NANDHA ENGINEERING COLLEGE

(An Autonomous Institution affiliated to Anna University Chennai and approved by AICTE, New Delhi)
Erode-638 052, Tamilnadu, India, Phone: 04294 – 225585

Curriculum and Syllabi
for
B.E – Electrical and Electronics Engineering [R17]
[CHOICE BASED CREDIT SYSTEM]

(This Curriculum and Syllabi are applicable to Students admitted from the academic year 2017-2018 onwards)

SEPTEMBER 2021

17EEX26-EMBEDDED SYSTEMS DESIGN					
		L	T	P	C
		3	0	0	3
PRE REQUISITE : NIL					
Course Objectives		**Course Outcomes**		**Related Program outcomes**	
1.0	To know the overview of embedded system and its challenging principles.	**1.1**	The students will be able to understand and Integrate new knowledge within the field.	a,b,c,d,e,f,g,h,k,l	
2.0	To learn various concepts of processor and its designing Principles.	**2.1**	The students will be able to design, execute and evaluate experiments on embedded Platforms	a,b,c,d,e,f,g,h,i,k,l	
3.0	To gain the basic knowledge about memories and their applications	**3.1**	The students will be able to learn the basic of memories and their applications	a,b,c,d,e,f,g,h,i,l	
4.0	To know about various interfacing techniques and various interfacing peripherals	**4.1**	The students will be able to use various interfacing techniques with numerous peripherals	a,b,c,d,e,f,g,h,i,k,l	
5.0	To acquire practical skills on embedded systems in various fields	**5.1**	The students will be able to gain practical knowledge on embedded systems	a,b,c,d,e,f,g,h,i,k,l	

UNIT I - INTRODUCTION	**(9)**
Embedded systems overview - Design challenges - Optimizing metrics - Processor technology - IC technology - Design technology- Automation- Synthesis - Verification: hardware,software co-simulation-trade-offs.	
UNIT II - PROCESSING ELEMENTS	**(9)**
Custom single purpose processor design - RT level custom single purpose processor design-Optimizing custom single purpose processors-General purpose processor's software: architecture, operation, programmer's view and development environment – ASIPs - selecting a microprocessor - General purpose processor design.	
UNIT III – MEMORIES	**(9)**
Introduction-Memory writes ability and storage Permanence-Common memory types-Composing memory-Memory hierarchy and caches-Advanced RAM.	
UNIT IV – INTERFACING	**(9)**
Introduction-Communication basics-Microprocessor interfacing: I/O addressing, interrupts,DMA-Arbitration Multilevel bus architectures-Advanced communication principles-Serial protocols-Parallel protocols-Wireless protocols-Standard single purpose processor's peripherals: Timers, PWM, LCD controllers, stepper motor controllers, RTC.	
UNIT V – APPLICATIONS	**(9)**
Digital camera-Washing machine-Cell phones-Home security systems-Finger print identifiers-Cruise control -Automated teller machine.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOK:
1. Jonathan.W.Valvano, "Embedded Microcomputer systems: Real Time Interfacing", Cengage learning,3 rd ed. 2012.
REFERENCES:
1. Vahid and Tony Givargis, "Embedded system design: A unified hardware/Software Introduction" John Wiley & sons,3rd edition, 2010. 2. Daniel D. Gajski, Samar and Abdi, Andreas. Gerstlauer, "Embedded system design: Modeling, synthesis and verification", Springer, 2009.

17EEX27-EMBEDDED SYSTEM FOR AUTOMOTIVE APPLICATIONS					
			L	T	P	C
			3	0	0	3
PRE REQUISITE : NIL					
Course Objectives		**Course Outcomes**			**Related Program outcomes**
1.0	To expose the students to the fundamentals and building of Electronic Engine Control systems	**1.1**	The students will be able to insight into the significance of the role of embedded system for automotive applications		a,b,c,d,e,f,g,h,i,j,k,l
2.0	To teach on functional components and circuits for vehicles	**2.1**	The students will be able to illustrate the need, selection of sensors and actuators and interfacing with ECU		a,b,c,d,e,f,g,h,i,j,k,l
3.0	To discuss on programmable controllers for vehicles management systems	**3.1**	The students will be able to develop the Embedded concepts for vehicle management and control systems		a,b,c,d,e,f,g,h,i,l
4.0	To teach logics of automation & commercial techniques for vehicle communication.	**4.1**	The students will be able to demonstrate the need of Electrical vehicle and able to apply the embedded system technology for various aspects of EVs		a,b,c,d,e,f,g,h,i,l
5.0	To introduce the embedded systems concepts for E-vehicle system development	**5.1**	The students will be able to improve Employability and Entrepreneurship capacity due to knowledge up gradation on recent trends in embedded systems design and its application in automotive systems.		a,b,c,d,e,f,g,h,i,j,k,l

UNIT I -BASIC OF ELECTRONIC ENGINE CONTROL SYSTEMS	**(9)**
Overview of Automotive systems - Fuel economy-Air-fuel ratio-Emission limits and vehicle performance: Automotive microcontrollers- Electronic control Unit- Hardware & software selection and requirements for Automotive applications - Introduction to AUTOSAR - Introduction to Society SAE- Functional safety ISO 26262.	
UNIT II- SENSORS AND ACTUATORS FOR AUTOMOTIVES	**(9)**
Review of sensors- sensors interface to the ECU-Conventional sensors and actuators-Modern sensor and actuators - LIDAR sensor- Smart sensors- MEMS/NEMS sensors and actuators for automotive applications.	
UNIT III -VEHICLE MANAGEMENT SYSTEMS	**(9)**
Electronic Engine Control - Engine mapping-fuel control-Electronic ignition - Adaptive cruise control - Speed control-anti-locking braking system-Electronic suspension - Electronic steering, Automatic wiper control- Body control system - Vehicle system schematic for interfacing with EMS, ECU - Electrically assisted power steering system- Adaptive lighting system - Safety and Collision Avoidance.	
UNIT IV -ONBOARD DIAGONSTICS	**(9)**
On board diagnosis of vehicles - Vehicle communication protocols -Bluetooth, CAN, LIN, FLEXRAY, MOST, KWP2000 - Recent trends in vehicle communications-Navigation-Tracking Security for data communication- Dashboard display and Virtual Instrumentation - Role of IOT in Automotive systems.	
UNIT V- ELECTRIC VEHICLES	**(9)**
Electric vehicles –Components- Plug in Electrical vehicle- Charging station – Aggregators- Fuel cells,Solar powered vehicles- Autonomous vehicles.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:
1. William B. Ribbens,"Understanding Automotive Electronics", Elseiver,2017. 2. Automotive Electricals / Electronics System and Components, Tom Denton, 5 rd Edition, 2017. 3. A. Galip Ulsoy , Huei Peng , Melih Cakmakci ,"Automotive Control Systems: For Engine, Driveline, and Vehicle", March 30, 2012.
REFERENCES:
1. Automotive Electricals Electronics System and Components, Robert Bosch Gmbh, 5 th Edition, 2007. 2. Electronic Engine Control technology – Ronald K Jurgen Chilton's guide to Fuel Injection– Ford,2004 3. Jack Erjavec, JeffArias,"Alternate Fuel Technology-Electric ,Hybrid& Fuel Cell Vehicles",Cengage ,2012.

17EEX28- SIGNAL PROCESSING					
			L	T	P	C
			3	0	0	3
PRE REQUISITE : NIL					
Course Objectives		**Course Outcomes**			**Related Program outcomes**
1.0	To impart basic knowledge about signals and systems	**1.1**	The student will be able to explain the various basic signals and systems parameters		a,b,c,d,f,g,j
2.0	To develop in students the ability to analyze various types of Fourier transform techniques	**2.1**	The student will be able to describe the properties and realize the filter structures		a,b,c,d,f,g,j
3.0	To make the students to understand the design of Infinite Impulse Response filters	**3.1**	The student will be able to design the IIR filters like butterworth and chebyshev approximations		a,b,c,d,f,g,j
4.0	To make the students to understand the design of Finite Impulse Response filters	**4.1**	The student will be able to design FIR filters and window functions.		a,b,c,d,f,g,j
5.0	To gain the knowledge about the digital signal processors	**5.1**	The student will be able to examine the functional blocks of digital signal processor and its internal features.		c,g,j

UNIT I – INTRODUCTION TO SIGNALS AND SYSTEMS.	**(9)**
Energy and power signals- Continuous and discrete time signal-Continuous and discrete amplitude signals-System properties: linearity: additivity and homogeneity, shift-invariance, causality, stability, reliability- Effects of sampling and quantization in discrete domain.	
UNIT II – DISCRETE FOURIER TRANSFORM	**(9)**
DTFT - frequency domain sampling-DFT :properties, frequency analysis, Radix-2 FFT algorithms, applications, Realization of filter structures: Direct forms I and II, cascade, parallel and lattice structures.	
UNIT III – DESIGN OF IIR FILTERS	**(9)**
Design techniques for analog low pass filter-Butterworth and Chebyshev approximations-frequency transformation, approximation of derivatives, Bilinear transformation and impulse invariant technique	
UNIT IV – DESIGN OF FIR FILTERS	**(9)**
FIR Filter Design: Phase and group delay, design characteristics of FIR filters with linear phase, frequency response-FIR filters using window functions: Rectangular, Hamming, Hanning, Bartlett, Blackman and Kaiser.	
UNIT V – DIGITAL SIGNAL PROCESSORS.	**(9)**
Digital signal processor architectures: TMS320C series, General purpose processors: fixed point and floating point, MAC, pipelining, addressing modes- Typical implementation of DSP algorithms.	
TOTAL(L:45) = 45 PERIODS	

TEXT BOOKS:
1. John G. Proakis, D. G. Manolakis, Digital Signal Processing Principles, Algorithms and Applications, 4th edition, Pearson Education,2016 2. Oppenheim V.A.V and Schaffer R.W, Discrete – time Signal Processing,3 rd Edition, Pearson,2014
REFERENCES:
1. Lawrence R Rabiner and Bernard Gold, Theory and Application of Digital Signal. Processing Pearson Education,2016 2. Steven W Smith, Digital Signal Processing: A Practical Guide for Engineers and Scientists, Newnes,2014

17EEX29-EMBEDDED CONTROL SYSTEM				
	L	T	P	C
	3	0	0	3

PRE REQUISITE : NIL

Course Objectives		Course Outcomes		Related Program outcomes
1.0	To learn the basics of sensors and actuators in embedded platform.	**1.1**	The students will be able to apply the basics of Sensors and actuators in embedded platform.	a,b,c,d,e,f,g,h,i,j,k,l
2.0	To know the interfacing techniques using communication Buses.	**2.1**	The students will be able to interface various Peripherals using communication buses.	a,b,c,d,e,f,g,h,i,j,k, l
3.0	To acquire knowledge on embedded controller and their Applications.	**3.1**	The students will be able to develop applications based on embedded controller.	a,b,c,d,e,f,g,h,i,l
4.0	To learn various software tools for controlling embedded based applications.	**4.1**	The students will be learn various software tools for controlling embedded based applications.	a,b,c,d,e,f,g,h,i,l
5.0	To understand the basics of contemporary RTOS.	**5.1**	The students will be make a Survey on basics of contemporary RTOS.	a,b,c,d,e,f,g,h,i,j,k,l

UNIT I – INTRODUCTION	**(9)**
Embedded systems - Interfacing a microprocessor to the analog world-Position and Velocity measurements - The world of sensors-Actuators-Motor control - Feedback systems - Haptic interfaces and Virtual environments Applications of embedded control systems	
UNIT II - INTERFACE WITH COMMUNICATION PROTOCOL	**(9)**
Design methodologies and tools – Design flow – Designing hardware and software interface – System integration – SPI - High speed data acquisition and interface - SPI read/write protocol - RTC interfacing and programming	
UNIT III - EMBEDDED SYSTEM ORGANIZATION	**(9)**
Embedded computing – Characteristics of embedded computing applications–Embedded system design challenges - Build process of real-time embedded system – Selection of processor – Memory - I/O devices -RS 485 - MODEM-Bus communication system using I2C- CAN- USB -ISA- EISA.	
UNIT IV - DESIGN OF SOFTWARE FOR EMBEDDED CONTROL	**(9)**
Software abstraction using Mealy - Moore FSM controller - Layered software development - Basic concepts of developing device driver – SCI – Interfacing & porting using standard C & C++ - Functional and performance debugging with benchmarking- Real-time system software – Survey on basics of contemporary RTOS – VXWorks - UC/OS-II.	
UNIT V - CASE STUDIES WITH EMBEDDED CONTROLLER	**(9)**
A low - cost web – Based infrared remote control system for energy management of aggregated air conditioners – PWM Motor speed controller – Serial communication interface.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:
1. Steven F. Barrett, Daniel J. Pack, "Embedded Systems – Design and Applications with the 68HC12 and HCS12", Pearson Education, 2008 2. Muhammad Ali Mazidi, Rolin D. Mckinlay, and Danny Causey, "PIC Microcontroller and Embedded Systems- Using Assembly and C for PIC18", Pearson Education, 2008.
REFERENCE:
1. Raj Kamal, "Embedded Systems- Architecture, Programming and Design", Tata McGraw Hill, 2017.

