statement, Functions: – Types of Functions –Recursion.

UNIT 2 ARRAYS, STRINGS AND STRUCTURES

9 Hrs.

Arrays : Single and Multidimensional Arrays— Array as Function Arguments, Strings: String Handling Functions, Structure: Nested Structures – Array of Structures – Structure as Function Argument–Function that Returns Structure, Union.

UNIT 3 POINTERS AND FILE PROCESSING

9 Hrs.

Pointers: Introduction, Arrays Using Pointers – Structures Using Pointers – Functions Using Pointer, Dynamic Memory Allocation, Storage Classes, File Handling in 'C'.

UNIT 4 OBJECT ORIENTED PROGRAMMING CONCEPTS

9 Hrs.

Introduction-Procedure vs. object oriented programming-Concepts: Classes and Objects-Operator & Function Overloading-Inheritance-Polymorphism and Virtual Functions.

UNIT 5 TEMPLATES AND EXCEPTION HANDLING

9 Hrs.

Function Templates and Class Templates – Name spaces – Standard Template Library - Casting – Exception Handling – case study.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, the student will be able to

- CO1 - Develop simple applications in C using basic constructs.
- CO2 - Design and Implement applications using arrays and strings.
- CO3 - Develop and Implement applications using memory allocation and File concepts.
- CO4 - Apply proper class protection to provide security.
- CO5 - Examine the reusability of code through Inheritance.
- CO6 - Analyze virtual functions to implement polymorphism.

TEXT / REFERENCE BOOKS

1. Deitel and Deitel, "C how to Program", 7th Edition, Pearson Education, 2013.
2. Brian W.Kernighan and Dennis M.Ritchie, "The C Programming Language", Pearson Education, 2015.
3. Yashavant Kanetkar, "Understanding Pointers in C", 4th Revised & Updated Edition, Bbp Publications, 2008.
4. E Balagurusamy, "Object Oriented Programming with C++", 3rd edition, Tata McGraw Hill, 2006.
5. Bhav, "Object Oriented Programming with C++", Pearson Education, 2004.
6. John R Hubbard, "Programming with C++", Schaums Outline Series, McGraw Hill, 2nd edition, 2009.
7. Bjarne Stroustrup, "Programming: Principles and Practice using C++", 1st Edition, Addison Wesley Publications, 2008.

SEEA1401	POWER ELECTRONICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To impart knowledge on different types of power semiconductor devices and its switching characteristics.
- To study the operation, characteristics and performance parameters of controlled rectifiers.
- To understand the operations of choppers and inverters.
- To get acquainted with the applications of power electronics converters.

UNIT 1 POWER SEMICONDUCTOR DEVICES

9 Hrs.

Overview of V-I characteristics of switching devices - Switching characteristics of Power Diode, Power BJT, Power MOSFETS, IGBT and Thyristor - SCR Protection circuits - Thyristor Turn-ON methods - Firing circuits - Commutation techniques.

UNIT 2 PHASE CONTROLLED RECTIFIERS

10 Hrs.

Principle of phase controlled converter operation - single phase half wave converter, semi converter & full converter with R, RL & RLE load - Freewheeling diode - Inverter operation of full converter - Three phase Semi converter & full converter with RL load.

UNIT 3 DC & AC CHOPPERS

9 Hrs.

DC - DC: Principle of operation of Step down and step up choppers - Control Strategies - One, Two and Four quadrant operation. AC - AC Chopper: Single phase AC voltage controllers with R & RL load - Multistage sequence control. Single phase step up and step down cycloconverters.

UNIT 4 INVERTERS

9 Hrs.

Principle of operation: Single phase half bridge & full bridge voltage source inverters –Series Inverters – Parallel Inverters. Three phase Voltage source inverters (120° and 180° mode) - Single phase current source inverter. PWM techniques: Single pulse PWM, Sinusoidal PWM, Modified sinusoidal PWM and multiple PWM.

UNIT 5 APPLICATIONS

8 Hrs.

SMPS: Flyback and Push Pull - UPS: Redundant and Non-Redundant - HVDC Transmission systems – DC – DC converters for Electric Vehicles - Inverters for standalone photovoltaic systems.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Examine the V – I and Switching Characteristics of various Semiconductor Devices.
- CO2 - Evaluate the various performance parameters of different converters.
- CO3 - Analyze different Chopper Circuits.
- CO4 - Design various Inverters based on real time applications.
- CO5 - Analyze the Knowledge acquired in Power Electronics for High voltage applications.
- CO6 - Design Power Electronic Converters to enhance the performance of Renewable Energy sources.

TEXT / REFERENCE BOOKS

1. Rashid M.H., "Power Electronics circuits Devices and Applications", Prentice Hall, 3rd Edition, New Delhi, 2013.
2. P.S.Bimbhra, "Power Electronics", Khanna Publishers, 4rd Edition, 2017.
3. P.C.Sen, "Power Electronics", Tata Mc Graw Hill Company, New Delhi, 2015.
4. M.D.Singh and K.B.Khanchandani, "Power Electronics" TMH, New Delhi, 2nd Edition, 2008.
5. Ned Mohan, Tore .M. Undel and William P. Robbins "Power Electronics: Converters, Applications and Design", John Wiley & Sons, 3rd Edition, 2003.
6. Philip T. Kerin, "Elements of Power Electronics" Oxford University Press, 2004 Edition.

SEEA1402	TRANSMISSION AND DISTRIBUTION	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- To impart knowledge about the fundamental concepts of electrical power transmission & distribution, both AC & DC and busbar arrangements.
- To interpret the transmission line parameters and performance of overhead transmission system.
- To have a knowledge on insulators and cables.
- To introduce the need of FACTS technology and high voltage AC and DC transmission.

UNIT 1 STRUCTURE OF ELECTRIC POWER SYSTEM

10 Hrs.

Single Line Diagram - Distributors with Concentrated and Uniform Loading - DC Two Wire and Three Wire Systems - AC Distributors - Radial and Ring Distributors - Interconnectors - **Electrical Layout & Bus Bar Arrangement in Generating Sub Stations and Bulk Power Substation** - Kelvin's Law for the Design of Feeders and its Limitations.

UNIT 2 TRANSMISSION LINE PARAMETERS

9 Hrs.

Resistance, Inductance and Capacitance of Single Phase and Three Phase (Including Double Circuits) Transmission Lines - Stranded and Bundled Conductors - Symmetrical and Unsymmetrical Spacing - Transposition - Application of Self and Mutual GMD - Skin and Proximity Effect - Inductive Interference with Neighboring Circuits - Corona - Factors Affecting Corona - Advantages and Disadvantages of Corona - Methods of Reducing Corona Effect.

UNIT 3 PERFORMANCE OF TRANSMISSION LINES

9 Hrs.

Equivalent Circuits for Short, Medium (π and T circuits) and Long Lines - Efficiency and Regulation - Attenuation Constant, Phase Constant, Surge Impedance and Surge Impedance Loading - Real and Reactive Power Flows in Lines - Power Circle Diagrams for Receiving and Sending Ends - Ferranti Effect.

UNIT 4 INSULATORS, CABLES AND MECHANICAL DESIGN OF OH LINES

9 Hrs.

Insulators - Types and Construction - Voltage Distribution in String Insulator - string Efficiency - Methods of Improving String Efficiency - Cables - types - Capacitance of Cables - Insulation Resistance - Dielectric Stress and Grading - Dielectric Loss - Thermal Characteristics - capacitance of Three Core Cables - Stress and Sag Calculations - Effect of Wind and Ice - Supports at Different Levels - stringing Chart.

UNIT 5 RECENT TRENDS IN TRANSMISSION

8 Hrs.

Extra High Voltage AC (EHVAC) Transmission - Need, Advantages, Limitations - High Voltage Direct current Transmission (HVDC) - Terminal Equipment for HVDC Systems - Classifications, Advantages, Limitations - Economic Distance for HVDC - Comparison of EHVAC and HVDC Transmission - Interconnection of HVDC & AC Systems - **Voltage Control of Lines** - **Introduction to FACTS Technology - SVC, TCSC, STATCOM, UPFC.**

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Apply basic circuit knowledge on calculating voltage-current for transmission and distribution system.
- CO2 - Evaluate transmission line parameters for single and three phase system.
- CO3 - Analyze the performance of over head transmission line.
- CO4 - Design the overhead transmission line on mechanical aspect and estimate the performance parameters of line insulator and cables.
- CO5 - Develop compensation techniques for transmission line using FACTS devices.
- CO6 - Examine the economic aspects of high voltage transmission (AC and DC).

TEXT / REFERENCE BOOKS

1. C.L. Wadhwa, "Electrical Power Systems", 6th Edition, New Age International (P) Limited, New Delhi, 2010.
2. V.K. Metha & Rohit Metha, "Principles of Power System", S. Chand, 3rd Edition, 2006.
3. S.L. Uppal, Electrical Power, Khanna Publishers, New Delhi, 2006.
4. Chakrabarti A., Soni M.I., Gupta P.V., "Textbook on power system engineering", Dhanpat Rai & Co., 2008.
5. S.N. Singh, "Electric Power Generation, Transmission & Distribution", Prentice Hall of India, New Edn, New Delhi, 2008.
6. Soni, Bhatnagar and Gupta, "Electrical Power", Dhanpat Rai & Sons, New Delhi, 2006.
7. Colin R. Bayliss, Brian Hardy, 4th Edition, "Transmission and Distribution Electrical Engineering", Newnes, 2012.

SEEA1403	INDUSTRY 4.0 For ELECTRICAL ENGINEERS	L	T	P	Credits	Total Marks
		2	0	0	2	100

COURSE OBJECTIVES

- To impart basic idea in Industry 4.0.
- To provide students with good depth of knowledge of designing Industrial 4.0 Systems for various application.
- Learn the design and analysis of Industry 4.0 systems for Energy and smart vehicular applications.

UNIT 1 INTRODUCTION TO INDUSTRY 4.0

9 Hrs.

Introduction, Historical Context, General framework, Application areas, Dissemination of Industry 4.0 and the disciplines that contribute to its development, Artificial intelligence, The Internet of Things and Industrial Internet of Things, Additive manufacturing, Robotization and automation, Current situation of Industry 4.0. Introduction to Industry 4.0 to Industry 5.0 Advances.

UNIT 2 INDUSTRY 4.0 AND CYBER PHYSICAL SYSTEM

9 Hrs.

Introduction to Cyber Physical Systems (CPS), Architecture of CPS, Data science and technology for CPS, Prototypes of CPS, Emerging applications in CPS, Domain applications of CPS: Agriculture, Infrastructure, Disaster management, Energy, Transportation. Case study: **Application of CPS in health care domain.**

UNIT 3 SMART ENERGY SOURCES

9 Hrs.

Energy Storage for Mitigating the Variability of Renewable Electricity Sources- Types of electric energy storage, Potential of Sodium-Sulfur Battery Energy Storage to Enable Integration of Wind-Case study. Electric Vehicles as Energy Storage: **V2G Capacity Estimation.**

UNIT 4 SMARTGRID

9 Hrs.

Smart grid definition and development Smart Grid, Understanding the Smart Grid, **Smart grid solutions, Design challenges of smart grid and Industry 4.0, Building the Smart Grid-Case study.**

UNIT 5 SMART APPLICATIONS

9 Hrs.

Understanding Smart Appliances -Smart Operation-Smart Monitoring-Smart Energy Savings-Smart Maintenance, Case study- **Smart Cars, Self-Driving Cars, Introducing Google's Self-Driving Car, Intellectual Property Rights.**

Max. 45 Hrs.

COURSE OUTCOMES

- On completion of the course, student will be able to
- CO1 - Understand the basic concepts of Industry 4.0 and the other related fields.
 - CO2 – Understand cyber physical system and the emerging applications.
 - CO3 - Analyze the different energy storage systems
 - CO4 - Analyze a smart grid system.
 - CO5 – Implement the industry 4.0 to solve engineering problems.
 - CO6 – Design of smart vehicle and analyze its performance.

TEXT / REFERENCE BOOKS

1. Jean-Claude André, —Industry 4.0II, Wiley- ISTE, July 2019, ISBN: 781786304827,2019.
2. Diego Galar Pascual, Pasquale Daponte, Uday Kumar, —Handbook of Industry 4.0 and SMART SystemsII Taylor and Francis,2020.
3. Miller M, —The internet of things: How smart TVs, smart cars, smart homes, and smart cities are changing the worldII, Pearson Education, 2015, ISBN: 9780134021300. Klaus Schwab, “Fourth Industrial Revolution”, Random House USA Inc, New York, USA, 2017.
4. Pengwei Du and Ning Lu, —Energy storage for smart grids: planning and operation for renewable and variable energy resources VERs II, Academic Press, 2018, Reprint edition, ISBN-13: 978-0128100714.
5. Hossam A. Gabbar, —Smart Energy Grid EngineeringII, Academic Press, 2017, ISBN 978-0-12- 805343-0..
6. Mini S. Thomas, John Douglas McDonald, —Power System SCADA and Smart GridsII, CRC Press, 2017.

SECA1502	ANALOG INTEGRATED CIRCUITS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To have thorough understanding of Op-Amp.
- To be able to design circuits using op amp for various applications.
- To acquire knowledge about ADC and DAC.
- To study the basic principles of PLL and Timer Circuit.
- To understand the concept of Special function ICs.

UNIT 1 INTRODUCTION TO OP- AMP AND ITS APPLICATIONS.

9 Hrs.

OP-AMP- DC and AC Characteristics- Input offset voltage- Input bias current-Input offset current- Total output offset voltage- Thermal drift- Slew rate- CMRR -Inverting amplifier- Non-inverting amplifier- Voltage follower- Summing and differential amplifier- Integrator- Differentiator- Logarithmic and Anti logarithmic amplifiers-Comparator and Schmitt trigger.

UNIT 2 FILTERS AND SIGNAL GENERATORS

9 Hrs.

First order and Second order Butterworth filters- low pass, high pass, band pass and band reject filters -RC phase shift, Wein's bridge oscillator- Astable and Monostable multivibrator-Precision half wave and full wave rectifiers.

UNIT 3 A/D AND D/A CONVERTERS

9 Hrs.

Sample and Hold circuit - Digital to analog converters: R-2R ladder network and Binary weighted - Characteristics of D/A converters - Analog to digital converters: Flash converter - Successive approximation converter - Dual slope ADC-Weighted-Capacitor DACs- Oversampling Converters.

UNIT 4 PLL AND TIMER CIRCUITS.

9 Hrs.

Phase Locked Loop IC 565- Block schematic - Applications of PLL: FM demodulator and Frequency synthesizers Demodulator- VCO IC LM 566 - Timer IC LM 555 and its applications: Astable and Monostable multivibrator.

UNIT 5 SPECIAL FUNCTION ICs

9 Hrs.

Integrated circuit Tuned amplifier, Instrumentation Amplifier, Monolithic voltage regulators 78XX,79XX Series ,Opto coupler, CMOS Operational Amplifier- Dc analysis- small signal analysis- specifications of IC MC 14573.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Design Summer, Subtractor, Multiplier and Divider circuits using op-amp.
- CO2 - Design filter circuits using analog IC's.
- CO3 - Design the op-amp based ADC and DAC converters.
- CO4 - Design suitable op-amp based circuits for the generation of sine, square and triangular waveforms..
- CO5 - Able to use OP Amp to generate sine waveform, Square wave form, Triangular wave forms.
- CO6 - Able to use OP Amp as analog to digital and digital to analog converter.

TEXT / REFERENCE BOOKS

1. Ramakant A.Gayakwad, "OP-AMP and Linear ICs", 4th Edition, Prentice Hall / Pearson Education, 2015.
2. D.RoyChoudary, Shail Jain, "Linear Integrated Circuits", New Age International Pvt. Ltd., 2000.
3. Grey and Meyer, "Analysis and Design of Analog Integrated Circuits", 4th Edition, Wiley International, 2001.
4. Michael Jacob, "Applications and Design with Analog Integrated Circuits", 2nd Edition, Prentice Hall of India, 1993.
5. S. Salivahanan, V.S. Kanchana Bhaaskaran, "Linear integrated circuits", 3rd Edition, McGraw-Hill, 2011.
6. William D.Stanely, "Operational Amplifiers with Linear Integrated Circuits", 4th Edition, Pearson Education, 2004.
7. Sergio Franco "Design with Operational Amplifiers and Analog Integrated Circuits" 4th edition, McGraw-Hill Education, 2015.

SECA1507	DIGITAL SIGNAL PROCESSING AND ITS APPLICATIONS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To impart basic ideas in discrete signals and systems.
- To gain knowledge of Analog and Digital filter design with various structural realizations.
- To learn DSP controller pertaining to Power Electronics via programming.

UNIT 1 INTRODUCTION TO DISCRETE TIME SIGNALS, SYSTEMS AND Z –TRANSFORM 9 Hrs.

Sampling theorem, Quantization, Quantization error, Aliasing- mathematical representation of signals, Classifications of Signals and Systems - Review of Z transform & Inverse Z Transform-ROC–Time response analysis using standard test signals (step and ramp) – linear convolution- Correlation.

UNIT 2 DISCRETE FOURIER TRANSFORM AND COMPUTATION 9 Hrs.