17EEX30-EMBEDDED PROCESSORS						
				L	T	P	C
				3	0	0	3
PRE REQUISITE : NIL						
Course Objectives		**Course Outcomes**		**Related Program outcomes**		
1.0	To impart basic knowledge about ARM architecture and cortex	**1.1**	The student will be able to explain the ARM and Cortex	a,b,c,d,e		
2.0	To impart the knowledge on timers, RTC, ADC & QEI	**2.1**	The student will be able to describe the operation of timers, RTC, ADC and QEI	a,b,c,d,e		
3.0	To make the students to understand the memory model and caches	**3.1**	The student will be able to explain the memory management and caches of ARM Cortex A architecture	a,b,c,d,e		
4.0	To make the students to understand the internal features of ARM Cortex A	**4.1**	The student will be able to explain the concepts of booting, power management and debugging	a,b,c,d,e,i		
5.0	To gain the knowledge about the functional blocks and tools of DSP processor	**5.1**	The student will be able to enumerate the various functions of DSP processor with its internal characteristics	a,b,c,d,e,i		

UNIT I – ARM ARCHITECTURE AND CORTEX	**(9)**
Introduction to the ARM Cortex M4 -ARM Cortex M4 architecture: address space, on- chip peripherals (analog and digital) Register sets, addressing modes and instruction set .	
UNIT II - TIMERS, PWM AND MIXED SIGNAL PROCESSING	**(9)**
Timer- Basic Timer, Real Time Clock (RTC), Timing generation and measurements, ADC-PWM Module - Quadrature Encoder Interface (QEI)	
UNIT III - ARM CORTEX A ARCHITECTURE	**(9)**
Introduction to ARMv8A- Memory Management-Memory Model, Caches and Branch Prediction, Synchronization and Cache coherency.	
UNIT IV - GUIDE LINES TO ARM CORTEX 64 BIT ARCHITECTURE	**(9)**
Booting- Power Management,-Virtualization,-Security- Debugging.	
UNIT V - DSP PROCESSORS	**(9)**
Architecture of TMS320CXX Processor – Addressing modes – Assembly language Instructions – Assembler directives, Pipeline structure, On-chip Peripherals – Block Diagram of DSP starter kit (DSK) – Software Tools, DSK on-board peripherals – Code Composer Studio – Support Files - Application Programs for processing real time signals.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. Joseph Yiu, "The Definitive Guide to ARM Cortex-M3 and Cortex-M4 Processors",3rd Edition, Newnes ,UK,2013
2. ARM Cortex-A Series Programmer's Guide for ARMv8-A Version: 1.0, ARM, United States,2015

REFERENCES:

1. Yifeng Zhu, Embedded Systems with ARM Cortex-M Microcontrollers in Assembly Language and C, E-Man Press LLC, United States, 2nd Edition 2015
2. Avtar Singh and S. Srinivasan, Digital Signal Processing – Implementations using DSP Microprocessors with Examples from TMS320C54xx, Cengage Learning India Private Limited, Delhi 2012.

17EEX31-EMBEDDED NETWORKING					
				L	T	P	C
				3	0	0	3
PRE REQUISITE : NIL							
Course Objectives		**Course Outcomes**		**Related Program outcomes**			
1.0	To understand the various proctocols in embedded system	**1.1**	The student will be able to know the concept of communication protocols	a,d,g,h,k			
2.0	To acquire knowledge on CANBUS and USB	**2.1**	The student will be able to learn the importance of USB and CAN Bus	a,d,e,f,g,h,k			
3.0	To learn the basic of ethernet controllers and elements of the network	**3.1**	The student will be able to apply advanced technical knowledge in multiple contexts	b,c,d,e,g,l			
4.0	To acquire the knowledge on embedded ethernet	**4.1**	The student will be able to design, execute and evaluate experiments on embedded platforms	a,d,g,k			
5.0	To understand the concept of wireless sensor network and its protocols.	**5.1**	The student will be able to learn the basics of wireless embedded networking	a,d,e,f,g,h,k			

UNIT I - EMBEDDED COMMUNICATION PROTOCOLS	**(9)**
Embedded Networking: Introduction – Serial/Parallel Communication – Serial communication protocols -RS232 standard – RS485 –Synchronous serial protocols -Serial Peripheral Interface (SPI) – Inter Integrated Circuits (I2C) – Parallel communication protocols -ISA/PCI Bus protocols –Firewire.	
UNIT II - USB AND CAN BUS	**(9)**
USB bus – Introduction – Speed Identification on the bus – USB States – USB bus communication: Packets –Data flow types –Enumeration –Descriptors –PIC18 Microcontroller USB Interface – C Programs –CAN Bus – Introduction - Frames – Bit stuffing –Types of errors –Nominal bit timing – A simple application with CAN.	
UNIT III - ETHERNET BASICS	**(9)**
Elements of a network – Inside Ethernet – Building a network: Hardware options – Cables, connections and network speed – Design choices: Selecting components –Ethernet Controllers – Using the internet in local and internet communications – Inside the Internet Protocol	
UNIT IV - EMBEDDED ETHERNET	**(9)**
Exchanging messages using UDP and TCP – Serving web pages with dynamic Data – Email for embedded Systems – Using FTP – Keeping devices and network secure.	
UNIT V - WIRELESS EMBEDDED NETWORKING	**(9)**
Wireless sensor networks – Introduction – Applications – Network topology – Localization –Time synchronization – Energy efficient MAC Protocols –SMAC – Energy efficient and robust routing – Data centric routing	
TOTAL(L:45) = 45 PERIODS	

TEXT BOOKS:
1. Jan Axelson,Parallel Port Complete**,** Programming, Interfacing, and Using the PC's Parallel Printer Port ,Jan Axelson Series,2012 2. Dogan Ibrahim,Advanced PIC microcontroller projects in CII, Elsevier 2008.
REFERENCE:
1. Jan Axelson, Embedded Ethernet and Internet Complete: Designing and Programming Small Devices for Networking Jan Axelson Series,2007.

17EEX32-VLSI DESIGN TECHNIQUES					
			L	T	P	C
			3	0	0	3
PRE REQUISITE : NIL					
Course Objectives		**Course Outcomes**		**Related Program outcomes**	
1.0	To impart basic knowledge about VLSI design methodology	**1.1**	The student will be able to explain the various VLSI design process	a,b,c,i,l	
2.0	To impart the knowledge on MOS device design and stick diagrams	**2.1**	The student will be able to describe the operation of nMOS and pMOS transistor and circuit model	a,b,c,i,l	
3.0	To make the students to understand the CMOS characteristics and its performance parameters	**3.1**	The student will be able to explain the various characteristics related to CMOS Inverter	a,b,c,e,j	
4.0	To make the students to understand the design of static and dynamic CMOS logic	**4.1**	The student will be able to design the static and dynamic CMOS logic	a,b,d,i,k	
5.0	To gain the knowledge about the design of arithmetic circuits and FIR filter design	**5.1**	The student will be able to design adders/subtractors, various multipliers and FIR filters	a,b,c,i,l	

UNIT I - VLSI DESIGN METHODOLOGY	**(9)**
VLSI design process: Architectural design, logical design, physical design- Layout styles: Full- custom, Semi-custom approaches	
UNIT II - MOS DEVICES	**(9)**
MOS Transistor Theory: nMOS, pMOS Enhancement Transistor-MOSFET as a Switch, Threshold voltage,MOS Device Design Equations, Second order effects-MOS Transistor Circuit Model, Stick Diagram, Layout Design Rules	
UNIT III - CIRCUIT CHARACTERIZATION AND PERFORMANCE ESTIMATION	**(9)**
DC Characteristics of CMOS Inverter- Switching Characteristics of CMOS Inverter-Transistor Sizing, Analytical Delay model: Rise Time, Fall Time, Gate Delays,RC Delay Models, Logical Effort- Power Dissipation: Static, Dynamic, Short Circuit Power Dissipation .	
UNIT IV-COMBINATIONAL LOGIC CIRCUITS	**(9)**
Static CMOS Design-Complex Logic Gates-Ratioed Logic-Pass-Transistor Logic-Transmission gate Logic-Dynamic CMOS Logic Design: Considerations, Speed and Power Dissipation-Signal integrity issues	
UNIT V -DESIGN OF ARITHMETIC CIRCUITS	**(9)**
Adders & subtractors-Array based multipliers,Tree based multipliers-Speed and Area trade-off,Pipelined Multiplier - Accumulator,FIR filter design .	
TOTAL(L:45) = 45 PERIODS	

TEXT BOOKS:
1. Neil H.E.Weste, David Money Harris, “CMOS VLSI DESIGN: a circuits and systems perspective”, 4th edition, Pearson 2015 . 2. Jan Rabaey, Anantha Chandrakasan, B.Nikolic, “Digital Integrated circuits: A design perspective”, Prentice Hall of India,2nd Edition 2016.
REFERENCES:
1. Samir Palnitkar, “Verilog HDL”, Prentice Hall, 2010 2. Sung-Ma Kong, Yusuf Leblebici and Chulwoo Kim, "CMOS digital integrated circuits: analysis and design", 4th edition, McGraw-Hill Education, 2015

17EEX33-EMBEDDED IOT					
			L	T	P	C
			3	0	0	3
PRE REQUISITE : NIL					
Course Objectives		**Course Outcomes**			**Related Program outcomes**
1.0	To impart basic knowledge of IOT and its applications.	**1.1**	The student will be able to explain the various applications of IOT		a,b,c,d,e,f,l
2.0	To acquire knowledge in understanding the basic components in IOT	**2.1**	The student will be able to describe the operation of IOT Architecture		a,b,c,d,e,f,l
3.0	To make the students to understand the Communication principles	**3.1**	The student will be able to explain the Communication Principles		a,b,c,d,e,f,l
4.0	To make the students to understand communication interfaces in IOT	**4.1**	The student will be able to explain communication interface in IOT		a,b,c,d,e,f,l
5.0	To gain the knowledge about the Cloud security concepts .	**5.1**	The student will be able to explain security concepts in cloud.		a,b,c,d,e,f,l

UNIT I - FUNDAMENTALS AND APPLICATIONS OF IoT	**(9)**
Introduction to Internet of Things (IoT)- Functional Characteristics- Recent Trends in the Adoption of IoT - Societal Benefits of IoT- Health Care -Smart Transportation- Smart Living -Smart Cities- Smart Grid.	
UNIT II - IoT ARCHITECTURE	**(9)**
Functional Requirements-Components of IoT-Sensors- Actuator- Embedded Computation Units - Communication Interfaces - Software Development	
UNIT III - COMMUNICATION PRINCIPLES	**(9)**
RFID – ZigBEE - Bluetooth - Internet Communication- IP Addresses - MAC Addresses - TCP and UDP - IEEE 802 Family of Protocols- Cellular-Introduction to Ether CAT	
UNIT IV- COMMUNICATION INTERFACE IN IOT	**(9)**
IEEE 802.11 Wireless Networks Attacks: Basic Types, WEP Key Recovery Attacks, Keystream Recovery Attacks against WEP – RFID Security – Security Issues in ZigBEE: Eavesdropping Attacks, Encryption Attacks - Bluetooth Security: Threats to Bluetooth Devices and Networks.	
UNIT V - CLOUD SECURITY CONCEPTS	**(9)**
Confidentiality, privacy, integrity, authentication, non-repudiation, availability, access control, defence in depth, least privilege,PAAS, IAAS and SAAS,Cryptographic Systems, Symmetric cryptography, stream ciphers, block ciphers, modes of operation, public-key cryptography, hashing, digital signatures, public-key infrastructures, key management,X.509 certificates, Open SSL.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. Adrian McEwen and Hakim Cassimally, Designing the Internet of Thingsǁ, John Wiley and Sons Ltd, UK, 2014.
2. Olivier Hersent, David Boswarthick and Omar Elloumi, The Internet of Things: Key Applications and Protocolsǁ, John Wiley and Sons Ltd., UK 2012.
3. Dieter Uckelmann, Mark Harrison, Florian Michahelles, ―Architecting the Internet of Things ǁ, Springer, New York, 2011.

REFERENCES:

1. Johnny Cache, Joshua Wright and Vincent Liu, Hacking Exposed Wireless: Wireless Security Secrets and Solutionsǁ, Tata McGraw Hill, New Delhi, 2010
2. Himanshu Dwivedi, Chris Clark and David Thiel, ―Mobile Application Securityǁ, Tata McGraw Hill, New Delhi, 2010.
3. Vijay Madisetti, Arshdeep Bahga, ―Internet of Things (A Hands-on Approach), Universities Press, 2015.
4. Tim Mather, Subra Kumaraswamy, ShahedLatif, "Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance" O'Reilly Media; 1 edition [ISBN: 0596802765], 2009

17EEX34-FUNDAMENTALS OF ELECTRIC VEHICLES					
			L	T	P	C
			3	0	0	3
PRE REQUISITE : NIL					
Course Objectives		**Course Outcomes**			**Related Program outcomes**
1.0	To know the concepts, principles, operation and performance of the electric vehicle.	**1.1**	The students will be able to explain the overview of Electric Vehicle		a,b,c,g
2.0	To gain knowledge about the basics of the Hybrid electric vehicle.	**2.1**	The students will be able to describe the overview of Hybrid Electric Vehicle		a,b,c,d,g
3.0	To acquire knowledge on the fundamentals of the vehicles	**3.1**	The students will be able to illustrate the fundamental terminologies of Electric vehicle		a,b,c,d,g
4.0	To develop the modeling of an electric vehicle.	**4.1**	The students will be able to design electric vehicle model		a,b,c,d,g,h,j,l
5.0	To understand the Design Considerations for Electric Vehicle.	**5.1**	The students will be able to Design an electric vehicle based on the requirement		a,b,c,d,g,h,j,l

UNIT I - ELECTRIC VEHICLES	**(9)**
Introduction to EV- History- Components of Electric Vehicle- General Layout of EV-EV classification- Comparison with Internal combustion Engine: Technology, Advantages & Disadvantages of EV.	
UNIT II – HYBRID ELECTRIC VEHICLES	**(9)**
Introduction to HEV- History-Components of Hybrid Electric Vehicle -General Layout of Hybrid EV- Comparison with Electric Vehicles- Advantages & Disadvantages of Hybrid EV.	
UNIT III – VEHICLE FUNDAMENTALS	**(9)**
Vehicle resistance,-Types: Rolling Resistance, grading resistance, Aerodynamic drag vehicle performance- Calculating the Acceleration Force, maximum speed- Total Tractive Effort, Torque Required on the Drive Wheel, Transmission: Differential, clutch &gear box- Braking performance	
UNIT IV – ELECTRIC VEHICLE MODELLING	**(9)**
Tractive Effort-Modelling Vehicle Acceleration-Acceleration performance parameters-Modelling the acceleration of an electric scooter-Modelling the acceleration of a small car.	
UNIT V – DESIGN CONSIDERATION FOR ELECTRIC VEHICLE	**(9)**
Aerodynamic Considerations-Consideration of Rolling Resistance-Transmission Efficiency-Consideration of Vehicle Mass-Electric Vehicle Chassis and Body Design	
TOTAL (L=45) = 45 PERIODS	

TEXT BOOKS:

1. Iqbal Hussain., "Electric and Hybrid Vehicles: Design Fundamentals", 3rd Edition, CRC press, Taylor & Francis Group, Florida,United States, 2021
2. MehrdadEhsani, YimiGao, Sebastian E. Gay, Ali Emadi, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals,Theory and Design", 3rd Edition, CRC Press, 2018

REFERENCES:

1. James Larminie, John Lowry, "Electric Vehicle Technology Explained", 2nd Edition, Wiley, 2012
2. L.Ashok Kumar, and S.Albert Alexander, Power Converters for Electric Vehicles. CRC Press, 2020..
3. Francois Beguin and Elzbieta Frackowiak ,"Super capacitors", Wiley, 2013.
4. Tom Denton, "Advance Automotive Fault Diagnosis Automotive Vehicle Maintenance and Repair", 4th Edition, Routledge Taylor & Francis Group, New York, 2017.

17EEX35-BATTERY PACK MODELING AND CHARGING OF ELECTRIC VEHICLE					
			L	T	P	C
			3	0	0	3
PRE REQUISITE : NIL					
Course Objectives		**Course Outcomes**			**Related Program outcomes**
1.0	To understand the different types of energy storage system.	**1.1**	The Students will be able to discuss about the different types of energy storage system.		a,b,c,d,e,f,l
2.0	To study about the battery characteristic & parameters.	**2.1**	The Students will be able to describe about the battery characteristic & parameters		a,b,c,d,e,f,l,l
3.0	To model the types of batteries	**3.1**	The Students will be able to model different types of batteries		a,b,c,d,e,l
4.0	To know the concepts of battery management system and design the battery pack	**4.1**	The Students will be able to apply the concepts of battery management system and design the battery pack		a,b,c,d,e,l
5.0	To enrich knowledge on various battery charging methods	**5.1**	The Students will be able to explain charging methods and its specifications		a,b,c,d,e,f,l

UNIT I - ENERGY STORAGE SYSTEM	**(9)**
Batteries: Lead Acid Battery, Nickel based batteries, Sodium based batteries, Lithium based batteries – Li-ion & Li-poly, Metal Air Battery, Zinc Chloride battery, Ultra capacitors,Flywheel Energy Storage System, Hydraulic Energy Storage System, Comparison of different Energy Storage System.	
UNIT II- BATTERY CHARACTERISTICS & PARAMETERS	**(9)**
Cells and Batteries- conversion of chemical energy to electrical energy- Battery Specifications: Variables to characterize battery operating conditions and Specifications to characterize battery nominal and maximum characteristics, Efficiency of batteries, Electrical parameters- Heat generation- Battery design- Performance criteria for Electric vehicles batteries- Vehicle propulsion factors- Power and energy requirements of batteries Meeting battery performance criteria- setting new targets for battery performance	
UNIT III - BATTERY MODELLING	**(9)**
General approach to modeling batteries- simulation model of a rechargeable Li-ion battery-simulation model of a rechargeable NiCd battery- Parameterization of the NiCd battery model- Simulation examples.	
UNIT IV-BATTERY PACK AND BATTERY MANAGEMENT SYSTEM	**(9)**
Selection of battery for EVs & HEVs- Traction Battery Pack design, Requirement of Battery Monitoring, Battery State of Charge Estimation methods-Battery Cell equalization problem, thermal control, protection interface, SOC Estimation, Energy & Power estimation, Battery thermal management system, Battery Management System: Definition, Parts: Power Module, Battery, DC/DC Converter, load, communication channel, Battery Pack Safety, Battery Standards & Tests.	
UNIT V -EV CHARGERS	**(9)**
Electric Vehicle Technology and Charging Equipment's- Basic charging -Block Diagram of Charger-Difference between Slow charger and fast charger-AC charging and DC charging- Inboard and off board charger specification	
TOTAL (L=45) = 45 PERIODS	

TEXT BOOKS:

1. Ibrahim Dinçer, Halil S. Hamut and Nader Javani, "Thermal Management of Electric Vehicle Battery Systems", John Wiley& Sons Ltd., 2016.
2. Chris Mi, Abul Masrur& David Wenzhong Gao, "Hybrid electric Vehicle- Principles & Applications with Practical Properties", Wiley, 2011
3. Mehrdad Ehsani, Yimin Gao, Ali Emadi, "Modern Electric Hybrid Electric and Fuel Cell Vehicles", Taylor& Francis Group, 2010.

REFERENCES:

1. G. Pistoia, J.P. Wiaux, S.P. Wolsky, "Used Battery Collection and Recycling", Elsevier, 2001. (ISBN: 0-444-50562-8)
2. James Larminie, John Lowry, "Electric Vehicle Technology Explained", John Wiley & Sons Ltd, 2003

17EEX36-EV DESIGN AND DEVELOPMENT					
			L	T	P	C
			3	0	0	3
PRE REQUISITE : NIL					
Course Objectives		**Course Outcomes**			**Related Program outcomes**
1.0	To learn about the basic concepts of electric vehicles.	**1.1**	The students should be able toDescribe about working principle of electric vehicles.		a,b,c,d,e,g,l
2.0	To learn about the motors & drives for electric vehicles.	**2.1**	The students should be able to know the construction and working principle of various motors used in electric vehicles.		a,b,c,d,e,l
3.0	To acquire knowledge on the battery characteristic & parameters	**3.1**	The students should be able to Describe about the battery characteristic & parameters.		a,b,c,d,e,l
4.0	To impart in-depth analysis of electronics and sensors in electric vehicles.	**4.1**	The students should be able to Understand about working principle of electronics and sensor less control in electric vehicles		a,b,c,d,e,l
5.0	To understand the concept of hybrid vehicles.	**5.1**	The students should be able to Describe the different types and working principle of hybrid vehicles		a,b,c,d,e,g,l

UNIT I - INTRODUCTION TO ELECTRIC VEHICLES	**(9)**
Electric Vehicle – Need - Types – Cost and Emissions – End of life. Electric Vehicle Technology – layouts, cables, components, Controls. Batteries – overview and its types. Battery plug-in and life, Ultra-capacitor, Charging – Methods and Standards. Alternate charging sources – Wireless & Solar.	
UNIT II -ELECTRIC VEHICLE MOTORS	**(9)**
Motors (DC, BLDC,PMSM) – Types, Principle, Construction, Control. Electric Drive Trains (EDT) – SeriesHEDT (Electrical Coupling) – Power Rating Design, Peak Power Source (PPS),Parallel HEDT (Mechanical Coupling) – Torque Coupling and Speed Coupling. Switched Reluctance Motors (SRM) Drives – Basic structure, Drive Convertor, Design.	
UNIT III - BATTERY CHARACTERISTICS & PARAMETERS	**(9)**
Cells and Batteries- conversion of chemical energy to electrical energy- Battery Specifications: Variables to characterize battery operating conditions and Specifications to characterize battery nominal and maximum characteristics, Efficiency of batteries, Electrical parameters- Heat generation- Battery design- Performance criteria for Electric vehicles batteries- Vehicle propulsion factors- Power and energy requirements of batteries Meeting battery performance criteria- setting new targets for battery performance.	
UNIT IV - ELECTRONICS AND SENSOR-LESS CONTROL IN EV	**(9)**
Basic Electronics Devices – Diodes, Thyristors, BJTs, MOSFETs, IGBTs, Convertors, Inverters. Safety – Risks and Guidance, Precautions, High Voltage safety, Hazard management. Sensors - Autonomous EV cars, self-drive Cars, Hacking; Sensor less – Control methods- Phase Flux Linkage-Based Method, Phase Inductance Based, Modulated Signal Injection, Mutually Induced Voltage-Based, Observer-Based.	
UNIT V -HYBRID VEHICLES	**(9)**
Hybrid Electric vehicles – Classification – Micro, Mild, Full, Plug-in, EV. Layout and Architecture- Series , Parallel and Series-Parallel Hybrid, Propulsion systems and components, Regenerative Braking, Economy, Vibration and Noise reduction, Hybrid Electric Vehicles System – Analysis and its types, Controls.	
TOTAL(L:45) = 45 PERIODS	

TEXT BOOKS:

1. Amir Khajepour, Saber Fallah and AvestaGoodarzi, "Electric and Hybrid Vehicles Technologies, Modelling and Control: A Mechatronic Approach", John Wiley & Sons Ltd,2014.
2. Jack Erjavec and Jeff Arias, "Hybrid, Electric and Fuel Cell Vehicles", Cengage Learning, 2012.
3. James Larminie, John Lowry, "Electric Vehicle Technology Explained", John Wiley & SonsLtd, 2003.