Discrete Time Fourier Transform analysis(DTFT), Discrete Fourier Transform (DFT)- Properties of DFT- frequency response analysis-magnitude and phase response, circular convolution, FFT computations using radix-2 Decimation in Time (DIT) and Decimation in frequency(DIF) algorithms.

UNIT 3 DESIGN OF INFINITE IMPULSE RESPONSE FILTER (IIR) 9 Hrs.

Design of IIR filters using Impulse invariant and Bilinear transformation method- Prewarping. Review of Butterworth and Chebyshev approximations- Frequency transformation in analog domain- Filter design using Butterworth and Chebyshev- Realization of recursive structures-Direct form-I-Direct form-II-Cascade-Parallel Forms.

UNIT 4 DESIGN OF FINITE IMPULSE RESPONSE (FIR) FILTER 9 Hrs.

Properties of IIR and FIR filters - Filter design using windowing techniques - Hamming, Hanning, Blackman, Rectangular, Triangular windows- Digital filter design using Frequency sampling technique- Realization of Structures for FIR and Linear phase FIR filter- Direct form-Transposed form- Cascaded form, Elementary Ideas of Finite Word Length effects in Digital Filters.

UNIT 5 DSP APPLICATIONS USING TMS 320C24X PROCESSOR 9 Hrs.

Nomenclature- TMS 320 family overview -Architectural Overview-Central Processing unit – Addressing modes- Event Manager- General purpose timers (GPR)- Full compare Unit (FCU)- Dead band unit- **simple programs for PWM generation using GPR and FCU pertaining to Power Electronic applications.**

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Analyze various signals, systems and transforms.
- CO2 - Apply Discrete-Fourier Transform and Fast Fourier Transform on discrete time signals.
- CO3 - Design IIR digital filters for suitable applications.
- CO4 - Design and analyze FIR digital filters.
- CO5 - Comprehend the architecture of digital signal processing controller (TMS320CX2407).
- CO6 - Develop ALP for motor control application using TMS320CX2407.

TEXT / REFERENCE BOOKS

1. John G. Proakis & Dimitris G.Manolakis, "Digital Signal Processing - Principles, Algorithms & Applications", 4th Edition, Pearson education / Prentice Hall, 2007.
2. Emmanuel C..Ifeachor, & Barrie.W.Jervis, "Digital Signal Processing", 2nd Edition, Pearson Education / Prentice Hall, 2002.
3. Alan V.Oppenheim, Ronald W. Schafer & Hohn. R.Back, "Discrete Time Signal Processing", Pearson Education, 2nd Edition, 2005.
4. Andreas Antoniou, "Digital Signal Processing", Tata McGraw Hill, 2001.

SECA1508	MICROPROCESSOR, INTERFACING AND ITS APPLICATIONS	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- To impart the knowledge of 8085 and 8086 processor.
- To develop assembly language program in 8085/8086 processor.
- To introduce the peripheral devices.
- To acquire the knowledge of interfacing and hardware implementation.

UNIT 1 8085 MICROPROCESSOR

9 Hrs.

8085 Architecture-Timing Diagram-Interrupts-Addressing Modes-Instruction Formats-Instruction Set-Programming of 8085.

UNIT 2 8086 MICROPROCESSOR

9 Hrs.

8086 Architecture-Maximum and Minimum Mode-Memory Banks-Memory Segmentation-Programming Model -Instruction Set-Programming of 8086.

UNIT 3 PERIPHERALS INTERFACING USING 8085/8086

9 Hrs.

Introduction, memory and I/O interfacing, data transfer schemes, programmable peripheral interface (8255), programmable DMA controller (8257), programmable interrupt controller (8259), Universal synchronous asynchronous receiver transmitter (USART) (8251), programmable counter/interval timer (8254).

UNIT 4 INTERFACING CONCEPTS WITH 8085/8086

9 Hrs.

Switches-Matrix Keyboard-interfacing LED, 7 segment LED, LCD, Analog to Digital Converter (ADC), Digital to Analog Converter (DAC), Memory Interfacing (RAM and ROM).

UNIT 5 APPLICATIONS USING 8085/8086

9 Hrs.

Stepper motor interfacing with ULN2003-specific angle rotation, Motor speed control, Temperature control system, Traffic light control-6V relay to control AC Bulb-PWM generation for Single phase- controlled rectifier with specific firing angle.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Apply the basics of 8-bit processor to do real time automation programming.
- CO2 - Analyze the 16-bit processors with memory segmentation technique for better programming technique.
- CO3 - Examine the performance enhancement of microprocessor with various peripheral interfacing IC's.
- CO4 - Investigate the operation of various peripheral devices to implement in real time applications.
- CO5 - Design the interfacing circuits for real time applications.
- CO6 - Develop the control circuits for various motor controlled by 8085/8086.

TEXT / REFERENCE BOOKS

1. Ramesh Gaonkar, "Microprocessor Architecture, Programming and applications with 8085", 6th Edition, Penram International Publishing Pvt. Ltd., 2014.
2. Douglas V. Hall, "Microprocessor and its Interfacing", Tata McGraw Hill, Edited second Version, 2006.
3. Nagoor Kani A, "Microprocessor (8085) and its Applications", 2nd Edition, RBA publications, 2013.
4. Mathur A.P, "Introduction to Microprocessor", Tata McGraw Hill, 3rd Edition 2002.

SEEA1501	POWER SYSTEM ANALYSIS	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- To impart knowledge in modelling of power system elements.
- To implement Numerical methods in power flow problem.
- To analyze the system in various fault conditions.
- To have a knowledge in stability of power systems.

UNIT 1 POWER SYSTEM MODELING

9 Hrs.

Need for system analysis in planning and operation of power system - per phase analysis of symmetrical three-phase system. General aspects relating to power flow, short circuit and stability analysis - Modeling of generator, load, shunt capacitor, transmission line, shunt reactor for short circuit, power flow and stability studies -per unit representation - bus admittance by analytical method and direct inspection method.

UNIT 2 POWER FLOW ANALYSIS

9 Hrs.

Problem definition - bus classification - derivation of power flow equation - solution by Gauss Seidel and Newton Raphson methods by polar form - P V bus adjustments for both methods - computation of slack bus power, line flow and transmission loss.

UNIT 3 SYMMETRICAL SHORT CIRCUIT ANALYSIS

9 Hrs.

Need for short circuit study - Bus impedance matrix formation - Symmetrical short circuit analysis using Z-bus. - computations of short circuit capacity, post fault voltage and current.

UNIT 4 UNSYMMETRICAL SHORT CIRCUIT ANALYSIS

9 Hrs.

Symmetrical component transformation - sequence impedances. - Sequence Networks - unsymmetrical short circuit analysis for single line fault, line to line fault and double line to ground fault using Z-bus - computations of short circuit capacity, post fault voltage and current.

UNIT 5 STABILITY & SECURITY ANALYSIS

9 Hrs.

Distinction between steady state and transient state - Concepts of Stability & Security - Swing equation-solution to swing equation - step by step method - power angle equation - equal area criterion - critical clearing angle and time. Stability analysis of single machine connected to infinite bus by modified Euler's method - Multi-machine stability analysis using Runge Kutta method.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Model Impedance and Reactance networks for the given power system Network and formulate bus admittance matrix.

CO2 - Apply Y Bus in load flow analysis and examine the power flows and voltages in a power grid.

CO3 - Formulate bus impedance matrix and apply Z Bus in symmetrical short circuit analysis and evaluate the fault currents and post fault voltages.

CO4 - Model sequence networks and apply Z Bus in unsymmetrical short circuit analysis and evaluate the fault currents and post fault voltages.

CO5 - Analyze the transient and steady state stability conditions.

CO6 - Solve transient stability problems.

TEXT / REFERENCE BOOKS

1. John J. Grainger and Stevenson Jr. W.D., "Power System Analysis", Tata McGraw Hill, 2017.
2. Kothari .D.P and Nagarath.I.J., "Power system Engineering", 2nd Edition, Tata McGraw Hill, 2011.
3. Pai. M.A., "Computer Techniques in Power System Analysis", Tata McGraw-Hill Publishing Company Limited, New Delhi, 2006.
4. Nagarath, I.J. and Kothari, D.P., "Modern Power System Analysis", 4th Edition, Tata McGraw Hill Publishing Company, 2011.
5. Hadi Saadat, "Power system Analysis", Tata McGraw Hill Publishing Company, 3rd Edition, 2011.

SEEA1502	CONTROL SYSTEMS	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- To impart knowledge regarding the various types of system and different transfer function analyzing techniques associated with control systems.
- To analyze the response and error of various types of system in time domain.
- To understand the stability analysis of frequency domain systems.
- To analyze the open loop system in frequency domain.
- To implement the design of controllers and compensators.

UNIT 1 SYSTEM CONCEPTS

10 Hrs.

Types of System - Open Loop Systems, Closed Loop Systems, Basic Elements in Control System - Mathematical Models of Physical System: Differential Equation- Transfer Functions of Single Input, Single Output and Multi Variable Systems - Simple Electrical Networks, **Electrical Analogous of Mechanical Translational and Rotational System** - D.C and A.C Servomotor - Mechanical System- Translational and Rotational System - Block Diagram Reduction Techniques - Signal Flow Graphs - Mason's Gain Formula.

UNIT 2 TIME RESPONSE ANALYSIS OF CONTROL SYSTEMS

9 Hrs.

Standard Test Signals -Time Response of First and Second Order System, Time Domain- Specifications - Generalized Error Series - Steady State Error - Static and Dynamic Error Constants.

UNIT 3 STABILITY OF CONTROL SYSTEM

9 Hrs.

Characteristics Equation - Location of Roots in S Plane for Stability - Routh Hurwitz Criterion - Root Locus Analysis - Effect of Pole Zero Additions on Root Locus - Nyquist Stability Criterion.

UNIT 4 FREQUENCY RESPONSE ANALYSIS

9 Hrs.

Frequency Response of the System - Correlation between Time and Frequency Response - Gain and Phase Margin - Bode Plot - Nyquist Plot (Polar Plot).

UNIT 5 COMPENSATION AND CONTROLLERS

8 Hrs.

Introduction to compensation networks - Lag, Lead and Lag Lead networks - Effect of providing Lag, Lead and Lag-Lead compensation on system performance and design using bode plot - **P, PI, PID Controllers design.**

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Determine the transfer function for an electrical and mechanical system.
- CO2 - Analyze the response of any linear time invariant system.
- CO3 - Examine the stability of a system using Routh Hurwitz and root locus criterion.
- CO4 - Analyze the frequency response for linear time invariant system using bode plot and Nyquist plot.
- CO5 - Design a PI, PID controller in existing world problem.
- CO6 - Design lag, lead and lag-lead compensator network for real world problem.

TEXT / REFERENCE BOOKS

1. I.J.Nagarath and M.Gopal, "Control System Engineering" New Age International (p) Limited Publishers, 2nd Edition, 2009.
2. Kausuhio Ogata, "Modern Control Engineering", Prentice Hall of India PVT. Ltd, 5th Edition, 2010.
3. Richard Dorf, "Modern Control Systems", Pearson Education Ltd, 11th Edition 2009.
4. M.N. Bandyopadhyay, "Control Engineering, Theory and Practice" PHI, 4th print, 2006.
5. N.K.Sinha, "Control Systems", New Age International Private Limited Publishers, 3rd Edition, Reprint, 2008.
6. A.Nagoorkani, "Control System", RBA Publications, 3rd Edition, reprint 2012.
7. U.A.Bakshi and S.C.Goyal, "Control System Engineering", Technical Publication, 2nd Revised Reprint 2007.

SEEA1601	ELECTRICAL MACHINE DESIGN	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- To impart knowledge about engineering materials, calculation of mmf for air and iron path for rotating machines.
- To impart knowledge in design of armature and field system of DC machines.
- To impart knowledge in design of core, yoke, windings and cooling systems of transformer.
- To impart knowledge in design of stator and rotor of induction machines.
- To impart knowledge in design of stator and rotor of synchronous machines.

UNIT 1 INTRODUCTION

9 Hrs.

Major considerations in Machine design - Limitations in design - Standard specifications - Electrical Engineering materials - High conductivity materials - Insulating materials - Magnetic circuit calculations - mmf for airgap and iron path - real and apparent flux densities in rotating machines - Choice of specific electric and magnetic loadings.

UNIT 2 DC MACHINES

9 Hrs.

Output equation - Main Dimensions - Choice of number of poles - Armature design - Estimation of number of conductors / turns - Coils armature slots- Conductor dimensions - Slot dimension - Design of field poles and field coil (shunt field) - Design of Commutators and Brushes.

UNIT 3 TRANSFORMERS

9 Hrs.

Output equation - Design of core and winding of single phase shell and core type transformer and three phase transformers -Temperature rise in transformers - Design of tank, cooling tubes and Ducts.

UNIT 4 INDUCTION MOTORS

9 Hrs.

Output equation, Main dimensions, Design of stator, Choice of L/D ratio - Air gap length - Design of rotor - Squirrel cage and Slip ring rotor.

UNIT 5 SYNCHRONOUS MACHINES

9 Hrs.

Output equation - Design of salient pole rotor machine - Dimensions - Short circuit ratio - Effect of Short Circuit ratio - Air gap length - Armature design - Slot dimensions - Rotor design - Design of damper winding - Design of cylindrical rotors.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Analyze the mmf for rotating machines based on the major considerations.

CO2 - Apply the design procedure for DC machines.

CO3 - Analyze the design procedure for core, yoke, winding and cooling systems of transformer.

CO4 - Analyze the design procedure for stator and rotor of induction machines.

CO5 - Analyze the design procedure for stator and rotor of synchronous machines.

CO6 - Design various machine components for specific application.

TEXT / REFERENCE BOOKS

1. A.K.Sawhney, A.Chakrabarti, "A course in Electrical machine Design", Dhanpat Rai and Sons, New Delhi, 6th Edition, 2010.
2. Albert E. Clayton and NN Hancock, "The performance and Design of Direct Current Machines", Oxford and IBH Publishing Co. Pvt.Ltd., New Delhi, Edition 2004.
3. A.Nagoorkani, "Electrical Machine Design", RBA Publications, 2nd Edition, 2014.
4. R.K.Agarwal, "Principles of Electrical Machine Design", 5th Edition, S.K.Kataria & Sons. 2014.

SEEA1602	ADVANCED CONTROL SYSTEMS	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- To gain knowledge in the designing of state space analysis.
- To obtain the state transition matrices and the solution of state equations.
- To design a state observer using the concept of controllability and observability.
- To have a clear understanding in Digital Data Systems.
- To have an exposure in different stability analysis of Nonlinear Systems.

UNIT 1 STATE SPACE MODEL

9 Hrs.

Introduction to State Space, State Variables, Physical Variables, Phase Variables-Matrices, Eigen Values and Eigen vectors - Diagonalization, Canonical and Jordan forms - State Space Models from Differential Equations - Conversion of State Variable Models to Transfer Function.

UNIT 2 MATHEMATICAL ANALYSIS

9 Hrs.

Computation of State Transition Matrix - Laplace Transformation Method, Canonical Transformation - Cayley Hamilton Theorem-Solution of State Equation.

UNIT 3 STATE FEEDBACK AND OBSERVERS

9 Hrs.

Concepts of Controllability and Observability - Design of State Space Feedback using Pole Placement Technique-State Observers.

UNIT 4 SAMPLED DATA SYSTEMS

9 Hrs.

Reconstruction of Sampled Signals using Hold Circuits - Zero Order Hold - its Representation - Bode Plot of Hold Circuit - Z - Transform of Sampled Signals - Theorems on Z- Transform - Inverse Z-transform - Mapping between s and z Planes - Pulse Transfer Function Impulse Response - Closed Loop Operation - Characteristic Equations - Jury's Stability Criterion

UNIT 5 NONLINEAR SYSTEMS

9 Hrs.

General Properties of Non-Linear Systems - Describing Function Method - On / Off, Dead Zone, Saturation and Hysteresis Non Linearities - Determination of Limit Cycle by Describing Function - Stability of Limit Cycle - System Stability in the Sense of Lyapunov - Lyapunov's Direct Method - Stability and Instability Theorems - Application of Lyapunov Method for Linear Systems - Basic Concepts of Phase Plane Method.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Develop the state model of any linear time invariant system
- CO2 - Obtain the state transition matrices and their solutions.
- CO3 - Analyze controllability and observability for real time systems
- CO4 - Design a state observer using pole placement technique.
- CO5 - Analyze any discrete systems.
- CO6 - Determine the stability of any Nonlinear systems.

TEXT / REFERENCE BOOKS

1. K.Ogata, "Modern control Engineering", 5th Edition. Prentice Hall India, New Delhi. 2010.
2. B.C.Kuo, "Automatic Control Systems", Phi learning Pvt Ltd, 9th Edition, 2009.
3. Philips C.L., & John Parr "Feedback Control Systems" 5th Edition, Prentice Hall International. 2010.
4. Naresh K. Sinha, "Control Systems", New Age International Ltd., Reprint 2004.
5. Stanley M.Shinners, "Modern Control System Theory and Design", 3rd Edition, John Wiley & Sons. 2004.
6. M.Gopal, "Digital Control and State Variable Methods", 4th Edition, Tata McGraw Hill Ltd., New Delhi, 2012.
7. Roy Choudhry, "Modern Control Engineering" Phi Learning, 2009.