REFERENCES:

1. Hybrid Electric Vehicle System Modeling and Control - Wei Liu, General Motors, USA, John Wiley & Sons, Inc., 2017.
2. Electric and Hybrid Vehicles Power Sources, Models, Sustainability, Infrastructure and the Market Gianfranco Pistoia Consultant, Rome, Italy, Elsevier Publications, 2017.
3. Krishnan R, "Permanent Magnet synchronous and Brushless DC Motor Drives", CRC Publishers,2010.
4. Antoni Szumanowski, "Hybrid Electric Power Train Engineering and Technology:Modelling, Control, and Simulation", IGI Global, 2013.

17EEX37- HYBRID ELECTRIC VEHICLES				
L	T	P	C
3	0	0	3

PRE REQUISITE : NIL

Course Objectives		Course Outcomes		Related Program outcomes
1.0	To understand the concept of electric vehicles.	**1.1**	The student will be able to describe about working principle of electric vehicles.	a,b,c,d,e,f,g,i,k,l
2.0	To study about the motors & drives for electric vehicles.	**2.1**	The student will be able to explain the construction and working principle of various motors used in electric vehicles.	a,b,c,d,e,f,g,i,k,l
3.0	To understand the electronics and sensors in electric vehicles.	**3.1**	The student will be able to Understand about working principle of electronics and sensor less control in electric vehicles.	a,b,c,d,e,f,g,i,k,l
4.0	To understand the concept of hybrid vehicles.	**4.1**	The student will be able to Describe the different types and working principle of hybrid vehicles.	a,b,c,d,e,f,g,i,k,l
5.0	To study about fuel cell for electric vehicles.	**5.1**	The student will be able to Illustrate the various types and working principle of fuel cells.	a,b,c,d,e,f,g,i,k,l

UNIT I - INTRODUCTION TO ELECTRIC VEHICLES	**(9)**
Electric Vehicle – Need - Types – Cost and Emissions – End of life. Electric Vehicle Technology – layouts, cables, components, Controls. Batteries – overview and its types. Battery plug-in and life. Ultra-capacitor, Charging – Methods and Standards. Alternate charging sources – Wireless & Solar.	
UNIT II - ELECTRIC VEHICLE MOTORS	**(9)**
Motors (DC, Induction, BLDC) – Types, Principle, Construction, Control. Electric Drive Trains (EDT) – Series HEDT (Electrical Coupling) – Power Rating Design, Peak Power Source (PPS); Parallel HEDT (Mechanical Coupling) – Torque Coupling and Speed Coupling. Switched Reluctance Motors (SRM) Drives – Basic structure, Drive Convertor, Design.	
UNIT III - ELECTRONICS AND SENSORLESS CONTROL IN ELECTRICAL VEHICLE	
Basic Electronics Devices – Diodes, Thyristors, BJTs, MOSFETs, IGBTs, Convertors, Inverters. Safety – Risks and Guidance, Precautions, High Voltage safety, Hazard management. Sensors - Autonomous EV cars, Self drive Cars, Hacking, Sensor less – Control methods- Phase Flux Linkage-Based Method, Phase Inductance Based, Modulated Signal Injection, Mutually Induced Voltage-Based, Observer-Based.	**(9)**
UNIT IV - HYBRID VEHICLES	
Hybrid Electric vehicles – Classification – Micro, Mild, Full, Plug-in, EV. Layout and Architecture – Series, Parallel and Series-Parallel Hybrid, Propulsion systems and components. Regenerative Braking, Economy, Vibration and Noise reduction. Hybrid Electric Vehicles System – Analysis and its Types, Controls.	**(9)**
UNIT V -FUEL CELLS FOR ELECTRIC VEHICLES	
Fuel cell- Introduction, Technologies & Types, Obstacles,Operation principles, Potential and I-V curve, Fuel and Oxidation Consumption, Fuel cell Characteristics -Efficiency, Durability, Specific power, Factors affecting, Power design of fuel Cell Vehicle and freeze capacity. Lifetime cost of Fuel cell Vehicle -System, Components, maintenance.	**(9)**
TOTAL(L:45) = 45 PERIODS	

TEXT BOOKS:

1. Jack Erjavec and Jeff Arias, “Hybrid, Electric and Fuel Cell Vehicles”, Cengage Learning, 2012.
2. Jack Erjavec and Jeff Arias, “Alternative Fuel Technology – Electric, Hybrid and Fuel Cell Vehicles”, Cengage Learning Pvt. Ltd., New Delhi, 2007
3. Mehrdad Ehsani, Yimin Gao, sebastien E. Gay and Ali Emadi, “Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design”, CRC Press, 2009.

REFERENCES:

1. Hybrid Electric Vehicle System Modeling and Control - Wei Liu, General Motors, USA, John Wiley & Sons, Inc., 2017.
2. Hybrid Electric Vehicles – Teresa Donateo, Published by ExLi4EvA, 2017
3. Electric and Hybrid Vehicles Power Sources, Models, Sustainability, Infrastructure and the Market Gianfranco Pistoia Consultant, Rome, Italy, Elsevier Publications, 2017.
4. Electric and Hybrid Vehicles, Tom Denton, Taylor & Francis, 2018.

17EEX38-TESTING AND ELECTRIC VEHICLE POLICY					
			L	T	P	C
			3	0	0	3
PRE REQUISITE : NIL					
Course Objectives		**Course Outcomes**			**Related Program outcomes**
1.0	To impart basic knowledge about classification of vehicles and its schemes	**1.1**	The student will be able to gain knowledge in the field of E-vehicle certification		a,b,c,g
2.0	To impart the knowledge on different types of static testing in E-vehicle	**2.1**	The student will be able to explain the concept of static testing of E-vehicle.		a,b,c,d,g
3.0	To make the students to understand the different types of dynamic testing in E-vehicle	**3.1**	The student will be able to explain the concept of dynamic testing of E-vehicle.		a,b,c,g
4.0	To make the students to understand the E-vehicle component testing	**4.1**	The student will be able to know about various E-vehicle component testing.		a,b,c,g
5.0	To gain the knowledge about the policies imposed by government on E-vehicles	**5.1**	The student will be able to know various E-vehicle policies offered by Government of India		a,b,c,d,g

UNIT I – INTRODUCTION	**(9)**
Specification & Classification of Vehicles (including M, N and O layout) -Homologation & its types-Regulations overview (EEC, ECE, FMVSS, AIS, CMVR)-Type approval Scheme-Homologation for export, Conformity of Production, various Parameters, Instruments and Types of test tracks-Hardware in The Loop (HIL) concepts for EV/HEVs	
UNIT II - STATIC TESTING OF VEHICLE	**(9)**
Photographs-CMVR physical verification-Tyre Tread Depth Test- Vehicle Weightment- Horn installation- Rear view mirror installation-Tell Tales-External Projection-Wheel Guard-Arrangement of Foot Controls for M1 Vehicle- Angle & Dimensions Measurement of Vehicle-The requirement of temporary cabin for drive- Chassis, electric vehicle -Safety norms, Energy consumption and power test.	
UNIT III - DYNAMICS TESTING OF VEHICLE	**(9)**
Hood Latch- Gradeability- Pass-by Noise- Interior Noise- Turning Circle Diameter & Turning Clearance Circle Diameter-Steering Effort-Constant Speed Fuel Consumption-Cooling Performance-Speedo-meter Calibration-Range Test- Maximum Speed- Acceleration Test-Coast-down test-Brakes Performance ABS Test, Broad band -Narrow band EMI Test-Electric vehicle - Range Test.	
UNIT IV - VEHICLE COMPONENT TESTING	**(9)**
Horn Testing- Safety Glasses Test: Windscreen laminated and toughened safety glass- Rear View Mirror Test- Hydraulic Brakes Hoses-Fuel Tank Test: Metallic & Plastic-Hinges and Latches Test-Tyre & Wheel Rim Test- Bumper Impact Test-Side Door Intrusion- Crash test with dummies- Demist test- Defrost Test-Interior Fittings-Steering Impact test (GVW<1500 kg)-Body block test- Head form test- Driver Field of vision- Safety belt assemblies-Safety belt anchorages-Seat anchorages & head restraints test- Airbag Test-Accelerator Control System-Motor power-Safety Requirements of Traction Batteries, EMI-EMC (CI, BCI, RE,RI and CTE).	
UNIT V -E-VEHICLE POLICIES	**(9)**
FAME II- PLI SCHEME- Battery Swapping Policy- Special Electric Mobility Zone- Tax Reduction on EVs.	
TOTAL(L:45) = 45 PERIODS	

TEXT BOOKS:
1. Michael Plint & Anthony Martyr, "Engine Testing & Practice", Butterworth Heinmenn, 3rd ed, 2007 2. Bosch Automotive Handbook, Robert Bosch, 7th Edition, 2007.
REFERENCES:
1. Vehicle Inspection Handbook", American Association of Motor Vehicle Administrators.Proceedings- Automotive Testing & Certification held on 20th to 24th July 2010

17EEX39-EV INTELLIGENT SYSTEM					
			L	T	P	C
			3	0	0	3
PRE REQUISITE : NIL					
Course Objectives		**Course Outcomes**			**Related Program outcomes**
1.0	To design and drive the mathematical model of a BLDC motor and its characteristics	**1.1**	Students will be able to design the mathematical model of a BLDC motor and to discuss about its characteristics		a,b,c,d,h,j,l
2.0	To learn the different control schemes for BLDC motor	**2.1**	Students will be able to demonstrate the PID control, ant windup controller, Intelligent Controller and Vector Control. Control applied to BLDC motor.		a,b,c,d,h,j,l
3.0	To study the basics of fuzzy logic controller	**3.1**	Students will be able to illustrate the basics of fuzzy logic system		a,b,c,d,j,l
4.0	To study the FPGA & VHDL basics	**4.1**	Students will be able to describe the basics of VHDL & FPGA applied to control of EVs.		a,b,c,d,j,l
5.0	To implement fuzzy logic control of BLDC motor in real time	**5.1**	Students will be able to design and implement of fuzzy logic control scheme for BLDC motor using FPGA in real time.		a,b,c,d,e,h,j,l

UNIT I - MATHEMATICAL MODEL AND CHARACTERISTICS ANALYSIS OF BLDC MOTOR	**(9)**
Structure and Drive Modes - Basic Structure-General Design Method-Drive Modes. Mathematical Model-Differential Equations-Transfer Functions-State-Space Equations. Characteristics Analysis-Starting Characteristics-Steady-State Operation- Dynamic Characteristics- Load Matching Commutation Transients.	
UNIT II - SPEED CONTROL FOR ELECTRIC DRIVES	**(9)**
Introduction -PID Control Principle- Anti windup Controller-Intelligent Controller- Vector Control-Control applied to BLDC motor	
UNIT III - FUZZY LOGIC CONTROLLER	**(9)**
Membership functions: features, fuzzification, methods of membership value assignments, Defuzzification: lambda cuts - methods - fuzzy arithmetic and fuzzy measures: fuzzy arithmetic - extension principle -fuzzy integrals - fuzzy rule base and approximate reasoning : truth values and tables- fuzzy propositions, formation of rules decomposition of rules- aggregation of fuzzy rules-fuzzy reasoning-fuzzy inference systems- overview of fuzzy expert system-fuzzy decision making.	
UNIT IV - FPGA AND VHDL BASICS	**(9)**
Introduction – FPGA Architecture-Advantages-Review of FPGA family processors- Spartan 3, Spartan 6 and Spartan 7. VHDL Basics- Fundamentals-Instruction set-data type-conditional statements- programs like arithmetic, sorting, PWM generation, Speed detection.	
UNIT V -REAL TIME IMPLEMENTATION	**(9)**
Inverter design- identifying rotor position via hall effect sensors-open loop and fuzzy logic control of 48 V BLDC motor using FPGA.	
TOTAL(L:45) = 45 PERIODS	

TEXT BOOKS:

1. Electric Powertrain Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles, John G. Hayes, G. Abas Goodarzi, Wiley 1st Edition 2018.
2. VHDL Primer, A (3rd Edition), Jayaram Bhasker, Prentice Hall, 1st Edition 2015.
3. Iqbal Hussain, "Electric and Hybrid Vehicles: Design Fundamentals, Third Edition" CRC Press, Taylor & Francis Group, 1st Edition,2021

REFERENCES:

1. Chang-liang, Permanent Magnet Brushless DC Motor Drives and Controls, Xia Wiley,1 st Edition,2012
2. M.N. Cirstea, A. Dinu, J.G. Khor,M. McCormick, Neural and Fuzzy Logic Control of Drives and Power Systems, Newnes publications, 1 st Edition, 2002.
3. Wei Liu, Hybrid Electric Vehicle System Modeling and Control, , 2nd Edition, Wiley 2017
4. Electric and Plug-in Hybrid Vehicle Networks Optimization and Control, Emanuele Crisostomi, Robert Shorten, Sonja Stüdli, Fabian Wirth, CRC Press, 1 st Edition. 2018.

17EEX40-ELECTRICAL VEHICLES IN SMART GRID					
			L	T	P	C
			3	0	0	3
PRE REQUISITE : NIL					
Course Objectives		**Course Outcomes**			**Related Program outcomes**
1.0	To know the impact of charging strategies and smart charging technologies	**1.1**	The students will be able to describe vehicle electrification and impact of charging strategies.		a,b,c,d,e,f,g,h,i,j,k,l
2.0	To acquire knowledge on the influence of EV's on power system	**2.1**	The students will be able to interpret influence of EVs on power system		a,b,c,d,e,f,g,h,l
3.0	To gain knowledge on frequency control reserves & voltage support from EV's	**3.1**	The students will be able explain frequency control reserves & voltage support from EV's		a,b,c,d,e,f,g,h,l
4.0	To learn about smart grid and ICT solutions to support EV deployment	**4.1**	The students will be able to illustrate smart grid architecture and ICT solutions to support EV deployment		a,b,c,d,e,f,g,h,i,j,k,l
5.0	To understand the centralized charging, decentralized charging schemes and energy storage integration into microgrid	**5.1**	The students will be able to demonstrate centralized charging, decentralized charging schemes and energy storage integration into microgrid		a,b,c,d,e,f,g,h,i,j,k

UNIT I - INTRODUCTION	**(9)**
Introduction- Impact of charging strategies-EV charging options and infrastructure-Energy- Economic and environmental considerations-Impact of EV charging on power grid- effect of EV charging on generation and load profile-Smart charging technologies- Impact on investment.	
UNIT II - INFLUENCE OF ELECTRIC VEHICLES ON POWER SYSTEM	**(9)**
Introduction- identification of EV demand- EV penetration level for different scenarios- Classification based on penetration level-EV impacts on system demand: dumb charging, multiple tariff charging, smart charging-case study	
UNIT III - FREQUENCY CONTROL RESERVES	**(9)**
Introduction-power system ancillary services-Electric vehicles to support wind power integration-Electric vehicle as frequency control reserves and tertiary reserves- Voltage support and electric vehicle integration-properties of frequency regulation reserves-Control strategies for EV's to support frequency regulation.	
UNIT IV - ICT SOLUTIONS TO SUPPORT EV DEPLOYMENT	**(9)**
Introduction-Architecture and model for smart grid & EV- ICT players in smart grid-Smart metering, information & communication models- functional and logical models- technology and solution for smart grid: interoperability, communication technologies.	
UNIT V - EV CHARGING FACILITY PLANNING	**(9)**
Energy generation scheduling-Different power sources- Fluctuant electricity-Centralized Charging schemes- Decentralized charging schemes-Energy storage integration into Micro-grid-Design of V2G Aggregator.	
	TOTAL(L:45) = 45 PERIODS

TEXT BOOKS:
1. Canbing Li, Yijia Cao, YonghongKuang and Bin Zhou, “Influences of Electric Vehicles on Power System and Key Technologies of Vehicle-to-Grid”, Springer-Verlag Berlin Heidelberg, 2016. 2. Qiuwei Wu, “Grid Integration of Electric Vehicles in Open Electricity Markets”, John Wiley & Sons, Ltd, 2013.
REFERENCE:
1. Harald Naunheimer , Bernd Bertsche , Joachim Ryborz , Wolfgang Novak "Automotive Transmission: Fundamentals, Selection, Design and Application", 2nd Edition, Springer, 2011.

17EEX41-DESIGN OF MOTOR AND POWER CONVERTERS FOR ELECTRIC VEHICLES					
				L	T	P	C
				3	0	0	3
PRE REQUISITE : NIL							
Course Objectives		**Course Outcomes**		**Related Program outcomes**			
1.0	To review the drive cycles and requirements of EVs	**1.1**	The Students will be able to analysis the Dynamics of Electric Vehicles	a,c,h,j,l			
2.0	To know the working of motors used in Electric Vehicle	**2.1**	The Students will be able to use appropriate electric machine for electric vehicle application	a,b,c,d,e,h,j,l			
3.0	To analyze and model the buck/boost converter operation and to design the same	**3.1**	The Students will be able to compute transfer function with factors such as constant, integral, differential, first order factor and second order factor (both numerators & denominators)	a,b,c,d,e,h,j,l			
4.0	To learn the simulation basics of control systems	**4.1**	The Students will be able to design buck, boost and buck-boost converter.	a,b,c,d,e,h,j,l			
5.0	To derive transfer functions for DC-DC converters	**5.1**	The Students will be able to compute a power stage transfer functions for DC-DC converters	a,b,c,d,e,h,j,l			

UNIT I - ELECTRIC VEHICLE DYNAMICS	**(9)**
Standard drive cycles-Dynamics of Electric Vehicles-Tractive force-Maximum speed-Torque-Power-Energy requirements of EVs	
UNIT II – ADVANCED MOTORS FOR ELECTRIC VEHICLES	**(9)**
Introduction – Speed and Torque control of above and below rated speed - Speed control of EV in the constant power region of electric motors. Switched Reluctance Motors (SRMs). Synchronous Reluctance Machines-Choice of electric machines for EVs	
UNIT III - CONTROL SYSTEMS SIMULATION	**(9)**
Transfer Function- Poles & zeros- bode plot -Bode Plots for Multiplication Factors, Constant, Single and Double Integration Functions, Single and Double Differentiation Functions, Single Pole and Single Zero Functions, RHP Pole and RHP Zero Functions- state space modelling-Transfer function from state space Model	
UNIT IV - MODELING OF DC-DC CONVERTERS	**(9)**
Overview of PWM Converter Modelling -Power Stage Modelling - PWM Block Modelling – Voltage Feedback Circuit and Small-Signal Model of PWM Converter - Averaging Power Stage Dynamics - Average Models for buck/boost Converter - Small-Signal Model of Converter Power Stage - Frequency Response of Converter	
UNIT V -POWER STAGE TRANSFER FUNCTIONS OF DC – DC CONVERTERS	**(9)**
Power Stage Transfer Functions of buck-boost Converter in CCM Operation- Input-to-Output Transfer Function-Duty Ratio-to-Output Transfer Function- Load Current-to-Output Transfer Function.	
TOTAL(L:45) = 45 PERIODS	

TEXT BOOKS:

1. Power Electronic Converters, Teuvo Suntio, Tuomas Messo, Joonas Puukko, First Edition 2017.
2. Fundamentals of Power Electronics with MATLAB, Randall Shaffer, 2nd Edition,Lakshmi publications,2013
3. Handbook of Automotive Power Electronics and Motor Drives, Ali Emadi, Taylor & Francis, 1st Edition,2005
4. Emerging Power Converters for Renewable Energy and Electric Vehicles Modeling, Design, and Control, Md. Rabiul Islam,Md. Rakibuzzaman Shah, Mohd. Hasan Ali, CRC Press 1st Edition,2021

REFERENCES:

1. Iqbal Hussain, "Electric and Hybrid Vehicles: Design Fundamentals, Second Edition" CRC Press, Taylor & Francis Group, Third Edition 2021.
2. Feedback Control problems using MATLAB and the Control system tool box, Dean Frederick and Joe Cho, 1st Edition, Cengage learning,2000.
3. Electrical Machine Fundamentals with Numerical Simulation using MATLAB/SIMULINK, Atif Iqbal, Shaikh Moinoddin, Bhimireddy Prathap Reddy, Wiley,1st Edition,2021

17EEM01-ELECTRIC CIRCUITS					
			L	T	P	C
			2	1	0	3
PRE REQUISITE : NIL					
Course Objectives		**Course Outcomes**		**Related Program outcomes**	
1.0	To impart basic knowledge about electric circuits and networks to the students	**1.1**	The student will be able to name the various circuit elements, explain the behavior of circuit elements and circuits and analyze the circuits using KVL, KCL, Mesh analysis and Nodal analysis techniques.	a,b,c,d,e,f,g,h,k.l	
2.0	To develop in students the ability to analyze various types of DC circuits using network theorems.	**2.1**	The student will be able to state the various network theorems, explain it and use it for solving the problems of electric circuits and networks	a,b,c,e,f,g,h,k.l	
3.0	To make the student s to understand circuit laws, waveform and network theorems in AC circuits	**3.1**	The student will be able to describe fundamental concepts used in single phase AC circuits, explain these concepts and solve problems pertaining to these circuits.	a,b,c,d,e,g,h,k.l	
4.0	To get an insight into analysis of resonance and coupled circuits	**4.1**	The student will be able to design resonance and coupled circuits	a,b,c,d,f,g,h,k,l	
5.0	To gain the knowledge about the three phase circuits	**5.1**	The student will be able to examine the 3-phase circuits for impedance, voltage, current, power, phase shift and power factor.	a,b,c,d,e,f,g,h,k,l	

UNIT I - DC CIRCUITS	**(6+3)**
Circuit Elements –Current and Voltage sources- Ohm's and Kirchhoff's laws – Resistive circuits- Series and parallel reduction –Current division rule and Voltage division rule - Mesh analysis for D.C circuits	
UNIT II -NETWORK REDUCTION AND NETWORK THEOREMS FOR DC CIRCUITS	**(6+3)**
Network reduction: Source transformation, Star delta transformation. **Network theorems**: Superposition theorem, Thevenin's theorem.	
UNIT III - AC CIRCUITS	**(6+3)**
Introduction to alternating quantities - Average and RMS values, Peak and Form Factors – Power and power factor of simple series RL circuits	
UNIT IV - RESONANCE AND COUPLED CIRCUITS	**(6+3)**
Resonance circuits: Resonant Frequency, Current and Voltage Variations, Bandwidth, Q factor for Series and Parallel Resonance Circuits. Coupled Circuits: Self and mutual inductance, Co-efficient of coupling.	
UNIT V -THREE PHASE CIRCUITS	**(6+3)**
Star and Delta systems – Line and Phase Quantities - Three Phase Power - Balanced and Unbalanced Circuit – Three wire and Four wire systems.	
TOTAL (L:30+T:15) = 45 PERIODS	

TEXT BOOKS:

1. Jr., William H. Hayt,Kemmerly, Jack E.Phillips, Jamie D.Durbin, Steven M. “Engineering Circuits Analysis” ,9th edition., Tata McGraw Hill publishers, New Delhi, 2020.
2. Sudhakar A and Shyam Mohan S Pall, “Circuits and Network Analysis and Synthesis”, McGraw Hill Education India pvt.ltd New Delhi, 2015.

REFERENCES:

1. Van Valkenburg M.E., “Network Analysis”, Pearson Education India, Revised 3 rd Edition, 2019
2. S.R. Paranjothi, "Electric Circuits Analysis”, New Age International Ltd., New Delhi, 4th Edition, 2014
3. Charles K. Alexander and Mathew N.O. Sadiku, “Fundamentals of Electric Circuits", 2nd Edition Tata McGraw Hill publishers, 2013.