SEEA1603	ELECTRICAL DRIVES AND CONTROL	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To impart knowledge in modeling of power converters.
- Understand the dynamics of mechanical system found in industrial application.
- Characterize the operation of motor, drive, sensor and mechanical power within the drive.
- Understand the operation of DC and AC Motor drive.
- Understand the method of starting and braking of electric motor.
- To have a knowledge of various motor drive applications.

UNIT 1 DRIVES CHARACTERISTICS

8 Hrs.

Electric drives - Advantages - Choice of electric drive, Speed/Torque Characteristics of various types of loads and drive motors, Classes of motor duty- Selection of power rating for drive motors with regard to duty. Thermal model of motor for heating and cooling, Overloading and load variation factors- load equalization.

UNIT 2 DC DRIVE

10 Hrs.

Starting and braking operations of DC motor drive-Speed control of DC motors - Ward Leonard scheme - Drawbacks - Ward Leonard Ilgen scheme - Thyristor converter fed DC Drives: single, two and four quadrant operations. Chopper fed DC Drives: control strategies - single, two and four quadrant operation.

UNIT 3 THREE PHASE INDUCTION MOTOR DRIVES

10 Hrs.

Speed control of three phase induction motors: Stator control - Stator voltage, frequency and voltage/frequency control - VSI, CSI and Cycloconverter fed induction motor drives. Rotor control : Rotor resistance control- Static control of rotor resistance using DC Chopper, slip power recovery schemes -Kramer and Scherbius drives.

UNIT 4 THREE PHASE SYNCHRONOUS MOTOR DRIVES

10 Hrs.

Speed control of three phase synchronous motors - types of control , Voltage source and current source converter fed synchronous motors -Cycloconverter fed synchronous motors –Commutator less DC motor- Effects of harmonics on the performance of AC motors - **Closed loop control of drive motors, Marginal angle control and power factor control.**

UNIT 5 DRIVE APPLICATIONS

7 Hrs.

Selection of drives and control schemes for steel rolling mills, Paper mills, textile mills and cranes - Traction- conventional DC and AC Traction drives- DC Traction using Chopper Controlled Drives- Poly phase AC motors for Traction Motors.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Select suitable drives for a specific application.
- CO2 - Analyze the construction, characteristics and application of D.C. motor.
- CO3 - Design the converter for AC and DC drives.
- CO4 - Analyze the performance of speed control of three phase synchronous motor drive.
- CO5 - Design solutions by using drives in traction unit in railways.
- CO6 - Design torque, speed and position controller of motor drives Control schemes for steel rolling mills, Paper mills, lifts and crane.

TEXT / REFERENCE BOOKS

1. Gopal K. Dubey, "Fundamentals of Electrical Drives", Alpha Science International Ltd, 2002.
2. Vedam.Subrahmanyam "Electric Drives" Mc graw hill, 2nd Edition 2011.
3. Rashid M.H., "Power Electronics circuits Devices and Applications", Prentice Hall, 3rd Edition, New Delhi, 2009.
4. Juha Pyrhonen , Valeria Hrabovcova & R. Scott Semken, "Electrical Machine Drives Control: An Introduction", 2016.
5. B.K.Bose, "Power Electronic & AC drives", Prentice Hall, 2006.
6. Control of Electrical Drives by Ws. Leonhard (Springer 2001).

SECA1706	PRINCIPLES OF EMBEDDED SYSTEM DESIGN	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- 8 bit RISC microcontroller.
- ARDUINO
- ARM Processor
- Real time operating system.

UNIT 1 RISC EMBEDDED CONTROLLER

9 Hrs.

Comparison of CISC and RISC controllers - PIC 16F877 architecture - Memory organization - Addressing modes - Assembly language instructions.

UNIT 2 ARDUINO

9 Hrs.

Introduction to ARDUINO, Architecture, overview of its I/O Ports, Serial Ports, PWM, ADC, Interfacing with different type of Sensors and Communication modules, Hardware timers, watchdogs and interrupt handling in Arduino. Controlling embedded system based devices using Arduino.

UNIT 3 ARM PROCESSOR BASED SoC and SoM

9 Hrs.

Overview of ARM 7 Architecture- Overview of Intel ARM based hard processor System on Chip (SoC) with an on chip FPGA - Overview of System on Module (SoM) using ARM based SoC.

UNIT 4 EMBEDDED NETWORKING

9 Hrs.

Embedded networking - RS 232 - RS485 - Inter-Integrated Circuit (I2C) - Serial Peripheral Interface (SPI) - Universal Serial Bus (USB) - Controller Area Network (CAN)- Ethernet- Distributed Embedded system

UNIT 5 EMBEDDED SOFTWARE DEVELOPMENT TOOLS and REAL TIME OPERATING SYSTEM

9Hrs.

Introduction to assembler - Compiler -Cross compilers -Linker/ Locators - Simulators - RToS - Desktop OS versus RTOs - Software architectures - Round Robin, Round-Robin with Interrupts, Function Queue Scheduling architecture - ISRs and Scheduling -Task management - Task scheduling - Race conditions - Priority Inversion — Inter task Communication.

Max. 45 Hrs.

COURSE OUTCOMES :

On completion of the course, student will be able to

CO1 - Analyze the architecture, functionalities of PIC 16F877A Microcontroller and apply for addressing the Engineering problems.

CO2 – Develop knowledge and skills required to develop an real time embedded system using ARDUINO for addressing Engineering problems

CO3 – Analyze the architecture of ARM processor and concepts of SoC and SoM.

CO4 - Analyse the various standards and protocols used for embedded interfaces.

CO5 - Analyze various embedded software development tools.

CO6 - Evaluate the concept of RTOS in real time embedded system.

TEXT / REFERENCE BOOKS

1. Muhammed Ali Mazidi, Rolin D.Mckinlay, Dannycauscy, "PIC microcontrollers and embedded systems using assembly and C", 1st edition, Pearson, 2007.
2. Rajesh Singh, Anita Gehlot, Bhupendra Singh, and Sushabhan Choudhury," Arduino-Based Embedded Systems, CRC Press; 1 edition, November 2017.
3. Ashwin Pajankar, ARDUINO MADE SIMPLE: With Interactive Projects, BPB Publications, 2018.
4. Raj Kamal, "Embedded system-Architecture, Programming, Design", Tata McGraw Hill, 2011.
2. Sriram. V. Iyer, Pankaj Gupta, "Embedded Real Time Systems Programming", 2004 Tata McGraw Hill Publishing Company Limited, 2006.
3. Frank Vahid, Tony Givargis, 'Embedded system Design - A unified Hardware / software Introduction', John Wiley and Sons, 2002.
4. Todd D Morton, 'Embedded Microcontrollers', Reprint by 2005, Low Price Edition.
5. Muhammed Ali Mazidi, Janice Gillispie Mazidi, 'The 8051 Microcontroller and Embedded Systems', Low Price Edition, Second Impression 2006.
- 6.<https://www.intel.com/content/dam/www/programmable/us/en/pdfs/literature/wp/wp-01167-custom-arm-soc.pdf>
7. <https://www.arm.com/resources/guide/designing-soc-with-cortex-m>
8. <https://www.microchip.com/design-centers/32-bit-mpus/sip-som/system-on-module>

SEEA1701	POWER SYSTEM PROTECTION AND SWITCHGEAR	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To discuss the cause and effect of abnormal operating conditions in a power system and the protective schemes along with the problems associated with circuit interruptions.
- To understand construction, operation and characteristics of various electromagnetic and static relays.
- To introduce apparatus protection for transformer, alternator, induction motor, transmission line and bus bar.
- To understand the arc quenching theories and operations of various types of circuit breakers and their ratings.

UNIT 1 INTRODUCTION DRIVES

8 Hrs.

Essential requirements of protection - Nature and causes of faults - Types of faults - Effects of faults - Zones of protection - Protection schemes - CTs and PTs and their applications - Basic relay terminology.

UNIT 2 PROTECTIVE RELAYS

10 Hrs.

Electromagnetic relays - Operating principle - Torque equation - Relay characteristics - Over current relay, Directional relay, Distance relay, Differential relay, Negative sequence relay, Amplitude and Phase comparator of over current static relays, Duality between comparators - Microprocessor based over current relay.

UNIT 3 APPARATUS PROTECTION

9 Hrs.

Protection of Generator - Stator & Rotor protection - Large Motor protection - Transformer protection - Bus bar Protection - Transmission line protection.

UNIT 4 THEORY OF ARC QUENCHING

9 Hrs.

Arcing phenomena - Theory and methods of arc quenching - Recovery voltage - Restriking voltage - RRRV - Resistance switching - Current chopping - Capacitive current breaking - Characteristics of fuses - HRC fuse.

UNIT 5 CIRCUIT BREAKERS

9 Hrs.

Classification of circuit breakers - Air circuit breakers - Oil circuit breakers - Vacuum circuit breaker - SF6 circuit Breakers - Selection of circuit breakers - Rating of circuit breakers - Testing of circuit breakers.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1- Categorize various faults, their effects on power system and need of protection.

CO2 - Analyze the various electromagnetic and static relay used in power system.

CO3 - Design appropriate relay for various power system apparatus.

CO4 - Investigate various Arc quenching technique for power system protection.

CO5 - Evaluate the effectiveness of various circuit breakers with respect to Arc quenching.

CO6 - Examine the characteristics, rating and testing of circuit breakers.

TEXT / REFERENCE BOOKS

1. L.G.Hewitson, Mark Brown, Ben Ramesh and Ramesh Balakrishnan, "Practical Power System Protection", Newnes Publications, Oxford, 2005.
2. Sunil S.Rao "Switchgear and protection", Khanna Publishers, New Delhi, 2008.
3. Badri Ram and D.N.Vishwakarma "Power System Protection and Switchgear", Tata McGraw Hill Publishing, New Delhi, 2005.
4. Soni, Gupta and Bhatnagar "A Course in Electrical power", Dhanpat Rai & Sons, New Delhi, 2010.
5. TSM Rao, "Digital Numerical Relays", Tata McGraw Hill publishing, New Delhi, 2005.
6. B.Ravindranath and N.Chander, "Power System Protection and Switchgear", New Age International (P) Ltd, 2005.

SEEA1801	SPECIAL ELECTRICAL MACHINES AND CONTROL	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To review the basic concepts of stepper motors and its applications.
- To understand the concept of the operating principle and characteristics of switched reluctance motors.
- To impart knowledge on the fundamental concepts and control of permanent magnet brushless DC motors.
- To introduce the concepts and control methods of permanent magnet brushless synchronous motors and synchronous reluctance motors.
- To impart knowledge on the microprocessor based control of special machines.

UNIT 1 STEPPING MOTORS

9 Hrs.

Constructional features, principle of operation, types, modes of excitation, Torque production in Variable Reluctance (VR) stepping motor, Static and Dynamic characteristics, Introduction to Drive circuits for stepper motor, suppressor circuits, Closed loop control of stepper motor- Applications.

UNIT 2 SWITCHED RELUCTANCE MOTORS

9 Hrs.

Principle of Operation, Constructional features, Torque equation, Power Semi-Conductor Switching Circuits, frequency of variation of inductance of each phase winding - Control circuits of SRM-Torque - Speed Characteristics, Microprocessor based control of SRM Drive, Applications.

UNIT 3 SYNCHRONOUS RELUCTANCE MOTORS

8 Hrs.

Constructional features: axial and radial air gap Motors. Operating principle, reluctance torque – Phasor diagram, Speed torque characteristics, Applications.

UNIT 4 PERMANENT MAGNET BRUSHLESS DC MOTORS

9 Hrs.

Commutation in DC motors, Electronic Commutation- Difference between mechanical and electronic commutators- Hall sensors, Optical sensors, Construction and principle of PMBL DC Motor, Torque and E.M.F equation, Torque-speed characteristics, Power Controllers-Drive Circuits, Applications.

UNIT 5 PERMANENT MAGNET SYNCHRONOUS MOTORS

10 Hrs.

Construction and types, Principle of operation, EMF and Torque equation, Phasor diagram- Torque Speed Characteristics, Power controllers- Self-control, Vector control, Microprocessor based Control, Applications.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Apply the reluctance concept to operation of various types of stepper motors.
- CO2 - Analyze the operation and characteristics of switched reluctance motors.
- CO3 - Evaluate the performance of synchronous reluctance motors.
- CO4 - Identify power controllers and driver circuits for permanent magnet brushless DC motor.
- CO5 - Justify best speed control for permanent magnet synchronous motor.
- CO6 - Develop control methods for Permanent magnet synchronous motor on real time applications.

TEXT / REFERENCE BOOKS

1. Miller T.J.E., "Brushless permanent magnet and reluctance motor drives", Clarendon Press, Oxford, 1989.
2. Kenjo T., "Stepping motors and their microprocessor control", Oxford University Press, 2000.
3. R.Krishnan, "Electric Motor Drives - Modeling, Analysis and Control", Prentice-Hall of India Pvt. Ltd., New Delhi, 2015.
4. Kenjo T. and Naganori, S "Permanent Magnet and Brushless DC motors", Clarendon Press, Oxford, 1985.
5. B.K. Bose, "Modern Power Electronics & AC drives", Dorling Kindersley India, 2006.

SEEA3004	FLEXIBLE AC TRANSMISSION SYSTEM	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To attain detailed knowledge in various reactive power compensators.
- To understand Thyristor Controlled Series Capacitor concepts.
- To attain the knowledge of series and shunt compensation.
- To analyze the behavior of STATCOM, UPFC and IPFC.
- To understand the implementation of FACTS controllers in improvement of power system performance.

UNIT 1 INTRODUCTION

9 Hrs.

Electrical Transmission Network, Emerging Transmission Network, Concept of Reactive Power, Load and System Compensation, Midpoint Voltage, Passive Compensation, Synchronous Condenser, Saturated Reactor, Classification of FACTS controllers.

UNIT 2 SHUNT COMPENSATION

9 Hrs.

Thyristor Controlled Reactor (TCR), Thyristor Switched Reactor (TSR), Thyristor Switched Capacitor (TSC), Fixed Capacitor-Thyristor Controlled Reactor (FC-TCR), Thyristor Switched Capacitor-Thyristor Controlled Reactor (TSC -TCR), V-I Characteristics of Static Var Compensator (SVC), Advantages of slope in dynamic Characteristic, Voltage control by SVC.

UNIT 3 THYRISTOR CONTROLLED SERIES CAPACITOR (TCSC)

9 Hrs.

Fixed Series Compensation, Need for Variable Series Compensation, TCSC: Basic principle, Modes of Operation, Advantages, Capability Characteristic, Variable Reactance Model, Application: Open loop & Closed loop Control.

UNIT 4 EMERGING FACTS CONTROLLER

9 Hrs.

Static Synchronous Compensator (STATCOM): Introduction, Principle of Operation, V-I Characteristic, Multilevel VSC based STATCOM, SSSC: Principle of Operation, Unified Power Flow Controller (UPFC): Principle of Operation, Interline Power Flow Controller (IPFC): Principle of Operation.

UNIT 5 SUB SYNCHRONOUS RESONANCE (SSR)

9 Hrs.

Concept of SSR, NGH-SSR Damping scheme: basic concept, design and operation aspect, Thyristor Controlled Braking Resistor (TCBR), Advanced Series Capacitor (ASC): Basic concept, Design and operation aspect.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Analyze different types of FACTS Controllers.
- CO2 - Examine the performance of various Shunt Compensators.
- CO3 - Analyze the impact of Thyristor Controlled Series Capacitor for open loop and closed loop applications.
- CO4 - Analyze the functional operation and control of Emerging FACTS controllers with voltage source and current source inverters.
- CO5 - Analyze the significance of SSR in Power System network.
- CO6 - Design Advanced Series Capacitor.

TEXT / REFERENCE BOOKS

1. R. Mohan Mathur and Rajiv K. Varma, "Thyristor based FACTS controllers for electrical transmission systems", IEEE Press John Wiley & Sons Inc. Publication, 2002.
2. Narin G.Hingorani and Laszlo Gyugi, "Understanding FACTS", IEEE Press Standard Publishers Distributors, 2001.
3. K.R.Padiyar, "FACTS controllers in power transmission and distribution", New Age International Publishers, 2009.
4. Xiao-Ping Zhang, Chrisyian Rehtanz and Bikash Pal, "Flexible AC Transmission Systems Modelling and Control", Springer International Publishers, 2015.

SEEA3007	HIGH VOLTAGE ENGINEERING	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To impart knowledge on the concepts of over voltages.
- To analyze the dielectric breakdown mechanisms.
- To measure and test High voltages and currents.

UNIT 1 OVERVOLTAGES IN ELECTRICAL POWER SYSTEMS

9 Hrs.

Causes of Over voltages Theory and Mechanism of Lightning phenomenon - Overvoltage due to Switching Surges - Protection against over voltages - Reflection and Refraction of Travelling waves - Insulation Coordination.

UNIT 2 CONDUCTION AND BREAKDOWN IN DIELECTRICS

9 Hrs.

Ionization of gases and current growth - Townsend's criterion for breakdown -Streamer theory of breakdown in gases. Paschen's Law - Vacuum breakdown - Various mechanisms of breakdown in liquid dielectrics -Various processes of breakdown in solid dielectrics.