17EEM02-SOLID STATE DEVICES					
			L	T	P	C
			3	0	0	3
PRE REQUISITE : NIL					
Course Objectives		**Course Outcomes**		**Related Program outcomes**	
1.0	To motivate the students to learn about the properties of semiconductor	**1.1**	The students will be able to understand the properties of semi conductor	a,b,c,e,f,g,k.l	
2.0	To educate about Carrier transport properties	**2.1**	The students will be able to gain adequate knowledge in carrier transport properties	a,b,c,e,f,g,k.l	
3.0	To learn about unidirectional diode	**3.1**	The students will be able to acquire knowledge of P-N junction diode	a,b,c,e,f,g,k.l	
4.0	To learn about Bipolar Junction Transistor	**4.1**	The students will be able to familiar with operation of Bipolar Junction Transistor	a,b,c,e,f,g,k.l	
5.0	To educate about Opto Electronic Devices	**5.1**	The students will be able to get dynamic understanding of Optical Devices	a,b,c,e,f,g,k.l	

UNIT I - PROPERTIES OF SEMICONDUCTOR	**(9)**
Intrinsic and Extrinsic Semiconductors –Majority and minority carrier concentration-Energy band diagrams for P and N type semiconductors – Allowed and forbidden energy bands – Electron effective mass – Concept of holes in semiconductor.	
UNIT II - CARRIER TRANSPORT PROPERTIES	**(9)**
Carrier drift – Drift current density – Mobility effects on carrier density – Conductivity in semiconductor – Carrier transport by diffusion – Diffusion current density – Total current density – Breakdown phenomena – Avalanche breakdown.	
UNIT III - PN JUNCTION DIODE	**(9)**
Qualitative description of charge flow in p-n junction – Boundary condition – Minority carrier distribution – Ideal p-n junction current – Temperature effects – Applications – The turn on transient and turn off transient.	
UNIT IV - BIPOLAR JUNCTION TRANSISTOR	**(9)**
Introduction to basic principle of operation – The modes of operation – Amplification – Minority carrier distribution in forward active mode – Non-ideal effects – Base with modulation– Breakdown voltage – Voltage in open emitter configuration and open base configuration.	
UNIT V - OPTO ELECTRONIC DEVICES	**(9)**
Optical absorption in a semiconductor-Photon absorption coefficient – Electron hole pair generation – Solar cell – Homo junction and hetero junction - Photo transistor –Laser diode.	
	TOTAL (L:45) = 45 PERIODS

TEXT BOOKS:

1. Donald A Neamen , Dhrubes Biswas “Semiconductor Physics and Devices” McGraw Hill Education; 4th edition 2017.
2. Albert Malvino , David J. Bates “Electronic Principles” McGraw Hill Education; 7th edition 2017

REFERENCES:

1. M.S. Tyagi, Introduction to Semiconductor materials and devices, John Wiley and sons,2008
2. S.M. Sze & K.Ng. Kwok, Physics of semiconductor devices, John Wiley and sons, Third edition 2008

17EEM03-POWER SEMICONDUCTOR DEVICES					
			L	T	P	C
			3	0	0	3
PRE REQUISITE : NIL					
Course Objectives		**Course Outcomes**		**Related Program outcomes**	
1.0	To acquire the knowledge on various power semiconductor switches	**1.1**	The students will be able to know about the construction, physics of operation, safe operating areas and protection circuits for various semiconductor devices	a,b,h	
2.0	To gain the knowledge on structure and switching characteristics of power diode and BJT	**2.1**	The students will be able to know about the Construction, static characteristics, and switching characteristics of power diode and power BJT	a,b,d,e,f	
3.0	To acquire the knowledge on basic operation and characteristics of thyristor and GTO	**3.1**	The students will be able to know about the Construction, static characteristics, and switching characteristics of SCRS and GTOs	a,b,d,e,f	
4.0	To understand the operation of IGBT and Power JFET and MOSFET	**4.1**	The students will be able to know about the Construction, static characteristics, and switching characteristics of IGBT and power FETS	a,b,d,e,f	
5.0	To acquire the knowledge on application of various converters.	**5.1**	The students will be able to get the idea of how to use these devices for various converters	a,b,d,e,f,h,i	

UNIT I-POWER SEMICONDUCTOR SWITCHES	**(9)**
Introduction – Diodes-Thyristors- BJTs-JFETs-MOSFETs- GTOs IGBTs- Comparison of these as switching devices.	
UNIT II - POWER DIODE AND POWER BJT	**(9)**
Basic structure and I-V & Switching characteristics of Power diode- Structure and Switching characteristics of Power BJT - Safe operating area –Snubber design for Power diode.	
UNIT III - THYRISTORS AND GTOs	**(9)**
Basic structures - I-V characteristics -Switching characteristics of Thyristors and GTOs– Derive circuits - Snubber circuits for Thyristors and GTOs - Over current protection of GTO.	
UNIT IV - IGBT AND POWER JFET & MOSFETS	**(9)**
Basic structures - I-V characteristics- Switching characteristics – Safe operating area of IGBT and Power JFET & MOSFET - Derive circuits and Protection.	
UNIT V - APPLICATIONS	**(9)**
Single phase converters ,Three phase converters using Diodes and Thyristors-Inverters using GTOs.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOK:
1. Rashid M.H., “Power Electronics Circuits, Devices and Applications ", Pearson, fourth edition, 2021.
REFERENCES:
1. MD Singh and K.B Khanchandani, “Power Electronics”, Tata McGraw Hill, 2010. 2. Mohan, Undcland and Robins, “Power Electronics – Concepts, applications and Design”, John Wiley and Sons, Singapore, 2000.

17EEM04-ELECTRICAL MEASUREMENTS AND INSTRUMENTS				
L	T	P	C
3	0	0	3

PRE REQUISITE : NIL

Course Objectives		Course Outcomes		Related Program outcomes
1.0	To educate the fundamental concepts and characteristics of measurement and errors	1.1	The students will be able to understand the fundamental art of measurement in engineering	a,b,c,d,e,f,l
2.0	To assimilate the operating principle of various measuring instruments	2.1	The students will be able to apply their knowledge to measure electrical quantities using analog instruments	a,b,c,d,e,l
3.0	To perceive knowledge on the fundamental working of potentiometer and instrument transformers	3.1	The students will be able to analyze and apply various transformers for measurement process	a,b,c,d,e,l
4.0	To impart the importance of various bridge circuits used with measuring instruments.	4.1	The students will be able to measure resistance, inductance and capacitance using various bridge circuits.	a,b,c,l,d,e,
5.0	To emphasize the need of digital instrumentation principles and display devices	5.1	The students will be able to understand the concept of digital instrumentation	a,b,c,d,e,l,l

UNIT I - MEASUREMENT OF VOLTAGE AND CURRENT	**(9)**
Galvanometers: Ballistic -D'Arsonval galvanometer -Calibration-Application -Principle of operation , Construction and working of moving coil, moving iron meters – Errors and compensation.	
UNIT II - MEASUREMENT OF POWER AND ENERGY	**(9)**
Electrodynamometer type wattmeter-LPF wattmeter-Phantom loading – Induction type KWH meter – Calibration of wattmeter, and energy meter.	
UNIT III – POTENTIOMETERS & INSTRUMENT TRANSFORMERS	**(9)**
DC potentiometer :Basic circuit, standardization – Laboratory type (Crompton's) – AC potentiometer : Drysdale (polar type) Gall-Tinsley (coordinate) type – Limitations & applications- C.T and V.T construction and operation, characteristics, testing, and error elimination – Applications	
UNIT IV-BRIDGES	**(9)**
Wheatstone bridge-Maxwell Bridge – Wein's bridge – Hey's bridge – Schering bridge – Anderson bridge	
UNIT V -DIGITAL INSTRUMENTS & DISPLAY DEVICES	**(9)**
Digital voltmeters (DVM) - Ramp type DVM- Integrating type- DVM and Successive approximation DVM.- Cathode ray tubes-Light emitting diodes-Liquid crystal displays.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:
1. A.K. Sawhney, Puneet Sawhney 'A Course in Electrical & Electronic Measurements & Instrumentation', Dhanpat Rai and Co, New Delhi, 29th Edition 2021. 2. H.S. Kalsi, 'Electronic Instrumentation', Tata McGraw-Hill, New Delhi, 2010
REFERENCES:
1. David A. Bell, Electronic Instrumentation and Measurements, Oxford University Press,2013 2. Jennings, Richard, and Fabiola De La Cueva. LabVIEW graphical programming, McGraw-Hill Education,2020 E. O. Doebelin and D. N. Manik, "Measurement Systems – Application and Design", Tata McGraw-Hill, New Delhi, 6th Edition 2017.

17EEM05-BASICS OF ELECTRICAL MACHINES					
			L	T	P	C
			3	0	0	3
PRE REQUISITE : NIL					
Course Objectives		**Course Outcomes**			**Related Program outcomes**
1.0	To know the construction, operation and characteristics of various types of DC Generators	**1.1**	The students will be able to illustrate the construction and principle of operation and characteristics of DC machines		a,b,c,d,e,l
2.0	To know the construction, operation and characteristics of various types of DC Motors	**2.1**	The students will be able to illustrate the construction and principle of operation and characteristics of DC motors		a,b,c,d,e,l
3.0	To impart knowledge on Construction, principle of operation and performance of single phase induction motors.	**3.1**	The students will be able to gain knowledge about the basic principles and working of Single phase induction motors.		a,b,c,d,e,l
4.0	To impart knowledge on construction, principle of operation and performance of induction machines	**4.1**	The students will be able to understand the construction and working principle of Three Phase Induction Motor		a,b,c,d,e,l
5.0	To impart knowledge on Special electrical machines	**5.1**	The students will be able to gain knowledge about the basic principles and working of Special electrical Machines.		a,b,c,d,e,l

UNIT I - DC GENERATORS	**(9)**
Principle of operation-Constructional details- Emf equation- Methods of excitation- Self and separately excited generators- Characteristics of series, shunt and compound generators- Applications.	
UNIT II - DC MOTORS	**(9)**
Principle of operation- Back emf and torque equation- Characteristics of series, shunt and compound motor-Starter- Starting methods- Applications.	
UNIT III -SINGLE PHASE INDUCTION MOTOR	**(9)**
Single Phase Induction Motor: Constructional details– Double field revolving theory and operation – Equivalent circuit – Starting methods - Capacitor start ,capacitor start and run induction motor,Shaded pole induction motor.	
UNIT III-THREE PHASE INDUCTION MOTOR	**(9)**
Constructional details – Types of rotors – Principle of operation – Slip – Equivalent circuit – Torque-Slip characteristics - Condition for maximum torque – Losses and efficiency – Load test - No load and blocked rotor tests.	
UNIT V- SPECIAL MACHINES	**(9)**
Special Machines-:Repulsion motor - Servo motor – Switched Reluctance motor – Universal Motor – BLDC motor.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:
1. P. S. Bimbhra, “Electric Machinery”, Khanna Publishers, 2nd Edition, 2021. 2. I. J. Nagrath and D. P. Kothari, “Electric Machines”, McGraw Hill Education, 5th Edition, 2017. 3. A. E. Fitzgerald and C. Kingsley, "Electric Machinery”, New York, McGraw Hill Education, 6th Edition 2017
REFERENCES:
1 . B.R.Gupta, ’Fundamental of Electric Machines’ New age International Publishers, 3rd Edition, Reprint 2015. 2. Murugesh Kumar, ‘Electric Machines’, Vikas Publishing House Pvt. Ltd, First edition 2010.

17EEM06-ELECTRIC DRIVES					
		L	T	P	C
		3	0	0	3
PRE REQUISITE : NIL					
Course Objectives		**Course Outcomes**		**Related Program outcomes**	
1.0	To provide knowledge on the process of learning fundamental concept of electrical drive systems and drive motor characteristics.	**1.1**	The students will be able to know the fundamental concept electrical drive, the selection process involved in drives and drive motor characteristics	a,b,c,e,i,k	
2.0	To know the fundamental of DC motor drives	**2.1**	The students will be able to understand the operation of the converter, chopper fed dc drive and solve simple problems	a,b,c,f,i	
3.0	To give exposure to understand and analyze the various speed control of induction motor drives.	**3.1**	The students will be able to study and analyze the speed control of induction motor drive	a,b,c,f,i	
4.0	To acquire knowledge on digital control techniques used for speed control of dives	**4.1**	The students will be able to use recent microcontroller for motor control and PLC based control of drives.	b,c,e,f,i,k,l	
5.0	To learn about the design of different controllers for drives	**5.1**	The students will be able analyze and design various controllers for drives	a,b,c,e,i	

UNIT I – INTRODUCTION	**(9)**
Basic elements and types of drives – Factors influencing the choice of electrical drives –Multi quadrant operation-heating and cooling curves – Loading conditions and classes of duty – Selection of power rating for drive motors –Drive motor characteristics - Braking of electrical motors	
UNIT II - DC DRIVES	**(9)**
Speed control of DC series and shunt motors - Armature and field control- Ward-Leonard control system – Steady state analysis of the single and three phase converter fed separately excited DC motor drive –4 quadrant operations of converter ,chopper fed drive.	
UNIT III - AC DRIVES	**(9)**
Speed control of three phase induction motor: Stator control: Voltage / frequency control – Constant airgap flux – Field weakening mode –AC voltage Regulator- Voltage / current fed inverter – Rotor control – Rotor resistance control and slip power recovery schemes- Principle of vector control.	
UNIT IV – STARTING AND SPEED CONTROL OF THREE PHASE INDUCTION MOTOR	**(9)**
Digital techniques in speed control - Advantages and limitations– Microprocessor based control of drives- Microcontroller based control of drives .	
UNIT V - DESIGN OF CONTROLLERS FOR DRIVES	**(9)**
Introduction-Transfer function for DC motor / load and converter – Closed loop control with Current and speed feedback– Armature voltage control and field weakening mode – Design of controllers: Current controller - Speed controller	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:
1. Dubey G.K., "Fundamentals of Electrical Drives", Narosa Publishing House, New Delhi, 2015. 2. Bose, B.K., Modern Power Electronics and AC Drives", Pearson Education (Singapore) Pvt.. Ltd, New Delhi, 2010 .
REFERENCES:
1. Vedam Subramanyam, Electric Drives: Concepts and Applications II, Tata McGraw hill Pvt. Ltd, New Delhi, 2011. 2. Krishnan R, Electric Motor Drives: Modeling, Analysis and Control II, Prentice Hall of India, Pvt. Ltd, New Delhi,2010 3. S.K.Pillai, "A First Course on Electrical Drives", II Edition, New Age International Publishers, 2010.

17EEM07-POWER SYSTEMS					
			L	T	P	C
			3	0	0	3
PRE REQUISITE : NIL					
Course Objectives		**Course Outcomes**		**Related Program outcomes**	
1.0	To know the structure of electric power system and classifications of power generation.	**1.1**	The students will be able to understand the concepts of various power generation systems.	a,b,c,d,e,f,g,h,i,j,k,l	
2.0	To give exposure to transmission line insulators and grounding concepts.	**2.1**	The students will be able to design modern substation layout with grounding techniques	a,b,c,d,e,f,g,h,i,j,k,l	
3.0	To learn about overvoltages in power system	**3.1**	The students will be able to impart knowledge of over voltage phenomenon in electrical power systems	a,b,c,d,e,f,g,h,i,j,k,l	
4.0	To edify basic things about reactive power control techniques.	**4.1**	The students will be able to acquire knowledge about reactive power control techniques.	a,b,c,d,e,f,g,h,i,j,k,l	
5.0	To study various methods of power quality monitoring.	**5.1**	The students will be able to impart knowledge on various methods of power quality monitoring.	a,b,c,d,e,f,g,h,i,j,k,l	

UNIT I – INTRODUCTION TO POWER SYSTEMS	**(9)**
Structure of power system-Classification of power generation systems:Thermal, hydel, nuclear, wind and solar Power plant.	
UNIT II – DISTRIBUTION SYSTEM	**(9)**
Insulators – Cables: types of underground cables and its construction - Key diagram of 11 kV/415 V substation- Methods of Grounding	
UNIT III – OVERVOLTAGES IN POWER SYSTEM	**(9)**
Causes of over voltages and its effects on power system – Lightning, switching surges and temporary overvoltages– Protection against over voltages	
UNIT IV – REACTIVE POWER CONTROL	**(9)**
Reactive power control in electrical power transmission lines -Uncompensated transmission line - Series compensation – Basic concepts of Static VAR Compensator (SVC) – Thyristor Controlled Series Capacitor (TCSC) – Unified Power Flow Controller (UPFC).	
UNIT V – POWER QUALITY MONITORING	**(9)**
Power line disturbance analyzer - Power quality measurement equipment - Harmonic / spectrum analyzer - Disturbance analyzer	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. D. P. Kothari, I. J. Nagrath, Power System Engineering, 3rd edition, McGraw Hill Education,2019
2. CL Wadhwa, Electrical Power Systems,7th Edition, New Age publication,2017
3. S.N. Singh, 'Electric Power Generation, Transmission and Distribution', Prentice Hall of India Pvt. Ltd, New Delhi, Second Edition, 2011.
4. S.Naidu and V. Kamaraju, ―High Voltage Engineering‖, Tata McGraw Hill, 5 th ed.,2013.
5. Narain G. Hingorani, ―Understanding FACTS -Concepts and Technology of Flexible AC Transmission Systems‖, Standard Publishers Distributors, 2011.

REFERENCES:

1. Arun Ingole, "power transmission and distribution" Pearson Education, 2017.
2. G.Ramamurthy, "Handbook of Electrical power Distribution," Universities Press, 2013.
3. V.K.Mehta, Rohit Mehta, 'Principles of power system', S.Chand & Company Ltd, New Delhi, 2013.
4. Roger.C.Dugan, Mark.F.McGranagham, Surya Santoso, H.Wayne Beaty, ―Electrical Power Systems Quality‖ McGraw Hill,2012

17EEM08-RENEWABLE ENERGY SYSTEM					
			L	T	P	C
			3	0	0	3
PRE REQUISITE : NIL					
Course Objectives		**Course Outcomes**		**Related Program outcomes**	
1.0	To understand the importance of solar energy and its applications	**1.1**	Students will be able to understand the working and applications of solar energy systems	a,b,c,e,g	
2.0	To acquire the knowledge principle of operation of wind energy and its applications	**2.1**	Students will be able to explain the working and applications of wind energy systems	a,b,c,e,g	
3.0	To gain the knowledge on principle of operation of Bioenergy,ocean energy and chemical energy sources	**3.1**	Students will be able to express the principle of the bio-energy production techniques and operation of geothermal energy and ocean energy sources	a,b,c,g	
4.0	To acquire the knowledge on chemical energy sources and additional energy sources.	**4.1**	Students will be able to explain the operation of additional alternate energy sources	a,b,c,e,g	
5.0	To gain knowledge on energy conservation technologies.	**5.1**	Students will be able to describe the principle of energy conservation and its technologies	a,b,c,g	

UNIT I - SOLAR ENERGY	**(9)**
Solar radiation at the earth‟s surface – Solar radiation measurements – Solar energy collectors: flat plate and concentrating collectors. Solar electric power generation: Solar Photo Voltaics – Applications of solar energy: solar pumping and solar cooking.	
UNIT II -WIND ENERGY	**(9)**
Basic components of a wind energy conversion system – Classification. Wing Energy Collectors: horizontal axis and vertical axis machines – Performance of wind machines – Generating system – Energy storage – Applications of wind Energy – Interconnected systems – Safety systems – Environmental aspects	
UNIT III- BIO ENERGY,OCEAN ENERGY AND GEOTHERMAL ENERGY	**(9)**
Bioenergy: Biomass conversion technologies – Biogas generation – Classification of biogas plants – Ethanol production. **Geothermal Energy:** Geothermal sources – Prime movers for geothermal energy conversion. **Ocean Energy:** Basic principle of tidal power – Components – Operation methods, Ocean waves **–** Energy and power from waves – wind energy conversion devices.	
UNIT IV- ADDITIONAL ALTERNATE ENERGY SOURCES AND CHEMICAL ENERGY SOURCES	**(9)**
MHD power generation – Thermoelectric power generation. Chemical energy sources: Hydrogen production – Storage – Transportation and utilization – Hydrogen as an alternative fuel for motor vehicles – Fuel cell – Principle – Types.	
UNIT V- ENERGY CONSERVATION	**(9)**
Principles of energy conservation – Energy conservation approach/ technologies – Co-generation – Waste heat utilization – Combined cycle power generation – Heat regenerators – Heat pipes – Heat pumps.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOK:

1. Rai G.D., "Non-Conventional Energy Sources", 6th Edition, Khanna Publishers, New Delhi, 2017.

REFERENCES:

1 Kothari D.P, Singal K.C & Rakesh Ranjan. "Renewable Energy Sources and Emerging Technologies", 2nd Edition, PHI Learning Pvt. Ltd., New Delhi, 2011.

2 John Twidell & Tony Weir. "Renewable Energy Resources", 3rd Edition, Routledge, New York, 2015.

NANDHA ENGINEERING COLLEGE

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Curriculum and Syllabi

for

B.E – Electrical and Electronics Engineering [R22]

[CHOICE BASED CREDIT SYSTEM]

(This Curriculum and Syllabi are applicable to Students admitted from the academic year (2022-23) onwards)

AUGUST 2022

22EEC03-ELECTRIC CIRCUIT THEORY *(For EEE Branch only)*				
	L	**T**	**P**	**C**
	2	**1**	**0**	**3**
PRE REQUISITE : NIL				

Course Objectives		**Course Outcomes**	
1.0	To impart basic knowledge about electric circuits and networks to the students	**1.1**	The student will be able to name the various circuit elements, explain the behavior of circuit elements and circuits and analyze the circuits using KVL, KCL, Mesh analysis and Nodal analysis techniques.
2.0	To develop in students the ability to analyze various types of DC circuits using network theorems.	**2.1**	The student will be able to state the various network theorems, explain it and use it for solving the problems of electric circuits and networks
3.0	To make the student s to understand circuit laws, waveform and network theorems in AC circuits	**3.1**	The student will be able to describe fundamental concepts used in single phase AC circuits, explain these concepts and solve problems pertaining to these circuits.
4.0	To get an insight into analysis of resonance and coupled circuits	**4.1**	The student will be able to design resonance and coupled circuits
5.0	To gain the knowledge about the three phase circuits and power measurement	**5.1**	The student will be able to examine the 3-phase circuits for impedance, voltage, current, power, phase shift and power factor.

UNIT I - BASIC CIRCUITS ANALYSIS	**(6+3)**
Introduction-Circuit Elements –Current and Voltage sources- Circuit variables -Ohm's and Kirchhoff's laws – Resistive circuits- Series and parallel reduction –Current division rule and Voltage division rule - Mesh and Nodal analysis for D.C circuits	
UNIT II -NETWORK REDUCTION AND NETWORK THEOREMS FOR DC CIRCUITS	**(6+3)**
Network reduction: Source transformation, Star delta transformation. Network theorems: Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem and Reciprocity theorem	
UNIT III - AC CIRCUITS	**(6+3)**
Introduction to alternating quantities - Average and RMS values, Peak and Form Factors – Power, Power factor and energy – AC signals and RLC circuits-Network theorems: Thevenin's, Norton's theorem	
UNIT IV - RESONANCE AND COUPLED CIRCUITS	**(6+3)**
Resonance in Electric circuits-Series and parallel resonance- Variation of impedance with frequency-Bandwidth of RLC circuit- Quality factor - Impedance of RLC circuit near resonance-Selectivity- Coupled Circuits: Self and mutual inductance, Co-efficient of coupling.	

UNIT V -THREE PHASE CIRCUITS AND POWER MEASUREMENTS	(6+3)
Three phase voltages and currents-Phase sequence-Line and phase quantities- Phasor diagrams-Balanced and unbalanced loads- Analysis of three phase 3-wire, 4-wire circuits with star and delta connected loads– Power and power factor measurements using single and two wattmeter methods.	
TOTAL (L:30+T:15) = 45 PERIODS	

TEXT BOOKS:

1. Jr., William H. Hayt,Kemmerly, Jack E.Phillips, Jamie D.Durbin, Steven M. "Engineering Circuits Analysis" ,9th edition., Tata McGraw Hill publishers, New Delhi, 2020
2. Sudhakar A and Shyam Mohan S Pall, "Circuits and Network Analysis and Synthesis", McGraw Hill Education India pvt.ltd New Delhi, 2015

REFERENCES:

1. Van Valkenburg M.E., "Network Analysis", Pearson Education India, Revised 3 rd Edition, 2019
2. S.R. Paranjothi, "Electric Circuits Analysis", New Age International Ltd., New Delhi, 4th Edition, 2014
3. Charles K. Alexander and Mathew N.O. Sadiku, "Fundamentals of Electric Circuits", 2nd Edition Tata McGraw Hill publishers, 2013.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	3	3	3	2	3	2	1	2	1	1	2	3	2
2	3	3	3	3	2	2	3	1	2	-	1	2	3	2
3	3	3	2	3	1	3	2	1	2	-	-	2	3	2
4	3	3	3	3	1	2	1	1	2	-	-	2	3	2
5	3	3	3	3	2	3	2	1	2	1	2	2	3	2
CO (W.A)	**3**	**3**	**2.8**	**3**	**1.6**	**2.6**	**2**	**1**	**2**	**1**	**1**	**2**	**3**	**2**

22EEP01- ELECTRIC CIRCUITS LABORATORY
(For EEE Branch only)

	L	T	P	C
	0	0	4	2

PRE REQUISITE : NIL

	Course Objectives		Course Outcomes
1.0	To provide fundamentals concepts of electric circuits.	**1.1**	The students will be able to analyze the electrical circuits using various circuit laws
2.0	To understand and analyze the basic theorems of Circuit theory.	**2.1**	The students will be able to examine the network theorems and operation of typical electrical circuits.
3.0	To understand the concept of network theorems using digital simulation.	**3.1**	The students will be able to simulate the resonance and network theorems using digital simulation software.
4.0	To understand the concept of resonance in series circuit.	**4.1**	The students will be able to design electric circuits under resonance to meet desired needs within realistic constraints.
5.0	To get an insight into solution of three phase power measurements.	**5.1**	The students will be able to find power and power factor in three phase circuits using two wattmeter method.