UNIT 3 GENERATION OF HIGH VOLTAGES AND CURRENTS

9 Hrs.

Generation of high DC voltages: Rectifier, Voltage doubler circuits, Cockroft Walton voltage multiplier circuit, Van de Graffe generator - Generation of high AC voltage: cascaded transformers, resonant transformers- Generation of high frequency a.c. high voltage - Generation of impulse voltages: Standard impulse waveshapes, Marx Circuit - generation of switching surges - generation of impulse current - tripping and control of impulse generators.

UNIT 4 MEASUREMENT OF HIGH VOLTAGES AND CURRENTS

9 Hrs.

High Resistance with series ammeter -Potential Divider - Generating Voltmeters - Capacitance Voltage Transformer, Electrostatic Voltmeters - Sphere Gaps - Hall generator - Resistive Shunts -Rogowski coils - Cathode Ray Oscillographs for impulse measurement.

UNIT 5 TESTING OF ELECTRICAL APPARATUS

9 Hrs.

Testing of Insulators and Bushings - Testing of Isolators and Circuit Breakers - Testing of Cables - Testing of Transformers - Testing of Surge arresters - Radio Interference Measurements - Standards and Specifications.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Select a suitable protection for over voltage in electrical power system.
- CO2 - Justify the suitable dielectric for High voltage application.
- CO3 - Evaluate the performance of high DC, AC voltages and currents generators.
- CO4 - Proposes a suitable techniques for measuring high voltage and currents.
- CO5 - Comprehended the testing procedure for isolator, circuit breakers, busing and transformer.
- CO6 - Develop a procedure for testing high voltage devices by adhering to the standards.

TEXT / REFERENCE BOOKS

1. M.S. Naidu and V. Kamaraju, 'High Voltage Engineering', 5th Edition Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2013.
2. C.L.Wadhwa, "High Voltage Engineering" - New Age International (P) Ltd, Publishers, 2007.
3. E.Kuffel and W.S. Zaengal, "High Voltage Engineering Fundamentals", 2nd Edition, Butterworth Heinemann, 2000.
4. H.M.Ryam, "High voltage Engineering and testing", 2nd Edition, 2001, IEEE Power and Energy Series 32.
5. Farouk A.M.Rizk and Giao N.Trinh, "High voltage Engineering", CRC Press, 1st Edition, 17 April 2014.
6. Dr.A.Haddad and D.F.Warne, "Advances in High voltage Engineering", Institution of Engineering and Technology, 22 October 2004.
7. Prof.D.V.Razevig, "High voltage Engineering", Khanna Publisher, 2nd Edition, 2000.

SCHA3008	Food Technology	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To impart knowledge to the students about advanced technology in food science and recent trends adapted in food industry

UNIT 1 FOOD PROCESSING ENGINEERING–FUNDAMENTALS

9 Hrs.

Fundamentals of Food Process Engineering, Application of Quantitative methods of Material & Energy Balances in Food Engineering Practices. Constituents of Food, Quality and Nutritive aspects, Food Adulterations, Deteriorative factors and Control..

UNIT 2 OPERATIONS IN FOOD INDUSTRIES

9 Hrs.

Fluid Flow, Thermal Process Calculations, Refrigeration, Evaporation and Dehydration operations in Food Processing

UNIT 3 FOOD CANNING TECHNOLOGY

9 Hrs.

Fundamentals of Food Canning Technology, Heat Sterilization of Canned food, Containers – metal, Glass and Flexible packaging. Canning Procedures for Fruits, Vegetables, Meat, Poultry and Marine Products

UNIT 4 FOOD PRESERVATION METHODS

9 Hrs

Preservation by Heat and Cold, Dehydration, Concentration, Drying, Irradiation, Microwave heating, Sterilization and Pasteurization, Fermentation and Pickling, Packaging Methods

UNIT 5 PRODUCTION AND UTILIZATION OF FOOD PRODUCTS

9 Hrs.

Cereal, Grains, Pulses, Vegetables, Fruits, Spices, Fats and Oils, Bakery, Confectionary and Chocolate Products. Soft and Alcoholic Beverages, Dairy Products, Meat, Poultry and Fish Products.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Understand the Quality and Nutritive aspects of various food constituents.

CO2 - Evaluate the various deteriorative factors of food and maintain quality.

CO3 - Demonstrate the unit operations involved in food industries

CO4 - Classify packaging technologies for appropriate food products.

CO5 - Compare the various food preservation technologies

CO6 - Demonstrate the principles of unit operation, preservation and packaging technologies for various food preparations.

TEXT / REFERENCE BOOKS

1. Heid J.L., Joslyn M.A., Fundamentals of Food Processing Operation, 6th Edition, The AVI publishing Co., West port 2018.
2. Potter N.N., Food Science, 6th Edition, The AVI publishing Co., Westport, 2007.
3. Heldman D.R., Food Process Engineering, 4th Edition, The AVI Publishing, 2005.
4. Owen R. Fennema, Food Chemistry, 4th Edition, Marcel Dekker Inc., New York, 2007

SCSA3092	Augmented and Virtual Reality	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To make students know the basic concept and framework of virtual reality.
- To teach students the principles and multidisciplinary features of virtual reality.
- To teach students the technology for multimodal user interaction and perception in VR, in particular the visual, aural and haptic interface and behavior.
- To teach students the technology for managing large scale VR environment in real time.
- To provide students with an introduction to the VR system framework and development tools

UNIT 1 INTRODUCTION OF VIRTUAL REALITY

9 Hrs.

Fundamental Concept and Components of Virtual Reality- Primary Features and Present Development on Virtual Reality - VR systems - VR as a discipline-Basic features of VR systems-Architecture of VR systems-VR hardware -VR input hardware: tracking systems, motion capture systems, data gloves-VR output hardware: visual displays.

UNIT 2 I/O INTERFACE AND TECHNIQUES IN VR

9 Hrs.

Multiple Modals of Input and Output Interface in Virtual Reality: Input -- Tracker, Sensor, Digital Glove, Movement Capture, Video-based Input, 3D Menus & 3D Scanner etc. Output -- Visual / Auditory / Haptic Devices. **Interactive Techniques in Virtual Reality: Body Track, Hand Gesture, 3D Manus, Object Grasp.**

UNIT 3 VISUAL COMPUTATION IN VIRTUAL REALITY

9 Hrs.

Fundamentals of Computer Graphics-Software and Hardware Technology on Stereoscopic Display-Advanced Techniques in CG: Management of Large Scale Environments & Real Time Rendering -Development Tools and Frameworks in Virtual Reality: Frameworks of Software Development Tools in VR. X3D Standard; Vega, MultiGen, Virtools etc

UNIT 4 INTRODUCTION OF AUGMENTED REALITY

System Structure of Augmented Reality-Key Technology in AR-- AR software development - AR software. **Camera parameters and camera calibration. Marker-based augmented reality. Pattern recognition. AR Toolkit.**

UNIT 5 APPLICATION OF VR IN DIGITAL ENTERTAINMENT

VR Technology in Film & TV Production.VR Technology in Physical Exercises and Games. Demonstration of Digital Entertainment by VR.3D user interfaces - Why 3D user interfaces. Major user tasks in VE. **Interaction techniques for selection, manipulation and navigation.3DUI evaluation**

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Design and implement the VR system.
- CO2 - Implement the Augmented Reality software.
- CO3 - Analyze and design the framework in VR using various software development tools in VR.
- CO4 - Design the multi modal user interface.
- CO5 - Describe the principles and features of VR and AR.
- CO6 - Recognize the technologies used to manage the large scale VR environment in real time.

TEXT / REFERENCE BOOKS

1. Sherman, William R. and Alan B. Craig. Understanding Virtual Reality – Interface, Application, and Design, Morgan Kaufmann, 2002.
2. Fei GAO. Design and Development of Virtual Reality Application System, Tsinghua Press, March 2012.
3. Guangran LIU. Virtual Reality Technology, Tsinghua Press, Jan. 2011.
4. Burdea, G. C. and P. Coffet. Virtual Reality Technology, 2 nd Edition. Wiley-IEEE Press, 2003/2006.

SCSA4007	Design and Development of Blockchain	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To understand how blockchain works in terms of Bitcoin and Ethereum.
- To learn about the various decentralized blockchain.
- To know the differences between proof of work and stake.
- To design and build own blockchain.
- To integrate own ideas with blockchain using Ethereum Wallet and Smart Contract

Unit 1 BLOCKCHAIN BASICS

9 Hrs.

Basics of Crypto economics- Blockchain – Cryptocurrencies overloaded –Blockchain in Nutshell: Benefits and Challenges – Blockchain types - Blockchain Peer to Peer Network: Consensus Mechanisms, Proof of Work, Proof of Stake, Mining Layer, Propagation Layer, Semantic Layer, Application Layer.

Unit 2 COMPONENTS AND STRUCTURE OF BLOCKCHAIN

9 Hrs.

Blocks – Chain between the blocks – Digital signatures and Hashing – Block data examples: Bitcoin block, Ethereum block, Block time and Block size, Global Size – Blockchain miners and validators – Blockchain speed: Blockchain throughput and comparison with traditional network

Unit 3 DECENTRALIZATION USING BLOCKCHAIN

9 Hrs.

Methods of decentralization – Routes to decentralization – Blockchain and full ecosystem decentralization: Computation, Storage, Communication and decentralization – Smart Contracts – Organization of decentralization: Decentralized Autonomous Organizations, Corporations, Societies, DApps and their requirements, Operations of DApps – Example of DApps: KYC-Chains, Open Bazaar, Lazooz

Unit 4 CREATING AN OWN BLOCK CHAIN

9 Hrs.

Creating: Basic P2P network, Genesis Blocks and Sharing Blocks – Registering Miners and Creating new blocks – Storing blocks – Creating: Blockchain wallet, API, Command Line Interface – Blockchain Wallet and Transaction: Wallet, Transaction and Colored Coins

Unit 5 HVDC Transmission

9 Hrs.

Ganache Full node Client – IntelliJ Plugin for Solidity – Truffle Suite: Create your Smart Contract – Connect Truffle to Smart Contract – Smart Contract: Hello world, MD5 Smart Contract, Smart Contract with truffle, Deploy the Smart Contract to your deployment network – Truffle Console – Operation with your Smart Contract via the Truffle CLI – Cryptocurrency Mining: Mining Hardware, Miner Types, Mining Pools, Mining Software

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 – Understanding emerging technology models of blockchain.
- CO2 - Known to deal with the component and structure of blockchain.
- CO3 - Deals to work with various decentralized blockchain.
- CO4 - Familiar with Ethereum wallet and smart contract.
- CO5 – Applications and implementation strategies CO6: Design and develop own blockchain for a real time application.

TEXT / REFERENCE BOOKS

1. EladElrom,"The Blockchain Developer A Practical Guide for Designing, Implementing, Publishing, Testing, and Securing Distributed Blockchain-based Projects",Apress (2019).
2. Brenn Hill, Samanyu Chopra, Paul Valencourt, Narayan Prusty, "Blockchain Developer's Guide Develop Smart Applications with Blockchain Technologies - Ethereum, JavaScript, Hyperledger Fabric, and Corda",Packt Publishing (2018).
3. Salman A. Baset, Luc Desrosiers, Nitin Gaur, Petr Novotny, Anthony O'Dowd, Venkatraman Ramakrishna, "Hands-On Blockchain with Hyperledger Building Decentralized Applications with Hyperledger Fabric and Composer", Packt Publishing (2018).
4. Imran Bashir, Narayan Prusty, "Advanced Blockchain Development Build Highly Secure, Decentralized Applications and SCSA4007 DESIGN AND DEVELOPMENT OF BLOCKCHAIN L T P Credits Total Marks 3 0 0 3 100 Conduct Secure Transactions",Packt Publishing (2019)

SITA3003	Advanced Java Programming	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To know about Enterprise architecture models.
- To introduce the basics of session tracking.
- To understand JSP and to write Custom Tags.
- To know about the development of Enterprise Java Beans. .
- To have knowledge advanced Java programming concepts like struts

UNIT 1 INTRODUCTION AND DATABASE PROGRAMMING

9 Hrs.

J2EE Platform – Enterprise architecture styles – J2EE run times – J2EE API – J2EE architecture – Containers – Introduction to J2EE technologies – Naming and directory services. Database programming with JDBC – JDBC/ODBC bridge – Establishing a connection – Creating and executing SQL statements – Querying – Report statements – Scrollable and updatable result sets – Java.sql packages – JDBC data sources – Connection pooling.

UNIT 2 SERVLET PROGRAMMING

9 Hrs.

Introduction to Servlet Programming - Servlet Implementations - Servlet configuration - Servlet exceptions - Servlet Life Cycle - Servlet Programming - Servlet Security- Servlet communication - Advanced Servlets : Approach to Session Tracking - Demonstrating Session - Lifecycle with Cookies - A simple shopping cart using Sessions - Servlet Context Interface - Servlet Collaboration.

UNIT 3 JSP AND JAVA MAIL

9 Hrs.

Java Server Pages : Intro to JSP - JSP Directives - Scripting elements - Standard Auctions - Implicit objects - Scope - JSP pages as XML documents - JSP Sample Program - Design Strategies - JSP tag Extensions-A simple TAG - Writing TAG Extensions. Java Mail API: Introduction to Java Mail - Mail Protocols- Java Mail Overview- Quick, Send me a Email: An example program

UNIT 4 ENTERPRISE JAVA BEANS

9 Hrs.

Overview of EJB-EJB Middleware Architecture - EJB Architecture- EJB Containers and its services - Design of EJB Tier - Session java Beans- Stateless and Stateful Beans, Entity Beans and Persistence - Container Vs Bean Managed Persistence, Message Driven Bean - Relationships, EJB Container Services.

UNIT 5 STRUTS

9 Hrs.

Struts: Development Models-Basic Components of Struts – Struts2 Architecture-Interceptors-Validation- Building simple struts Application

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Implement JDBC connectivity
- CO2 - Implement Servlets and advanced Servlets
- CO3 - Implement JSP and Java Mail
- CO4 - Implement EJB
- CO5 - Implement Struts
- CO6 - Develop enterprise java applications thereby meeting the industrial requirements.

TEXT / REFERENCE BOOKS

1. Subrahmanyam Allamaraju and Cedric Buest , "Professional Java Server Programming", A press,J2EE 1.3, 2007.
2. Jim Keogh , "Completer Reference, J2EE",Tata McGraw Hill, 2007.
3. James Holmes-Struts,"The complete Reference", 2nd Edition, Tata McGraw Hill, 2007.
4. <http://www.java.sun.com/tutorial>.

SCSA4003	Business Analytics	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
- To understand the different basic concept / fundamentals of business statistics.
- To become familiar with the processes needed to develop, report, and analyze business data.

UNIT OVERVIEW OF BUSINESS ANALYTICS

9Hrs.

Definitions and Examples in Business Intelligence - Need, Features and Use of Business Intelligence (BI) - BI Components- Data Warehouse - Business Performance Management . User Interface Business Analytics: Introduction to Business Analytics (BA) – Need- Components (Business Context, Technology, Data Science) - Types (Descriptive, Predictive and Prescriptive) - Business Intelligence versus Business Analytics

UNIT II TYPES OF DIGITAL DATA

9 Hrs.

Definition, Sources, Storage and Characteristics of data - Structured, Unstructured and Semi Structured Data - Importance of data quality - Dealing with missing or incomplete data - Data Classification Data Warehouse: Definition, characteristics, framework- Data lake - Business Reporting, Visual Analytics: Definition, concepts - Different types of charts and graphs - Emergence of data visualization and visual analytics

UNIT III INTRODUCTION TO DATA MINING

9 Hrs.

Data Mining: Concepts and applications - Data mining process - Text & Web Analytics: Text analytics and text mining overview Text mining applications- Web mining overview- Social media analytics- Sentiment analysis overview- Big Data Analytics: Definition and characteristics of big data- Fundamentals of big data analytics

UNIT IV TRANSACTION PROCESSING

9 Hrs.

Data Mining Tasks, OLAP and Multidimensional data analysis, Basic concept of Association Analysis and Cluster Analysis - Transaction processing v/s Analytic Processing- OLTP v/s OLAP- OLAP Operations - Data models for OLTP (ER model) and OLAP (Star & Snowflake Schema).

UNIT V BUSINESS PERFORMANCE MANAGEMENT

9 Hrs.

Business performance management cycle - KPI, Dashboard - Analytics in Business Support Functions: Sales & Marketing Analytics - HR Analytics - Financial Analytics - Production and operations analytics- Analytics in Industries: Telecom, Retail, Healthcare, Financial Services - Decision Making under Uncertainty Case study: prepare a detailed report on applications of analytics in different industries.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1: Comprehend Knowledge of basic concept / fundamentals of business statistics, business intelligence
- CO2: Evaluating basic concepts of digital data and data warehouse
- CO3: To apply analytics methodologies on various real time data
- CO4: To create data schema and transaction processing methodology for a given real time data set.
- CO5: Analyze various types of analytics on data from various domains.
- CO6: To perform practical application by taking managerial decision and evaluating the Concept of Business Analytics.

REFERENCES

1. Shmueli, Patel, and Bruce: Wiley, Data Mining for Business Intelligence, Concepts, Techniques and Applications, Wiley, 2010
2. Fisher and Raman , The New Science of Retailing,.: Harvard Business Press, 2012

3. Ramesh Sharda, DursunDelen, Efraim Turban Business Intelligence: A Managerial Perspective on Analytics Pearson 3 rd edition, 2017
4. R.N.Prasad and Seema Acharya Fundamentals of Business Analytics Wiley 2016
5. U. Dinesh Kumar Business Analytics – The Science of Data Driven Decision Making Wiley 2017
6. Anil Maheshwari Data Analytics McGraw Hill 2017
7. JesperThorlund&Gert H.N. Laursen Business Analytics for Managers: Taking Business Intelligence beyond Wiley Latest
8. Sahil Raj, Business Analytics Cengage, 7th edition Wayne L. Winston. ISBN-13: 9789353502553

SBAA4002	PRINCIPLES OF MANAGEMENT AND PROFESSIONAL ETHICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To gain knowledge about the fundamentals of management.
- To understand the tools and techniques of the various aspects of management.
- To apply management concepts in decision making.

UNIT 1 MANAGEMENT THEORIES

9 Hrs.

Definition of management, science or art, manager vs entrepreneur; Types of managers - managerial roles and skills; Evolution of management-scientific, human relations, system and contingency approaches; Types of Business Organizations, sole proprietorship, partnership, company, public and private enterprises; Organization culture and environment; Current trends and issues in management.

UNIT 2 PLANNING, DECISION MAKING AND ORGANISING

9 Hrs.

Nature and purpose of Planning, types of Planning, objectives, setting objectives, policies, Strategic Management, Planning Tools and Techniques, Decision making steps & processes. Nature and purpose of Organizing, formal and informal organization, organization structure, types, line and staff authority, departmentalization, delegation of authority, centralization and Decentralization, job design.

UNIT 3 STAFFING AND LEADING

9 Hrs.

Human resource management, HR Planning, Recruitment selection, training & development, performance management, career planning and management, Directing individual and group behavior, motivation, motivation theories, motivational techniques, job satisfaction, job enrichment, leadership, types & theories of leadership, effective communication.

UNIT 4 CONTROLLING AND REPORTING

9 Hrs.

Controlling, system and process of controlling, budgetary and non-budget control technique, use of computer and IT in management control, productivity problems and management, control and performance, direct and preventive control, reporting.

UNIT 5 VALUES AND ETHICS

9 Hrs.

Human Values – Natural acceptance - Ethics – Definition- Objectives - Virtues – Challenges in the work place - Engineering ethics - Scope - Moral issues and judgment - Moral development theories – Engineers as responsible experimenters - Codes of ethics - Industrial standards - Global Issues: Environmental ethics- Computer ethics - Ethics and codes of business conduct in MNC.

Max. 45 Hrs.

COURSE OUTCOME

On completion of this course, the students will be able to

CO1 - Describe the evolution and development of management concepts.

CO2 - Understand the functions of management.

CO3 - Apply the concepts and develop key competencies for managing human resources.

CO4 - Analyze appropriate management techniques for Controlling and Reporting.

CO5 - Evaluate the various aspects of decision making and demonstrate critical thinking.

CO6 - Elaborate the importance of the ethical dimension in workplace.

TEXT / REFERENCE BOOKS

2. Robins S.P. and Couiter M, "Management", Prentice Hall India, 11th Edition, 2012.
3. Harold Koontz and Heinz Weihrich, "Essentials of Management", Tata McGraw Hill, 10th Edition, 2015.
4. Nagaraazan. R. S, "A Text Book on Human Values and Ethics", New Age International Publishers, New Delhi, 2018.
5. Stoner James A. F., Freeman. R. E and Gilbert. R. D, "Management", Pearson Education, 6th Edition, 2018.
6. Griffin, R. W., "Management", South-Western College Publication 11th Edition, 2012.
7. Gregory. G. D, Gerry. M. C and Alan. E, "Strategic Management: Text and Cases", McGraw Hill, 8th Edition, 2018.
8. Tripathy. P. C & Reddy. P. N, "Principles of Management", Tata McGraw Hill, 5th Edition, 2012.
9. Gupta C.B., "Management Theory and Practice", Sultan Chand and Sons, New Delhi 19th Revised and Enlarged Edition, 2017.
10. Tulsian. P.C & Pandey. V, "Business Organisation & Management", Pearson - Education, 2011.
11. Joseph L. Massie, "Essentials of Management", Pearson Education, 4th Edition, 2016.
12. Harris Pritchard and Rabins, "Engineering Ethics", Cengage Learning, New Delhi. 4th Edition, 2014.

SCSA2102	FUNDAMENTALS OF PYTHON PROGRAMMING LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

COURSE OBJECTIVES

- To learn the fundamentals of Python programming language.
- To handle and apply the complex type of data.
- To handle and manipulate files.
- To develop GUI based applications.
- To understand various widgets.
- To handle database programming with Python.

SUGGESTED LIST OF EXPERIMENTS

1. Program to handle Input and Output statements.
2. Program using Lists, Tuples, Dictionary and Sets.
3. Program using conditional statements.
4. Program using looping constructs.
5. Program using functions and modules.
6. Program using File handling.
7. Program using Exception handling.
8. GUI Programming using Python - Canvas Widget.
9. GUI Programming using Python - Frame, label, button, check box, entry, list box, message, radio button, text, spinbox.
10. Database Programming using Python.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Develop programs with input, output and conditional statements using Python.
- CO2 - Handle effectively data handling types.
- CO3 - Handle Code reusability using functions and modules.
- CO4 - Handle exception mechanism.
- CO5 - Develop widgets with various controls.
- CO6 - Connect to database package and manipulate the data (CRUD operation).

SECA1201	DIGITAL LOGIC CIRCUITS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To impart knowledge on various types of Binary logics.
- To design a binary logic circuit for an arithmetic expressions.
- To understand the usage of registers and counters used in various digital circuits.
- To understand the design of memory devices used.
- To get an exposure about the electronics behind design of Basic digital logical elements.

UNIT 1 NUMBER SYSTEMS, LOGIC FUNCTIONS AND BOOLEAN ALGEBRA

9 Hrs.

Number systems – Number systems conversions - Binary arithmetic – Binary codes – Logic functions-Universal gate functions - Boolean algebra – Functionally complete operation sets, Reduction of switching equations using Boolean algebra, Realization of switching function.

UNIT 2 DESIGN OF COMBINATIONAL LOGIC

9 Hrs.

Design procedure of Combinational Logic – Design of two level gate networks - Sum of Products (SOP) - Product of Sums(POS) - Canonical SOP - Canonical POS - Karnaugh Map - Simplifications of Boolean functions using Karnaugh Map and implementation using Logic function – Advantages and limitations of K-Map - Tabulation method - Simplifications of Boolean functions using Tabulation method.

UNIT 3 COMBINATIONAL CIRCUITS

9 Hrs.

Introduction to Combinational circuits – Half Adder, Full Adder - Half Subtractor, Full Subtractor- Parallel binary Adder, Parallel binary Subtractor - Carry look ahead Adder- BCD Adder- Decoders- Encoders - Priority Encoder- Multiplexers- MUX as universal combinational modules- Demultiplexers- Code convertors- Magnitude Comparator.

UNIT 4 SEQUENTIAL CIRCUITS

9 Hrs.

Introduction to Sequential circuits – Flip flops – SR, JK, D and T flip flops, Master Slave flip flop, Characteristic and excitation table – Realization of one flip flop with other flip flops – Registers – Shift registers – Counters – Synchronous and Asynchronous counters – Modulus counters – Ring Counter – Johnson Counter – State diagram, State table, State minimization – Hazards.

UNIT 5 DIGITAL LOGIC FAMILIES, MEMORIES AND PROGRAMMABLE DEVICES

9 Hrs.

Classification and characteristics of logic family – Bipolar logic family – Saturated logic family – Non saturated family – Unipolar family – MOS, CMOS logic families. Classification and Organization of memories – Programmable Logic Devices – Programmable Logic Array(PLA) – Programmable Array Logic (PAL) – Field Programmable Gate Arrays (FPGA).

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Analyze various coding techniques and number conversion systems.
- CO2 - Develop suitable techniques to minimize the Boolean equations.
- CO3 - Design the digital circuit using combinational logic.
- CO4 - Design the digital circuit using sequential logic.
- CO5 - Analyze the performance of various digital logic families.
- CO6 - Solve the arithmetic expressions using memories and programmable logic devices and implement memory units with Programmable logic devices

TEXT / REFERENCE BOOKS

1. John M. Yarbrough, "Digital logic: Applications and Design", Thomas - Vikas Publishing House, 2002.
2. Morris Mano, "Digital design-With an Introduction to the Verilog HDL", 5th Edition, Pearson, 2013.
3. R.P.Jain, "Modern Digital Electronics", 4th Edition, TMH, 2010.
4. Thomas L Floyd, "Digital Fundamentals", 11th edition, Pearson, 2015
5. William H. Gothmann, "Digital Electronics", Prentice Hall, 2001.
6. Tutorial Website: https://www.tutorialspoint.com/digital_circuits/index.htm.

SEEA1201	CIRCUIT THEORY	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- To impart sound knowledge in the analysis of electrical circuits.
- To educate the phasor concepts in A.C circuits.
- To introduce the knowledge of resonance and transients.
- To impart knowledge of tuned circuits.

UNIT 1 D.C.CIRCUITS

9 Hrs.

Electrical quantities, Ohm's Law, Resistors - Series and parallel combinations, Current Division rule, Voltage Division rule, Source transformation - Kirchhoff's laws, Nodal and Mesh Analysis, Star Delta Transformation.

UNIT 2 SINGLE PHASE AC CIRCUITS

9 Hrs.

Sinusoidal Functions - RMS(effective) and Average Values - Phasor Representation - J operator – Sinusoidal Excitation Applied to Purely Resistive - Inductive and Capacitive Circuits - RL - RC and RLC Series and Parallel Circuits- Power and Power Factor.

UNIT 3 THREE PHASE AC CIRCUITS

9 Hrs.

Analysis of three phase 3-wire and 4-wire circuits with star and delta connected loads, balanced & unbalanced – phasor diagram of voltages and currents – power measurement in three phase circuits.

UNIT 4 TRANSIENT RESPONSE ANALYSIS

9 Hrs.

Time Domain Analysis - Transient response of RL, RC & RLC Networks with DC Input and Sinusoidal AC input.

UNIT 5 RESONANCE AND COUPLED CIRCUITS

9 Hrs.

Series and Parallel resonance - Quality factor and Bandwidth - Self and mutual inductance – Coefficient of coupling – Tuned circuits – Single tuned circuits.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Analyze dc circuits by different methods.

CO2 - Determine both magnitude and phase angle for various parameters of single phase AC circuits.

CO3 - Analyze three phase balanced and unbalanced circuits.

CO4 - Apply Laplace transform for time domain circuits.

CO5 - Convert the single tuned & double tuned circuits in to differential equation.

TEXT / REFERENCE BOOKS

2. Mittle B.N., Aravind Mittle, "Basic Electrical Engineering", Tata McGraw Hill, 2nd Edition, July 2017.
3. Charles Alexander, Mathew Sadiku, "Fundamentals of Electric Circuits", Tata McGraw Hill, 6th Edition, 2017.
4. Smarajit Ghosh, "Fundamentals of Electrical and Electronics Engineering", PHI Learning Private Ltd, 2nd Edition, 2010.
5. Abhijit Chakrabarti, Sudiptanath & Chandan Kumar Chanda, "Basic Electrical Engineering", Tata McGraw Hill, 1st Edition, 2010.
6. Wadhwa C.L., "Basic Electrical Engineering", New Age International, 4th Edition, 2007, Reprint June 2010.

SEEA2201	ELECTRICAL CIRCUITS AND ELECTRONIC DEVICES LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

COURSE OBJECTIVES

- To know the usage of Electrical and Electronic equipment.
- To know the testing of components.
- To understand the transient and resonance circuits.
- To understand the PN diode operation in forward and reverse bias.
- To know the characteristics of transistor in CB, CE configurations.

SUGGESTED LIST OF EXPERIMENTS

Electrical Circuits Lab

1. Verification of Kirchoff's Law.
2. Verification of Theorems.
3. Series and Parallel A.C circuits.
4. R-L and R-C transients with DC transients.
5. Series and Parallel Resonance.
6. Clippers and Clampers.

Electronic Devices Lab

1. Characteristics of Semiconductor diode and Zener diode to find static and dynamic resistance from the characteristics.
2. Characteristics of CB configuration.
3. Characteristics of CE configuration.
4. Drain and transfer characteristics of JFET. To obtain gain, trans conductance and amplification factor.
5. Characteristics of SCR, find holding current, break over voltage and holding voltage.
6. Characteristics of UJT, find intrinsic standoff ratio, Peak voltage and valley voltage.
7. Characteristics of LDR with illumination and without illumination.
8. Voltage multipliers.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Examine waveforms using function generator and measure voltage, frequency and phase of any waveform using CRO

CO2 - Apply various electrical components to verify Kirchoff's Law.

CO3 - Apply laws to verify various theorems.

CO4 - Analyze the performance of transients and resonance circuits.

CO5 - Analyze the characteristics of different electrical and electronic devices such as diodes, transistors etc. CO6 - Design and verify the characteristics of different electronic circuits like rectifiers, amplifiers

etc.

SEEA2202	DC MACHINES AND TRANSFORMERS LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

COURSE OBJECTIVES

- To impart knowledge to conduct test on various types of machines and transformer.
- To practice different types of wiring and apparatus connection.
- To analyze the operation of various DC machines with different load condition.
- To obtain the characteristics of DC machines and transformer by performing suitable test.

SUGGESTED LIST OF EXPERIMENTS

- 1 OCC and load characteristics of self- excited DC shunt generator.
- 2 OCC and load characteristics of separately excited DC shunt generator.
- 3 Load characteristics of DC series generator.
- 4 Load characteristics of DC compound generator (Differential and Cumulative).
- 5 Load characteristics of DC shunt motor.
- 6 Load characteristics of DC series motor.
- 7 Load characteristics of DC compound motor (Differential and Cumulative).
- 8 Speed control of DC shunt motor.
- 9 Swinburne's test on DC shunt motor.
- 10 Hopkinson's test.
- 11 OC and SC test on Single Phase Transformer.
- 12 Load test on Single Phase Transformer.
- 13 13 Parallel Operation of Single Phase Transformer.
- 14 14 Sumpner's Test on Single Phase Transformer.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Analyze the internal, external and efficiency characteristics of various types of DC generators.

CO2 - Analyze the electrical and mechanical characteristics of various types DC motors.

CO3 - Predict the of efficiency in a DC Machine.

CO4 - Determination the efficiency of a Single- Phase Transformer.

CO5 - Deduce the electrical equivalent circuit parameters of a Single- Phase Transformer.

CO6 - Demonstrate the various speed control operations of a DC motor...

SEEA2301	AC MACHINES LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

COURSE OBJECTIVES

- Acquire knowledge about the construction details of Synchronous and Asynchronous machines.
- To impart knowledge on self-starting methods of AC machines.
- To convey knowledge on Starting of three-phase induction motors.
- To analyze the operation of various Asynchronous machine with different load condition.
- To obtain the characteristics of Synchronous and Asynchronous machines by performing suitable test.

SUGGESTED LIST OF EXPERIMENTS

1. Regulation of Alternator by EMF and MMF method.
2. Regulation of Alternator by Potier method.
3. Regulation of salient pole Alternator by slip test.
4. Load test on 3 Phase Alternator.
5. Synchronizing and parallel operation of three phase Alternator with infinite bus bar.
6. V curve and inverted V curves of synchronous motor.
7. Brake load test on three phase squirrel cage induction motor.
8. Load test on three phase Slip ring Induction motor.
9. Load test on Single phase Induction motor.
10. Equivalent circuit of Single phase Induction motor.
11. Circle diagram and performance of three phase Induction motor.
12. Study on characteristics of Induction generator.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Evaluate the voltage regulation of alternator with different indirect method.
- CO2 - Analyze the voltage regulation of alternator with various load.
- CO3 - Develop the synchronization circuit for alternator.
- CO4 - Analyze the performance characteristics of Induction motor.
- CO5 - Examine performance characteristics of single- phase induction motor.
- CO6 - Analyze the characteristics of asynchronous machine.

SECA2305	ELECTRONIC CIRCUITS LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

COURSE OBJECTIVES

- To illustrate the students different electronic circuit and their application in practice.
- To impart knowledge on assessing performance of electronic circuit through monitoring of sensitive parameters.
- To evaluate the use of computer based analysis tools to review performance of semiconductor device circuit.

SUGGESTED LIST OF EXPERIMENTS

1. Determination of Ripple factor, % Regulation of HWR with and without filter.
2. Determination of Ripple factor, % Regulation of FWR with and without filter.
3. Design of series voltage regulator and perform line and load regulation.
4. Design of various Biasing techniques for CE amplifier.
5. Design and construct BJT Common Emitter Amplifier using voltage divider bias (self-bias) with and without bypassed emitter resistor.
6. Darlington Amplifier using BJT.
7. Differential amplifier using BJT.
8. Design of RC Phase shift oscillator for a specified frequency.

SIMULATION USING PSPICE

1. Frequency response of BJT Common Emitter Amplifier.
2. Frequency response of BJT Common Base Amplifier.
3. Frequency response of JFET Common Source Amplifier.
4. Time response of Astable Multivibrator, Mono stable Multivibrator and Bistable Multivibrator.
5. Frequency response of Class A Power Amplifier.
6. Frequency response of Series and Shunt Feedback amplifier.
7. Time response of Hartley, Colpitts Oscillator.
8. Time and frequency response of Single Tuned Amplifier.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Analyze the performance characteristics of rectifiers circuits with and without filters.

CO2 - Examine the operation of amplifier circuits under different operating conditions.

CO3 - Apply various design techniques to the transistor amplifier circuits.

CO4 - Examine the theoretical and practical values for various semiconductor devices.

CO5 - Analyze the characteristics of different electronic circuits like rectifiers, amplifiers, Oscillators, etc.,

CO6 - Design the amplifier and oscillator circuits using Spice.

SCSA2203	PROGRAMMING IN C AND C++ LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

COURSE OBJECTIVES

- To understand the basic concepts of C/C++ programming.
- To demonstrate the techniques for implementing engineering applications using computer programs.
- To equip students with sound skills in C/C++ programming language.
- To Identify, formulate and solve problems by using computer programming Language.
- To write diversified solutions using C language.

SUGGESTED LIST OF PROGRAMS

1. Programs using Control Statements.
2. Programs using Arrays and Functions.
3. Programs using Structures and Union.
4. Programs using Dynamic Memory Allocation.
5. Programs using Files.
6. Programs using Class and Objects.
7. Programs using Constructor and Destructor.
8. Programs using Function & Operator overloading.
9. Programs using Virtual Functions.
10. Programs using Inheritance.

COURSE OUTCOMES

On completion of the course, the students will be able to

- CO1 - Apply good programming design methods for program development.
- CO2 - Construct programs that demonstrate effective use of C features including arrays, structures, pointers and files.
- CO3 - Develop Recursive Programs.
- CO4 - Develop programs that perform explicit memory management.
- CO5 - Develop programs in object oriented programming.
- CO6 - Apply generic progr

SECA2507	INTEGRATED CIRCUITS LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

COURSE OBJECTIVES

- To study the basic principles, configurations and practical limitations of op-amp.
- To understand the various linear and non-linear applications of op-amp.
- To analyze and design op-amp oscillators, single chip oscillators and frequency generators.
- To analyze, design and explain the characteristics and applications of active filters, including the switched capacitor filter.
- To understand the operation of the most commonly used D/A and A/D converter types and its applications.

SUGGESTED LIST OF EXPERIMENTS

ANALOG INTEGRATED CIRCUITS

1. Design and construct using IC741
 - a). Inverting
 - b). Non-inverting
 - c). Adder
 - d). Schmitt Trigger
 - e). Differentiator
2. Waveform Generators using IC741
 - a). Triangular wave generator
 - b). Square wave generator
 - c). Sine Wave generator
3. Design and construct PWM using IC 555 timer
4. Design a 3 bit DAC in R-2R ladder Configuration
5. Design, construct the filters using PSPICE
 - (a). Low pass filter
 - (b). High pass filter
 - (c). Band pass filter
 - (d). Band reject filter

DIGITAL INTEGRATED CIRCUITS

6. Verify the Basic gates / Boolean function using logic gates.
7. To Construct and verify the full and half adder using logic gates.
8. To Verify 2x4 Decoder and 4x2 Encoder functionally.
9. To construct and study the working of RS flip-flop, D flip-flop, T flip-flop, JK flip-flop
10. To verify various shift register
 - (a). SISO
 - (b). SIPO
 - (c). PISO
 - (d).PIPO
11. Design a counter using suitable flip-flop
 - (a). MOD Counter
 - (b). Ripple Counter
 - (c). Up- Down Counter

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Evaluate the op-amp's basic construction, characteristics, parameter limitations, various configurations and countless applications of op-amp.
- CO2 - Examine operation registers, flipflop counter.
- CO3 - Analyze basic op-amp circuits, particularly various linear and non-linear circuits, active filters, signal generators and data converters.
- CO4 - Examine the basic configuration of IC741, IC555 and various counter operation.
- CO5 - Evaluate the logic gates and combinational circuit using the suitable IC.
- CO6 - Evaluate the various characteristics of the filter circuits using Orcad PSPICE.

SECA2508	MICROPROCESSOR LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

COURSE OBJECTIVES

- To impart the knowledge of 8085 and 8086 processor.
- To develop assembly language program in 8085/8086 processor.
- To introduce the peripheral devices.
- To acquire the knowledge of interfacing and hardware implementation.

SUGGESTED LIST OF EXPERIMENTS

2. Programs for 8 bit Addition, Subtraction, Multiplication and Division.
3. Perform 32 bit Addition of two numbers.
4. Counting numbers of 1's in given word.
5. Arithmetic mean of Square of N Numbers.
6. Code Conversion – BCD to ASCII Conversion, ASCII to BCD Conversion.
7. Finding largest & smallest of given 16 bit Numbers.
8. To Sort given set of Numbers in Ascending & Descending Order.
9. Program using look up table Concept.
10. Matrix Manipulation – 16 bit addition.
11. Perform LCM of two 16 bit numbers, GCD of four 16 bit numbers.
12. Generate Fibonacci Series, Factorial of given Numbers.
13. Interfacing 8086 with Stepper motor. Use Step angle Calculation & rotate motor to a Specified angle.
14. Interface 8086 with DC motor & Control the Speed of the DC Motor using PWM.
15. Interface 8086 With ADC & display the digital input, Perform the resolution calculation and cross verify the result.
16. Interface 8086 With DAC & display the following waveform in CRO. a). Triangular b). Saw tooth c). Staircase.
17. Interface 8086 with 7 segment display to display numbers as Characters.
18. Interface 8086 with LCD to display the name of the person.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Understand the basic arithmetic operations using 8085/8086 microprocessor instruction set.
- CO2 - Familiarize with the Assembly Language programming and concepts of 8085/8086 microprocessors.
- CO3 - Ability to provide solutions to the problems related to advanced data processing.
- CO4 - Design and develop interfacing circuits for stepper motor and DC motor.
- CO5 - Design and develop interfacing circuits for ADC and DAC.
- CO6 - Design and develop interfacing circuits for LCD and Seven segment display.

SEEA2601	MEASUREMENTS AND CONTROLS LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

COURSE OBJECTIVES

- To impart knowledge on analysis and design of control system along with basics of instrumentation.
- To implement the measurement techniques for various electrical quantities.
- To analyze the transfer function of DC machines.
- To design compensators for an appropriate applications.
- To synthesis speed of multiple machines by applied voltage control method.

SUGGESTED LIST OF EXPERIMENTS

- 1 Measurement of self-inductance by Maxwell's inductance bridge.
- 2 Calibration of Ammeter, Voltmeter and Wattmeter.
- 3 Calibration of Three phase energy meter.
- 4 Instrumentation Amplifier.
- 5 Study of LVDT and Pressure Transducer.
- 6 Design of P, PI and PID controller.
- 7 Study of temperature measuring transducers (Thermocouple).
- 8 Transfer function of DC generator.
- 9 Transfer function of Field controlled DC motor.
- 10 Transfer function of Armature controlled DC motor.
- 11 Speed Control of Ward Leonard system.
- 12 Transfer function of lag, lead and lag-lead network.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Apply optimal control and non-linear control techniques.

CO2 - Analyze design and operation of control systems employed in various industries.

CO3 - Analyze the transfer function of various DC Machines.

CO4 - Describe P, PI, PID controller for any applications using MATLAB.

CO5 - Examine the physical parameters by using various transducers.

CO6 - Evaluate the basic meters and energy meter by calibrating the error.
ammung techniques to solve practical engineering problems.

SEEA2602	POWER SYSTEMS LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

COURSE OBJECTIVES

- To have hands on experience on various system studies and different techniques used for system planning using Software packages.
- To gain Knowledge in designing of automation problem.

SUGGESTED LIST OF EXPERIMENTS

1. Computation of Power System Components in Per Unit.
2. Formulation of the bus admittance matrix by Direct inspection method.
3. Formulation of the bus admittance matrix by Singular transformation method.
4. Formation of bus impedance matrix.
5. Analysis of Daily Load Curve.
6. Automatic Generation Control .
7. Determination of Transmission line parameters.
8. Numerical Integration of Swing equation.
9. Load flow solution using Gauss – Seidal method.
10. Load flow solution using Newton – Rapson method.
11. Fault analysis.
12. Characteristics of Microcontroller based Frequency relay.
13. Construction of simple ladder program for Logic gates.
14. Applications of Delay Timers in PLC.
15. Applications of Counters in PLC.

COURSE OUTCOMES:

On completion of the course, student will be able to

- CO1 - Create bus impedance and admittance matrix and compute P.U power system model.
- CO2 - Estimate the various fault currents in power system and compute inductance in Transmission lines.
- CO3 - Solve the power flow analysis using Gauss Seidel and N-R method.
- CO4 - Analyze the daily load curve and automatic generation control.
- CO5 - Identify the stability of system and characteristics of various relay.
- CO6 - Design ladder diagram for different automation problem using PLC.

SITA3011	Block Chain Technologies	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To introduce Bit coin and other crypto currencies.
- To study the algorithms and techniques in block chain.
- To understand the practical aspects in the design of crypto currency
- To understand the function of Block chains as a method of securing distributed ledgers.
- To design, code, deploy and execute a smart contract.

UNIT 1 INTRODUCTION TO BLOCKCHAIN

Basics of blockchain-Public Ledgers-Block Chain as Public Ledgers-Types of Block chains- Pillars of Block chain Government Initiatives of Block Chain-Bitcoin-Smart Contracts

UNIT 2 ARCHITECTURE AND CONCEPTUALIZATION OF BLOCK CHAIN, CRYPTO CURRENCIES

Block in a Block chain-find Transactions-Distributed Consensus-Proof of work, Stake, Space- Attacks on POW-EthereumPos/POW Hybrids-Crypto currency to block chain 2.0, Model of Blockchain-Algorand.

UNIT 3 CRYPTO PRIMITIVES, SECURING AND INTERCONNECTING PUBLIC AND PRIVATE BLOCK CHAINS

Hash Function and Merle Tree-Security Properties-Security Considerations for block chain-Digital Signature-Public Key Cryptography-Bit coinblock chain incentive structures- Nash Equilibriums- evolutionary stable strategies,-and Pareto→ efficiency (game theory) Weaknesses and news Points of Failure→ Mitigation Methods→ Redundancies and fall-back methods

UNIT 4 MINING AND CRYPTO CURRENCIES - HOW TO USE AND INTERACT

Mining-Pools-Impact of CPU and GPU-Transaction in Bit coin Network- Block Mining-Block propagation and block relay

UNIT 5 USE CASES-APPLICATIONS IN DIFFERENT AREAS

Industry applications of Blockchain-Blockchain in Government-Government use cases-Preventing Cybercrime through block chain-Block Chain in defense, tax payments

COURSE OUTCOMES:

On completion of the course, the student should be able to

- CO1: Explain the structure of a block chain.
- CO2 :Analyze the incentive structure in a block chain based system.
- CO3 :Judge the scenario where “smart” contract is most appropriate.
- CO4 :Identify Basic knowledge of Bitcoin, Ethereum.
- CO5 :Apply Blockchain in future use cases for security.
- CO6 :Understand the various Block Chain applications.

TEXT / REFERENCE BOOKS

1. Mastering Bitcoin: Unlocking Digital Cryptocurrencies, by Andreas Antonopoulos O'Reilly, First Edition, 2014.
2. Blockchain by Melanie Swa, O'Reilly Media 2015
3. Zero to Block chain - An IBM Redbooks course, by Bob Dill, David Smits -

SECA2703	EMBEDDED AND DSP LAB	L	T	P	Credits	Total Marks
		0	0	4	2	100

Course Objectives

- To impart knowledge in basic of embedded programming using AT89C51.
- To implement filters using MATLAB.
- To analyze the various application of embedded systems.
- To have a knowledge in DSP processor, TMS320C24X.

SUGGESTED LIST OF EXPERIMENTS

Basic illustration programs using arithmetic, Logical and bit-oriented instructions for AT89C51

Interfacing light bulb using relay.

Interfacing LCD display in static display.

Interfacing stepper motor with ULN2003 to rotate in specific angle.

Interfacing DC motor with H-bridge to make it rotate in front, back, left, right.

Illustration of interrupts using LED on/off using timer delay.

Illustration of serial communication to transfer data from one microcontroller to other.

PROGRAMS USING MATLAB

1. Generation of Standard Signals.

2. Design of FIR filters using Windowing technique. 3. Design of IIR Filters using Butterworth filters

USING TMS320CX2407 DSP Processor

1. Single pulse fixed PWM generation using general purpose Timers.
2. Two pulse fixed PWM generation using Timer 1 and Timer 2.

Course Outcomes

On completion of the course, the student should be able to

CO1 - Familiarize with the various basic operations using AT89C51.

CO2 - Explain the various signals using MATLAB.

CO3 - Apply MATLAB to design a filter.

CO4 - Examine the PWM pulse operation in DSP processor.

CO5 - Evaluate the applications of embedded systems.

CO6 - Design of microcontroller-based embedded systems



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1.1.3. Courses having focus on Employability / Entrepreneurship / Skill Development

Programme: M.

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 Employability

 Entrepreneurship

 Skill Development

SEEA5103	ADVANCED POWER SEMICONDUCTOR DEVICES	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To study the characteristics of advanced power semiconducting switches.
- To analyse the on-state and switching losses involved in the operation of power semiconducting switches.
- To study the firing and protection circuits of advanced power semiconducting switches.

UNIT 1 INTRODUCTION

9 Hrs.

Power switching devices overview – Attributes of an ideal switch, application requirements, circuit symbols; Power handling capability – (SOA); Device selection strategy – On-state and switching losses – EMI due to switching –Power diodes - Types, forward and reverse characteristics, switching characteristics – Rating.

UNIT 2 CURRENT CONTROLLED DEVICES

9 Hrs.

BJT's – Construction, static characteristics, switching characteristics; Negative temperature co-efficient and secondary breakdown; Power Darlington – Thyristors – Physical and electrical principle underlying operating mode, Two transistor analogy – concept of latching; Gate and switching characteristics; converter grade and **inverter grade and other types; series and parallel operation; comparison of BJT and Thyristor – Steady state and dynamic models of BJT & Thyristor.**

UNIT 3 VOLTAGE CONTROLLED DEVICES

9 Hrs.

Power MOSFETs and IGBTs – Principle of voltage controlled devices, construction, types, static and switching characteristics, steady state and dynamic models of MOSFET and IGBTs – **Basics of GTO, MCT, FCT, RCT** and IGCT.

UNIT 4 FIRING AND PROTECTING CIRCUITS

9 Hrs.

Necessity of isolation, pulse transformer, opto-coupler – Gate drive circuit: SCR, MOSFET, IGBTs and base driving for power BJT. - Over voltage, over current and gate protections; Design of snubbers.

UNIT 5 THERMAL PROTECTION

9 Hrs.

Heat transfer – conduction, convection and radiation; Cooling – Liquid cooling, vapour – Phase cooling; Thermal modelling of power switching devices: Thermal equivalent circuit, Coupling of electrical & thermal components, heat sink types and design – Mounting.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Understand the concept of Power semiconductor devices.
- CO2 - Study the performance of the current controlled and voltage controlled devices.
- CO3 - Explain the working of power semiconductor devices.
- CO4 - Evaluate the characteristics of all power semiconductor devices.
- CO5 - Examine the applications of power semiconductor devices.
- CO6 - Design firing circuits protection circuits and to provide thermal protection for power semiconductor devices.

TEXT / REFERENCE BOOKS

1. Mohan N., Undeland and Robbins, "Power Electronics – Converters, Application & Design", John Wiley & Sons, Inc, 3rd Edition, Newyork, Reprint, 2009.
2. Simon M.Sze & Kwok K.Ng, "Physics of Semiconductor Devices", A Wiley Inter Science Publications, John Wiley and Sons, New Jersey, 3rd Edition, 2007.
3. Rashid M.H., "Power Electronics Circuits, Devices and Applications", Pearson Education, 2013.
4. M.D.Singh and K.B. Khanchandani, "Power Electronics", Tata McGraw Hill Companies, Electrical and Electronics Engineering Series, 2nd Edition, 3rd Reprint, 2008.
5. Jayant Baliga, "Advanced Power Rectifier Concepts", Springer, 2008.
6. Jayant Baliga, "Advanced High Voltage Power Devices Concepts", Springer, 2010.
7. Dieter K.Schroder, "Semiconductor Material and Device Characterization", A John Wiley and Sons Inc, Publication, New Jersey, 2006.
8. Robert F.Pierret, "Semiconductor Device Fundamentals", Pearson Education, 2nd Impression, 2008.
9. Donald A.Neamen, "Semiconductor Physics and Devices", McGraw Hill companies, Special Indian Edition, 2007.
10. P.C. Sen, "Power electronics", S.Chand Ltd., 2007.

SECA5209	EMBEDDED SYSTEM DESIGN	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To learn the architecture and instruction sets of an ARM processor.
- To comprehend the concepts of RTOS and Embedded networking.
- To realize the basic interfacing circuits using ARM processor.

UNIT 1 ARM ARCHITECTURE

9 Hrs.

ARM Architecture, ARM Design Philosophy, Registers, Program Status Register, Instruction Pipeline, Interrupts and Vector Table.

UNIT 2 ARM INSTRUCTION SET

9 Hrs.

Data Processing Instructions, Addressing Modes, Branch, Load, Store Instructions, PSR Instructions, Conditional Instructions. Thumb Instruction Set: Register Usage, Other Branch Instructions, Data Processing Instructions, Single Register and Multi Register Load -Store Instructions, Stack, Software Interrupt Instructions

UNIT 3 REAL TIME OPERATING SYSTEM

9 Hrs.

Real time operating systems (RTOS) – real time kernel – OS tasks – task states – task scheduling – interrupt processing – clocking communication and synchronization – control blocks – memory requirements and control –kernel services.

UNIT 4 EMBEDDED NETWORKS

9 Hrs.

Embedded Networks - Distributed Embedded Architecture – Hardware and Software Architectures, Networks for embedded systems– I2C, CAN Bus, Ethernet, Internet, Network–Based design– Communication Analysis, system performance Analysis, Hardware platform design, Allocation and scheduling, Design Example: Elevator Controller.

UNIT 5 SYSTEM DESIGN

9 Hrs.

Switches and LED interfacing-LCD Display interfacing- Analog sensors interfacing for digital data conversion -Access control using analog keypad - Pulse width modulation technique for motor speed control

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Gain significant knowledge about the complete architecture of an ARM processor.
- CO2 - Understand various instruction sets of ARM processor and their significance.
- CO3 - Analyze the various functionalities of Real Time Operating System
- CO4 - Compare and contrast the various embedded networking buses and justify their choice for an embedded system.
- CO5 - Design basic interfacing circuits using ARM processor.
- CO6 - Implement the knowledge of instructions in programming and developing an embedded system.

TEXT / REFERENCE BOOKS

1. Andrew N.Sloss, Dominic Symes, Chris Wright, "ARM Systems Developer's Guide: Designing & Optimizing System Software", Elsevier, 2004.
2. Jonathan W. Valvano, "Embedded Microcomputer Systems: Real Time Interfacing", Cengage Learning, 2011
3. Wayne Wolf, "Computers as Components: Principles of Embedded Computing System Design", Morgan Kaufman Publishers, 2008.
4. C.M. Krishna, Kang G. Shin, "Real time systems", Mc-Graw Hill, 3rd reprint, 2010.
5. Herma K., "Real Time Systems: Design for Distributed Embedded Applications", Kluwer Academic Publishers, 1997.
6. William Hohl, "ARM Assembly Language, Fundamentals and Techniques", Taylor & Francis, 2009.

SEEA7001	SPECIAL MACHINES AND THEIR CONTROLLERS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To impart knowledge on working principle, characteristics and applications of special electrical machines.
- To learn various controller circuits of special electrical machines.
- To analyze performance characteristics of universal motor and Linear Electric motors.

UNIT 1 STEPPER MOTORS

9Hrs.

Introduction to stepper motor - Constructional features and principle of operation - Single phase stepper motors - Modes of excitation - Characteristics - PM stepper motor, Hybrid Stepper motor - Construction and operation of Enhanced PMH stepper motor, Disc Magnet stepper motor, Electro hydraulic stepper motor - Drive circuits for stepper motor – Open loop control and Closed loop control of stepping motor - Single stack variable reluctance stepper motor - Multi-stack stepper motor – Electromagnetic torque developed in reluctance motor - Effect of saturation - Static and dynamic characteristics - Applications of stepper motor.

UNIT 2 SWITCHED RELUCTANCE MOTORS

9Hrs.

Constructional features - Principle of operation - Torque equation - Power electronic converter circuits - Characteristics and control - Torque-speed Characteristics, Current sensing - Rotor position measurement and estimation - Sensor less rotor position estimation - Incremental inductance measurement and constant flux linkages method – Control of SRM for traction type load.

UNIT 3 PERMANENT MAGNET BRUSHLESS DC MOTORS

9Hrs.

Commutation in DC motor - Difference between mechanical and electronic commutators - Hall effect sensors - Optical sensors - Multiphase brushless motor - Square wave permanent magnet brushless motor drives - Torque and EMF equation – Torque - speed characteristics – Controllers

UNIT 4 PERMANENT MAGNET SYNCHRONOUS MOTORS

9Hrs.

Construction and operation of permanent magnet synchronous motors - EMF and torque equation - phasor diagram - Locus diagram - torque-speed characteristics - microprocessor based control of PMSM. Vector control, self-control and - microprocessor based control of permanent magnet synchronous motors -.

UNIT 5 UNIVERSAL MOTOR AND LINEAR ELECTRIC MOTORS

9Hrs.

Universal motor - Classification - Design considerations - principle - performance analysis - Equivalent circuit - characteristics - speed control. Linear Electric motors - comparison between linear electric motor and rotary motor - Linear Induction motors - construction, principle, Equivalent circuit, characteristics and Design aspects. Linear Synchronous motor - classification, principle, performance equations, LSM control, static power converter.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Acquire knowledge about the fundamentals, characteristics and control of stepper motors.
- CO2 - Acquire knowledge about the fundamentals, characteristics and control of switched reluctance motors.
- CO3 - Analyze the characteristics and commutation circuits of permanent magnet brushless DC motors.
- CO4 - Acquire knowledge about the fundamentals, characteristics and control of permanent magnet Synchronous motors.
- CO5 - Acquire knowledge on Design considerations, performance analysis and speed control of Universal motor.
- CO6 - Analyze the fundamentals, Equivalent circuit, characteristics and Design aspects of Linear Electric motor.

TEXT / REFERENCE BOOKS

1. Miller. T.J.E. "Brushless Permanent Magnet and Reluctance Motor Drives", Clarendon Press, Oxford, 1989.
2. Kenjo. T, "Stepping motors and their Microprocessor control", Clarendon Press, Oxford, 1989.
3. R.Krishnan, "Switched Reluctance Motor Drives – Modelling, Simulation, Analysis, Design and Applications", CRC Press, 2001.
4. J.F.Gieras, "Advancements In Electrical Machines", Springer Publishers, 2008.
5. Kenjo, T and Nagamori, S, "Permanent Magnet and Brushless DC motors", Clarendon Press, Oxford, 1989.
6. K.Venkataratnam, "Special Electrical Machines", University Press Private Limited, 2008.
7. K.Dhayalini, "Special Electrical machines", Anuradha Publications, Reprint 2015.

SEEA7002	POWER ELECTRONICS IN POWER SYSTEMS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To understand the concepts of Reactive power requirement and load compensation.
- To impart knowledge on FACTS devices and power factor improvement.
- To provide a chance for the students to learn about the different power converter and its methods of commutation.
- To impart more knowledge about Tap changing transformer, UPS, HVDC, etc which helps in energy storage and effective utilization.

UNIT 1 LOAD COMPENSATION

9 Hrs.

Introduction – Need for Compensation – Objectives in load compensation – Specifications of load compensator – Ferranti Effect - Classification of compensation – Shunt & Series Compensation – Voltage Sag, Swell, Surges - Effects of Voltage Collapse

UNIT 2 INTRODUCTION TO FACTS DEVICES

9 Hrs.

Thyristor Controlled Reactor (TCR) – Thyristor Switched Capacitor (TSC) – Saturable Reactor – Saturated Reactor Compensator – Static VAR Compensator (SVC) – Thyristor Controlled Series Capacitor (TCSC) – Unified Power Flow Controller (UPFC) - STATCOM – Dynamic Voltage Restorer (DVR)

UNIT 3 HARMONICS CONTROL AND POWER FACTOR IMPROVEMENT

9 Hrs.

Reactive power variation for fully controlled converter – Half controlled converter – Fully controlled converter with controlled freewheeling – Methods of employing natural commutation – Methods of employing forced commutation – Implementation of forced commutation

UNIT 4 VOLTAGE CONTROL USING STATIC TAP CHANGER

9 Hrs.

Introduction to voltage regulators – Single Phase voltage controllers – Sequence control of AC voltage controllers – Manually controlled voltage regulator (Conventional Methods) – Static Tap changer using thyristors - Application of Tap-Changing Transformers to Transmission Systems.

UNIT 5 UNINTERRUPTIBLE POWER SUPPLY SYSTEMS

9 Hrs.

Switched mode power supply (SMPS) – Parallel UPS – Rotating UPS – Static UPS types – UPS using resonant power converters – High voltage DC transmission – Static circuit breakers

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Remember the importance of reactive power compensation and power factor improvement.
- CO2 - Understand the various FACTS devices and its role in compensation.
- CO3 - Apply various methods of commutation for converters.
- CO4 - Categorise different tap changing transformer and its applications.
- CO5 - Justify the importance of UPS and SMPS.
- CO6 - Design and construct HVDC transmission, static circuit breakers.

TEXT / REFERENCE BOOKS

1. Miller.T.J.E, "Reactive Power Control in Electric Systems", Wiley-Interscience, New York, 1982.
2. G.K.Dubey, "Thyristorised Power Controllers", New Age International Publishers, 2nd Edition (2012).
3. P.S.Bimbhra, "Power Electronics", Khanna Publishers, 5th Edition, 2014.
4. R. Mohan Mathur, Rajiv K. Varma, "Thyristor-based Facts Controllers for Electrical Transmission systems", Wiley-IEEE, 2002.
5. P.C.Sen, "Power Electronics", Tata Mc Graw Hill, 2008.
6. "Static compensator for AC power systems", Proc.IEE Vol.128, pt.c, Nov 1981, pp362-406.
7. "A static alternative to the Transformers on Load tap Changing", IEEE Trans. on PAS, Vol.101, Sep.982, pp3091-3095.
8. K.R. Padiyar, "FACTS Controllers in Power Transmission and Distribution", New Age International, 2007(Reprint 2013).
9. Narain G.Hingorani and Laszlo Gyugyi, "Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems", Wiley-IEEE Press, 1999.

SEEA7007	POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To provide the knowledge of photo voltaic system and wind energy system.
- To analyse the knowledge for standalone PV systems.
- To obtain the analysis of power control through PV inverters for hybrid and grid connected PV systems.
- To design control and gate driver circuitry for wind energy converter.
- To develop a prototype of wind energy converter with recent control technique.

UNIT 1 INTRODUCTION

9Hrs.

Overview of Indian energy scenario – Energy sources and availability – Energy crisis – Need to develop new energy technologies – Solar energy availability in India – Wind survey in India – Emerging trends in electrical energy utility – Energy and environment.

UNIT 2 POWER ELECTRONICS FOR PHOTOVOLTIC SYSTEMS

9 Hrs.

Solar cell fundamentals – Conversion of sunlight to electricity – Cell performance – Basics of photovoltaic – Types of PV power systems – Standalone PV systems – Battery charging – PV charge controllers – Maximum Power Point Tracking (MPPT) – Inverters for stand alone PV systems – Solar water pumping – Power conditioning unit for PV water pumping.

UNIT 3 HYBRID AND GRID CONNECTED PV SYSTEMS

9 Hrs.

PV Diesel hybrid systems – Control of PV – Diesel hybrid system – Grid connected PV systems – Inverters for grid connected applications – Inverter – Inverter types – Power control through PV inverters – System configuration – Grid inverter characteristics.

UNIT 4 POWER ELECTRONICS FOR WIND POWER SYSTEM

9Hrs.

Basics of wind power – Types of wind turbines – Types of wind generators – Types of wind power systems – Stand alone wind diesel hybrid systems – Grid connected wind energy systems.

UNIT 5 SYSTEM MANAGEMENT OF WIND ENERGY CONVERTER

9Hrs.

Prototype development – Control circuitry – Microcontroller – Complex programmable logic device – Gate driver circuitry for wind energy applications.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Understand the concepts of photovoltaic system and wind energy system.
- CO2 - Apply power electronics for standalone photovoltaic systems.
- CO3 - Design a hybrid grid connected PV systems.
- CO4 - Develop a power electronics based grid connected wind energy system.
- CO5 - Analyse gate driver circuitry for wind energy applications.
- CO6 - Understand the knowledge of prototype development.

TEXT / REFERENCE BOOKS

1. Rashid. M. H, "Power Electronics Handbook", Academic press, 4th edition, September 29th, 2017.
2. Erickson. R., Angkrtitrakul. S, Al – Nasean. O and Lujan. G, "Novel power electronics systems for wind energy applications" – Final report, National Renewable Energy Laboratory, Colorado, US. – Aug 24, 1999 – Nov 30, 2002.
3. Rai. G. D, "Non-conventional energy sources", Khanna Publishers, 6th Edition 2015.
4. B.H.Khan, "Non-conventional Energy Resources", Tata McGrawHill, 2nd Edition 2009.
5. J.K.Manwell, J.G.McGowan, A.L.Rogers, "Wind energy explained – Theory Design and applications", John Wiley & Sons, 2nd Edition 2009.

SEEA5202	INDUSTRY 4.0 FOR POWER ELECTRONICS AND DRIVES	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To learn the architecture and instruction sets of an ARM processor.
- To comprehend the concepts of RTOS and Embedded networking.
- To realize the basic interfacing circuits using ARM processor

UNIT1 INTRODUCTION TO INDUSTRY 4.0

9 Hrs.

Introduction, Historical Context, General framework, RAMI model for Industry 4.0, Application areas, Pillars on of Industry 4.0 - Artificial intelligence, The Internet of Things and Industrial Internet of Things, Additive manufacturing, Robotization and automation, Industry 4.0 and Sustainable Development, Current situation of Industry 4.0. Introduction to Industry 4.0 to Industry 5.0 Advances.

UNIT 2 INDUSTRY 4.0 AND CYBER PHYSICAL SYSTEM

9Hrs.

Introduction to Cyber Physical Systems (CPS), Characteristics of CPS, Components of CPS, physical and cyber components, 5C Architecture of CPS, Tools for Artificial Intelligence, Big Data and Data Analytics, Virtual Reality, Augmented Reality, IoT, Robotics. Emerging applications in CPS

UNIT 3 SMART ENERGY SOURCES

9Hrs.

Need for Electrical Energy Storage system, Types of electric energy storage, Potential of Sodium-Sulfur Battery Energy Storage to Enable Integration of Wind-Case study. Electric Vehicles as Energy Storage: V2G Capacity Estimation..

UNIT 4 SMART GRID

9Hrs.

Smart grid definition and development Smart Grid, Understanding the Smart Grid, Smart grid solutions, Design challenges of smart grid and Industry 4.0, Building the Smart Grid-Case study..

UNIT 5 APPLICATIONS AND FUTURE OF INDUSTRY 4.0

9Hrs.

Domain applications of Industry 4.0 in Agriculture, Infrastructure, Disaster management, Energy, Transportation, health care, education domain. Case study-Smart Cars, Intellectual Property Rights. Skills required for Future, Framework for achieving vision, Challenges.

Max. 45 Hrs.

Course Outcomes

On completion of the course, the student should be able to

CO1 - Understand the basic concepts of Industry 4.0 and the other related fields.

CO2 - Understand cyber physical system and the emerging applications.

CO3 - Analyze the different energy storage systems

CO4 - Analyze a smart grid system.

CO5 – Implement the industry 4.0 to solve engineering problems.

CO6 – Design of smart system and analyze its performance

TEXT / REFERENCE BOOKS

1. Jean-Claude André, –Industry 4.0II, Wiley- ISTE, July 2019, ISBN: 781786304827,2019.
2. Diego Galar Pascual, Pasquale Daponte, Uday Kumar, –Handbook of Industry 4.0 and SMART SystemsII Taylor and Francis,2020
3. Miller M, –The internet of things: How smart TVs, smart cars, smart homes, and smart cities are changing the worldII, Pearson Education, 2015, ISBN: 9780134021300.
4. Pengwei Du and Ning Lu, –Energy storage for smart grids: planning and operation for renewable and variable energy resources VERs II, Academic Press, 2018, Reprint edition , ISBN-13: 978-0128100714
5. Hossam A. Gabbar, –Smart Energy Grid EngineeringII, Academic Press, 2017, ISBN 978-0-12-805343-0.
6. Mini S. Thomas, John Douglas McDonald, –Power System SCADA and Smart GridsII, CRC Press, 2017.
7. <https://sdgs.un.org/goals>
8. <https://doi.org/10.1002/bse.2867>

SEEA5101	ANALYSIS OF RECTIFIERS AND CHOPPERS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To have in-depth knowledge on single and three phase rectifiers
- Understand the operation and to analyse AC and DC choppers
- To learn the operation of cycloconverter and special converters

UNIT 1 SINGLE PHASE RECTIFIERS

9 Hrs.

Introduction – Principle of phase controlled converter operation – Single phase full converter with R, RL and RLE loads – Effect of Freewheeling diodes – Effect of source inductance – Single phase semi converter – Single phase dual converter – Single phase series converter.

UNIT 2 THREE PHASE RECTIFIERS

9 Hrs.

Three phase half wave converter – Three phase semi converter – Three phase full converter with R, RL and RLE loads. – Effect of source and load inductance - Three phase dual converter – Power factor improvements

UNIT 3 DC CHOPPERS

9 Hrs.

Introduction – Principles of step-down operation, step-down chopper with RL load – Principle of step-up operation with resistive load – Converter classification – Switching mode regulators – Analysis of buck, boost, buck boost and CUK converter – Comparison of regulators – Multi output boost converter.

UNIT 4 AC CHOPPERS

9 Hrs.

Introduction – Principle of ON-OFF control – Principle of phase control – Single phase bidirectional controllers with resistive loads – Single phase controllers with Inductive loads – Three phase half wave and full wave controllers – Three phase bi-directional delta connected controllers. AC voltage controllers with PWM control.

UNIT 5 CYCLOCONVERTER AND SPECIAL CONVERTERS

9 Hrs.

Cycloconverters – Single phase step up and step down cycloconverter – Single phase to three phase cycloconverter – Three phase to single phase cycloconverter - Study of Harmonics- Introduction to Matrix converter.

Max. 45 Hrs.

COURSE OUTCOMES

On the completion of the course, student will be able to

- CO1 - Analyse single phase rectifiers with various loads
- CO2 - Analyse three phase rectifiers with various loads
- CO3 - Analyse DC chopper for a particular load
- CO4 - Design and analyse AC voltage controllers
- CO5 - Design various power converters
- CO6 - Develop new converters to meet industrial requirements

TEXT / REFERENCE BOOKS

1. Rashid M.H., "Power Electronics Circuits, Devices & Applications", Pearson Education, 4th Edition, 2017.
2. P.S.Bimbhra, "Power Electronics", Khanna Publishers, 5th Edition, 2014.
3. Mohan N., Undeland & Robbins, "Power Electronics Converters, Application & Design", John Wiley & Sons, Inc, 3rd Edition, Reprint, 2009.
4. P.C.Sen, "Modern Power Electronics", S.Chand Ltd., 2005.

SEEA5102	ANALYSIS OF INVERTERS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- Understand the basic inverter circuit operation.
- Understand the three phase inverter types VSI, CSI and Z source inverter.
- Understand the Purpose and need of multilevel inverter.
- Design an inverter for electrical drive, photovoltaic application etc.
- Able to analyze the inverter output using Fourier analysis for harmonics.

UNIT 1 SINGLE PHASE INVERTER

9 Hrs.

Introduction – Principle of operation – Performance parameters – Single phase half bridge Inverters – Single phase full bridge Inverter – Single phase Series Inverter – Single phase parallel Inverter - Modified McMurray Inverter – McMurray Bedford half bridge and full Inverter Voltage control of single phase Inverters

UNIT 2 VOLTAGE SOURCE AND CURRENT SOURCE INVERTER

9 Hrs.

Three phase bridge Inverter with 180° and 120° mode of operation – Voltage control of three phase Inverters -Analysis of single phase and three phase auto sequential current source Inverter - Current source bridge Inverter– Harmonic Elimination Techniques.

UNIT 3 Z-SOURCES INVERTER

9 Hrs.

Single phase and three phase z source inverter -Comparison with VSI and CSI-Equivalent circuit and operation –Circuit analysis and calculation-Introduction to Quasi Z- source inverter-basic topology-Extended boost quasi Z- source inverter topologies.

UNIT 4 RESONANT PULSE INVERTERS

9 Hrs.

Introduction – Series resonant Inverters with unidirectional and Bidirectional switches – Parallel resonant Inverters– Class E resonant Inverter - Zero current switching resonant converter – Zero voltage switching resonant converter– Two quadrant ZVS resonant converter – Resonant DC link Inverter.

UNIT 5 MULTILEVEL INVERTER

9 Hrs.

Multilevel concept – Diode clamped – Flying capacitor – Cascade type multilevel Inverters - Comparison of multi-level Inverters - Application of multilevel Inverters.

Max. 45 Hrs.

COURSE OUTCOMES

On the completion of the course, student will be able to

- CO1 - Understand the Operation of inverter for single phase and three phase circuits
- CO2 - Understand how to do the analysis for the inverter for harmonics.
- CO3 - Control the inverter output voltage by using the modulation techniques.
- CO4 - Design an inverter for a particular application and power level.
- CO5 - Understand the need for multi-level inverter and its operation.
- CO6 - Increase the efficiency by performing the soft switching in the inverter circuit.

TEXT / REFERENCE BOOKS

1. Rashid M.H., "Power Electronics – Circuits, Devices & Applications", Pearson Education, 2013.
2. P.S.Bimbira, "Power Electronics", Khanna Publishers, 5th Edition, 2014.
3. Fang Lin lu, Hong Ye, "Advanced DC/AC Inverters:Applications in Renewable Enegy", CRC Press, Taylor and Francis Group, 2013.
4. Mohan N., Undeland & Robbins, "Power Electronics – Converters, Application & Design", John Wiley & Sons Inc., 2nd Edition,Newyork, 2001.
5. P.C. Sen, "Modern Power Electronics", S.Chand Ltd., 2005.
6. Rashid M.H., "Hand book on Power Electronics", Nihar Kularatna, Newnes, 1998.
7. M.D. Singh & K.B. Khanchandani, "Power Electronics", Tata McGraw Hill Publishing Company Limited, 2ndEdition, 3rdReprint, 2008.

SEEA5104	SOILD STATE DC DRIVES	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To study and analyze the operation of the converter / chopper fed DC drive, both qualitatively and quantitatively.
- To analyze and design the current and speed controllers for a closed loop solid state DC motor drives.
- To study and design the Siemens drive system for speed control, current and torque measurement.

UNIT 1 REVIEW OF CONVENTIONAL DC DRIVES

9 Hrs.

Different techniques of speed control and methods of braking of series and separately excited DC motor, Ward leonard speed control, Model and transfer function of series and separately excited DC motor.

UNIT 2 CONVERTER CONTROL OF DC MOTORS

9 Hrs.

Analysis of series and separately excited DC motor with single phase and three phase converters operating in different modes and configurations, Problems on DC machines fed by converter supplies, drive employing dual converter.

UNIT 3 CHOPPER CONTROL OF DC MOTORS

9 Hrs.

Introduction to time ratio control and frequency modulation; Class A,B,C,D and E chopper controlled DC motor – Performance analysis, multi-quadrant control – Chopper based implementation of braking schemes – Multiphase Chopper.

UNIT 4 DESIGN OF CONVERTER AND CHOPPER FOR DC DRIVES

9 Hrs.

Speed loop, P, PI, PID controllers, Current loop, Armature current reversal, Field current reversal – Digital controller and firing circuits, Simulation.

UNIT 5 INDUSTRIAL DC DRIVES

9 Hrs.

Introduction to Siemens drive system - Speed control with emf feedback & tachogenerator – Current measurement & Torque Measurement - Tuning of drive, Phase locked loop control of DC drives.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Understand the principle and modelling of DC motor and conventional drives.
- CO2 - Analyze the operation of single and three phase converter fed DC motor drives.
- CO3 - Analyze the operation of chopper fed DC motor drives.
- CO4 - Apply the various methods of closed loop speed control of DC drives.
- CO5 - Evaluate the performance of Siemens drive system for speed control of DC drives.
- CO6 - Evaluate the performance the phase locked loop for speed control of DC drives.

TEXT / REFERENCE BOOKS

1. Buxbaum.A, Schierau.K and Staughem, "A Design of Control Systems for D.C.Drives", Springer - Verlag, Berlin, 1990.
2. Dubey .G.K , "Power Semiconductor Controlled Drives", Prentice Hall International, New jersey, 1989.
3. Sen P.C, "Thyristor D.C Drives", Krieger Publishing Company, 1991.
4. Subrahmanyam .V, "Electric Drives Concept and Applications", Tata McGraw Hill Publishing Co., LTD., New Delhi, 1st reprint 2010.
5. Siemen's Course Material
6. R. Krishnan, "Electric Motor Drives: Modelling, Analysis, and Control", Prentice Hall; 1st edition, 2001.
7. Leonhard, Werner, "Control of Electrical Drives", 3rd edition, 2001, Springer 2001.

WEB SITES

1. www.automation.siemens.com
2. www.legacypower.net

SEEA6101	POWER ELECTRONICS AND DRIVES LAB - I	L	T	P	Credits	Total Marks
		0	0	4	2	100

COURSE OBJECTIVES

- To design and analyze the various DC and AC drives.
- To generate the firing pulses for converters and inverters.
- To design three phase AC voltage regulator.

SUGGESTED LIST OF EXPERIMENTS

1. Single Phase Half and Full converter with R, RL, RLE loads.
2. Three Phase Half and Full converter with R, RL, RLE loads.
3. Three Phase AC voltage regulator.
4. Four quadrant chopper.
5. Modified McMurray - Bedford Inverter.
6. Resonant DC to DC Converter.
7. Speed control of PMDC motor using Voltage Commutated Chopper.
8. Speed control of PMDC motor using Current Commutated Chopper.
9. IGBT based speed control of three phase induction motor using PWM technique.
10. Speed control of BLDC motor.
11. Speed control of SRM motor.
12. Speed control of PMSM
13. Single phase Multi Level Inverter based induction motor drive.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Acquire knowledge about the half and full converter with R, RL and RLE load.
- CO2 - Determine the voltage for three phase AC voltage regulator.
- CO3 - Understand speed control of PMDC motor using VCC and CCC.
- CO4 - Analyze the performance characteristics of DC-DC converter.
- CO5 - Determine performance characteristics of various motor drives.
- CO6 - Understand the characteristics of Multilevel Inverter based induction motor drive.

SEEA5201	SOLID STATE AC DRIVES	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- Ability to understand and analyse the VSI and CSI fed drive.
- Understand the speed control of induction motor by stator and rotor side control.
- Ability to learn synchronous motor drives with fixed and variable frequency.

UNIT 1 STATOR VOLTAGE CONTROL OF INDUCTION MOTOR

9 Hrs.

Torque, Slip characteristics, Equivalent circuit, Speed control – Variable Voltage, Variable Frequency, Constant V/F operation. Operation with different types of loads, Performance, Comparison of different AC power controllers, Speed reversal, Closed loop control.

UNIT 2 STATOR FREQUENCY CONTROL

9 Hrs.

Operation of induction motor with non sinusoidal supply waveforms, Variable frequency operation of 3 phase induction motors, Constant flux operation, Current fed operation, Dynamic and regenerative braking of CSI and VSI fed drives.

UNIT 3 ROTOR RESISTANCE CONTROL

9 Hrs.

Torque, Slip characteristics, Types of rotor choppers, Torque equations, Constant torque operation, TRC strategy, Closed loop speed control.

UNIT 4 SLIP POWER RECOVERY SCHEME

9 Hrs.

Equivalent circuit, Torque equation, Torque - Slip characteristics - Power factor considerations - Sub synchronous operation and closed loop speed control, Vector or Field control - Direct Vector control.

UNIT 5 SYNCHRONOUS MOTOR DRIVES

8 Hrs.

Need for leading PF operation - Open loop VSI fed drive and its characteristics - Self control - Torque angle control - Power factor control - Brush less excitation system - Starting methods - Principles of vector control.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Operate and maintain solid state drives for speed control 3 phase induction motor
- CO2 - Exposed to different speed control methods in A.C motors using thyristor based control schemes.
- CO3 - Use vector control method for controlling the Induction motor drive.
- CO4 - Use vector control method for controlling the synchronous motor drive.
- CO5 - Operate and maintain solid state drives for speed control of 3 phase Synchronous motor

TEXT / REFERENCE BOOKS

- Murphy, J.M.D, Turnbull F.G., "Thyristor control of AC motors", Pergamon Press, 2010.
- B.K.Bose, "Power Electronics & AC drives", Academic Press, 2006.
- Dubey .G.K., "Power Semiconductor Controlled Drives", Prentice Hall International, Newyork, 2001.
- Dewan.S.B. Slemon, G.R. Straughen.A., "Power semiconductor drives", John wiley and sons, Newyork, 1984.
- I.J.Nagrath & D.P.Kothari, "Electrical Machines", Tata McGraw-Hill Publications, 2006.
- V.R.Moorthi, "Power Electronics Drives, Circuits, and Industrial Applications," Oxford University press, First published in India 2005, (sixth impression 2008).
- R. Krishnan, "Electric Motor Drives: Modelling, Analysis, and Control", Prentice Hall, 2001.
- Leonhard, Werner, "Control of Electrical Drives", 3rd edition, 2001, Springer 2001.
- Paul C. Krause, Oleg Wasynczuk, Scott D. Sudhoff - "Analysis of Electric Machinery and Drive systems", IEEE press, 2013.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100

Exam Duration: 3 Hrs.

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

30 Marks

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

70 Marks

SECA5209	EMBEDDED SYSTEM DESIGN	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To learn the architecture and instruction sets of an ARM processor.
- To comprehend the concepts of RTOS and Embedded networking.
- To realize the basic interfacing circuits using ARM processor.

UNIT 1 ARM ARCHITECTURE

9 Hrs.

ARM Architecture, ARM Design Philosophy, Registers, Program Status Register, Instruction Pipeline, Interrupts and Vector Table.

UNIT 2 ARM INSTRUCTION SET

9 Hrs.

Data Processing Instructions, Addressing Modes, Branch, Load, Store Instructions, PSR Instructions, Conditional Instructions. Thumb Instruction Set: Register Usage, Other Branch Instructions, Data Processing Instructions, Single Register and Multi Register Load -Store Instructions, Stack, Software Interrupt Instructions

UNIT 3 REAL TIME OPERATING SYSTEM

9 Hrs.

Real time operating systems (RTOS) – real time kernel – OS tasks – task states – task scheduling – interrupt processing – clocking communication and synchronization – control blocks – memory requirements and control –kernel services.

UNIT 4 EMBEDDED NETWORKS

9 Hrs.

Embedded Networks - Distributed Embedded Architecture – Hardware and Software Architectures, Networks for embedded systems– I2C, CAN Bus, Ethernet, Internet, Network–Based design– Communication Analysis, system performance Analysis, Hardware platform design, Allocation and scheduling, Design Example: Elevator Controller.

UNIT 5 SYSTEM DESIGN

9 Hrs.

Switches and LED interfacing-LCD Display interfacing- Analog sensors interfacing for digital data conversion -Access control using analog keypad - Pulse width modulation technique for motor speed control

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Gain significant knowledge about the complete architecture of an ARM processor.
- CO2 - Understand various instruction sets of ARM processor and their significance.
- CO3 - Analyze the various functionalities of Real Time Operating System
- CO4 - Compare and contrast the various embedded networking buses and justify their choice for an embedded system.
- CO5 - Design basic interfacing circuits using ARM processor.
- CO6 - Implement the knowledge of instructions in programming and developing an embedded system.

TEXT / REFERENCE BOOKS

1. Andrew N.Sloss, Dominic Symes, Chris Wright, "ARM Systems Developer's Guide: Designing & Optimizing System Software", Elsevier, 2004.
2. Jonathan W. Valvano, " Embedded Microcomputer Systems: Real Time Interfacing", Cengage Learning, 2011
3. Wayne Wolf, "Computers as Components: Principles of Embedded Computing System Design", Morgan Kaufman Publishers, 2008.
4. C.M. Krishna, Kang G. Shin, "Real time systems", Mc-Graw Hill, 3rd reprint, 2010.
5. Herma K., "Real Time Systems: Design for Distributed Embedded Applications", Kluwer Academic Publishers, 1997.
6. William Hohl, "ARM Assembly Language, Fundamentals and Techniques", Taylor & Francis, 2009.

SEEA6201	POWER ELECTRONICS AND DRIVES LAB II	L	T	P	Credits	Total Marks
		0	0	4	2	100

COURSE OBJECTIVES

- To make the students familiar with the digital tools used in generation of gate pulses for the power electronic switches using Matlab.
- To make the students acquire knowledge on mathematical modeling of power electronic circuits and implementing the same using simulation tools.
- To Implementation of closed loop system using hardware simulation.

SUGGESTED LIST OF EXPERIMENTS

1. Open Loop Control of Separately Excited DC Motor.
2. Open Loop Control of DC Series Motor.
3. Closed Loop Control of Separately Excited DC Motor.
4. Thyristor Static and Dynamic Behaviour.
5. Simulation of Single Phase Semi Converter with motor load.
6. Simulation of Three Phase Converter with different loads.
7. Simulation of Single and Three phase PWM circuits.
8. AC – DC – AC PWM converter.
9. Three Phase Matrix Converter.
10. Simulation of Single Phase Half Converter with different loads.
11. Three Phase Full Controlled Rectifier with R, RL loads.
12. Simulation of Buck Converter.
13. Simulation of Boost Converter.
14. Simulation of Buck-Boost Converter.
15. Chopper fed DC motor drive.
16. Speed control of induction motor.
17. Speed control of BLDC motor.
18. Closed loop control of dc-dc converter.
19. Three phase Inverter using 180 mode of conduction for induction motor drive.
20. Three phase Inverter using 120 mode of conduction for Induction motor drive.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Acquire knowledge about the MATLAB/Simulink for open loop control of various DC.Motor.
- CO2 - Determine the voltage using Buck, Boost and Buck-Boost Converter.
- CO3 - Understand speed control of Induction motor and BLDC motor.
- CO4 - Analyze the performance of half, semi and fully controlled converter.
- CO5 - Determine performance characteristics of Inverter.
- CO6 - Understand the open and closed loop control of DC-DC converter.