List of Experiments

1. Experimental verification of Ohm's law
2. Experimental verification of Kirchhoff's voltage and current laws
3. Experimental verification of Superposition theorem
4. Experimental verification of Thevenin's theorem
5. Experimental verification of Norton's theorem
6. Experimental verification of Reciprocity theorem
7. Verification of KVL and KCL by using digital simulation
8. Verification of Superposition theorem & Thevenin's theorem by using digital simulation
9. Verification of Reciprocity theorem & Maximum power transfer theorem by using digital simulation
10. RLC series resonance circuits by using digital simulation

ADDITIONAL EXPERIMENTS:

11. Study of DSO and measurement of sinusoidal voltage, frequency and power factor
12. Experimental determination of power in three phase circuits by two-watt meter method

TOTAL (P:60) = 60 PERIODS

Mapping of COs with POs / PSOs														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3	3	3	3	-	3	-	1	3	1	2	2	2	3
2	3	3	3	3	-	2	2	1	2	1	2	2	2	3
3	3	3	2	-	3	2	2	1	2	1	2	3	2	3
4	3	3	3	-	3	2	1	1	2	1	2	3	2	3
5	3	2	3	2	-	2	2	1	2	1	2	2	2	3
CO (w.A)	**3**	**2.8**	**2.8**	**2.6**	**3**	**2.2**	**1.7**	**1**	**2.2**	**1**	**2**	**2.4**	**3**	**3**

22EEC05 - ELECTRONIC DEVICES AND CIRCUITS *(For EEE Branch only)*				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

PRE REQUISITE :NIL

Course Objectives		**Course Outcomes**	
1.0	To motivate the students to learn about unipolar and bipolar devices	**1.1**	The students will be able to learn about the various types of diodes
2.0	To educate about current and voltage controlled devices	**2.1**	The students will be able to acquire knowledge about current and voltage controlled device
3.0	To learn about various BJT amplifiers	**3.1**	The students will be able to analyze various configurations of BJT Amplifiers
4.0	To learn about various FET amplifiers	**4.1**	The students will be able to analyze various configurations of FET Amplifiers
5.0	Develop a strong basis of oscillator	**5.1**	The students will be able to recognize about the Oscillator and its types

UNIT I - DIODE CIRCUITS	**(9)**
Diodes - Rectifier circuits - Zener diode circuits - Clipper and Clamper circuits –Schotty diode ,PIN diode,tunnel diode ,LED and Photodiode.	
UNIT II - JUNCTION TRANSISTOR	**(9)**
Operation of NPN and PNP Transistor, Characteristics of BJT in CB, CE and CC configurations- Bipolar transistor biasing-Construction, Operation, Characteristics of JFET and MOSFET-Applications of Junction Transistor	
UNIT III - BJT AMPLIFIERS	**(9)**
Analog signals and linear amplifiers - Basic transistor amplifier configurations-CE amplifiers - CC (Emitter Follower) amplifier - CB amplifier - Comparison of the three basic amplifiers.	
UNIT I V - FET AMPLIFIERS	**(9)**
Introduction to FET amplifier - Calculation of voltage Gain, Input Impedance and Output Impedance- Common source amplifier - Source follower amplifier - Common gate configuration - comparison of the three basic amplifiers.	
UNIT V - OSCILLATORS	**(9)**
Condition for oscillations- Hartley, Colpitts and Clapp Oscillators- Phase shift and Wien bridge Oscillator - Crystal oscillators	
TOTAL = 45 PERIODS	

TEXT BOOKS:

1. Donald A Neamen , Dhrubes Biswas "Semiconductor Physics and Devices" McGraw Hill Education; 4th edition 2017.
2. Albert Malvino , David J. Bates "Electronic Principles" McGraw Hill Education; 7th edition 2017
.

REFERENCES:

1. M.S. Tyagi, Introduction to Semiconductor materials and devices, John Wiley and sons,2008
2. S.M. Sze & K.Ng. Kwok, Physics of semiconductor devices, John Wiley and sons, Third edition 2008

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	2	2	1	2	2	1	1	2	1	2	2	3	1
2	3	2	2	1	2	2	1	1	2	2	2	2	3	1
3	3	2	2	2	2	1	2	1	3	2	2	1	3	1
4	3	2	2	2	2	1	2	1	3	1	2	1	3	1
5	3	2	2	2	2	2	1	1	3	1	2	2	3	1
CO	**3**	**2**	**2**	**2**	**2**	**1**	**1**	**1**	**1**	**1**	**2**	**1**	**3**	**1**

22EEC06 -ELECTRICAL MACHINES-I *(For EEE Branch only)*					
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**
PRE REQUISITE : 22EEC03					
Course Objectives		**Course Outcomes**			
1.0	To Understand the concepts of field energy, co energy, mechanical force and production of torque and EMF	1.1	The students will be able to understand the generation of EMF and Torque in rotating Machines		
2.0	To know the construction, operation and characteristics of various types of DC Generators	2.1	The students will be able to illustrate the construction and principle of operation and characteristics of DC machines		
3.0	To learn starting, starters and methods of speed control of DC motors.	3.1	The students will be able to select appropriate DC motor as well as to choose an appropriate method of Speed control for any industrial application		
4.0	To understand different types of Transformer construction, working principle and their performance	4.1	The students will be able to identify the transformer parameters from the equivalent circuit		
5.0	To analyze the various losses and efficiency taking place in DC Machines and transformers	5.1	The students will be able to evaluate the performance of DC machines and transformers		

UNIT I - BASIC CONCEPTS OF ROTATING MACHINES	**(9)**
Basics of magnetic circuit parameters -Principles of electro mechanical energy conversion- Single and multiple excited systems- Concepts of co-energy- Generated voltage- Torque in DC Machines.	
UNIT II - DC GENERATORS	**(9)**
Principle of operation-Constructional details- Emf equation- Methods of excitation- Self and separately excited generators- Characteristics of series, shunt and compound generators- Armature reaction and commutation- Parallel operation of DC shunt and compound generators – Applications.	
UNIT III - DC MOTORS	**(9)**
Principle of operation- Back emf and torque equation- Characteristics of series, shunt and compound motor- Starter- Starting methods- Speed control of DC shunt motors – Applications.	
UNIT IV -TRANSFORMERS	**(9)**
Constructional details of core and shell type transformers- Types of windings- Principle of operation- Emf equation- Transformer on no load- Parameters referred to HV/LV windings- Equivalent circuit- Transformer on load- Regulation- Parallel operation of single phase transformers-Construction and working of Auto transformer- Construction of three phase transformer.	
UNIT V -TESTING OF DC MACHINES AND TRANSFORMERS	**(9)**
Losses and efficiency in DC machines and transformers- Condition for maximum efficiency- Testing of DC machines- Brake test, Swinburne's test, Hopkinson's test- Testing of transformers- Polarity test, Load test, open circuit and short circuit tests- All day efficiency.	
TOTAL(L:45) = 45 PERIODS	

TEXT BOOKS:

1. P. S. Bimbhra, "Electric Machinery", Khanna Publishers, 2nd Edition, 2021.
2. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", New York, McGraw Hill Education, 6th Edition 2017.

REFERENCES:

1. I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 5th Edition, 2017.
2. H .Cotton, "Advanced Electrical Technology", CBS Publishers and distributors, 1967.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2	3	3	3	2	2	2	1	1	2	-	2	3	1
2	2	3	3	3	3	3	2	1	1	2	1	2	3	1
3	2	3	3	3	3	3	2	1	1	2	1	2	3	1
4	3	3	3	3	3	3	3	1	1	2	1	3	3	1
5	2	3	3	3	3	3	3	1	1	2	1	3	3	1
CO (w.A)	**2.2**	**3**	**3**	**3**	**2.8**	**2.8**	**2.4**	**1**	**1**	**2**	**0.8**	**2.4**	**3**	**1**

22EEC07 –ELECTROMAGNETIC FIELDS *(For EEE Branch only)*					
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**
PRE REQUISITE : NIL					
Course Objectives		**Course Outcomes**			
1.0	To understand basics of vector algebra and its applications.	1.1	The students will be able to Locate the position of a point in a given or its transformed coordinate system.		
2.0	To analyze fields a potential due to static charges.	2.1	The students will be able to Determine the electric field at a point due to a charge that is continuously distributed using Coulomb's law and Gauss's Law.		
3.0	To evaluate static magnetic fields.	3.1	The students will be able to Calculate energy associated with a magnetic field using the concepts of Biot-savart's law, Ampere's Circuit law and Magnetic flux density.		
4.0	To understand the relation between the fields under time varying situations.	4.1	The students will be able to emphasize the ideas about faradays laws, induced emf and their applications.		
5.0	To understand principles of propagation of uniform plane waves	5.1	The students will be able to Calculate the power associated with an Electromagnetic wave using the Poynting theorem and also summarize the sources of EMI and the control techniques to reduce EMI		

UNIT I -INTRODUCTION TO ELECTROMAGNETIC FIELDS	**(9)**
Sources and effects of electromagnetic fields – Introduction to vector algebra – Co-ordinate systems – Vector calculus: Gradient, divergence and curl – Divergence theorem – Stoke's theorem.	
UNIT II - ELECTROSTATICS	**(9)**
Coulombs law – Electric field intensity –Charge distribution – Electric Field due to straight conductor and circular disc – Electric flux density – Gauss's law and its applications –Electric Potential – Electric dipole – Boundary conditions at the interface of conductor and dielectric – Poisson's and laplace's equation – Capacitors.	
UNIT III - MAGNETOSTATICS	**(9)**
Biot-Savart's law – Ampere's circuital law –Magnetic flux and magnetic flux density – Scalar and vector magnetic potentials –Magnetic materials – Magnetic boundary conditions – Self and mutual inductance – Inductance of solenoid and toroid.	
UNIT IV - ELECTROMAGNETIC FIELDS	**(9)**
Time varying fields: Time Varying Fields – Transformer and Rotational EMF. Maxwell's equation: Maxwell's Equation in Point Form and Integral Form – Comparison of Circuit Theory with Field Theory. Electromagnetic Waves: Electromagnetic wave equation – Wave equation for free space – Poynting theorem – Standing wave ratio – Antenna and its types – Antenna measurements.	

UNIT V -ELECTROMAGNETIC INTERFERENCE & COMPATIBILITY (Qualitative analysis only)	(9)
Introduction to Electromagnetic Interference and Electromagnetic Compatibility (EMI & EMC) – Sources and Characteristics of EMI –Control Techniques of EMI – Grounding – Shielding – Filtering.	
TOTAL(L:45) = 45 PERIODS	

TEXT BOOKS:

1. Sadiku Matthew N.O., "Principles of Electromagnetics", 6th Edition, Oxford University Press, New Delhi, 2015.
2. Hayt Jr W.H., Buck J.A., Jaleel Akhtar M.," Engineering Electromagnetics " 9th Edition McGraw Hill Education, India, 2020.

REFERENCES:

1. Gottapu Sasibhushana Rao., "Electromagnetic Field Theory and Transmission Lines", 1st Edition, John Wiley and Sons, India, 2013
2. David J Griffith, "Introduction to Electrodynamics", Pearson Education, 4th ed., 2012.
3. Ashutosh Pramanik, "Electromagnetism – Theory and Applications", Prentice-Hall of India Private Limited, New Delhi, 2006.
4. Fawwaz. T.Ulaby, "Electromagnetics for Engineers", Pearson Education, 2005.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	3	3	3	2	3	2	1	2	1	1	2	3	2
2	3	3	3	3	2	2	3	1	2	-	1	2	3	2
3	3	3	2	3	1	3	2	1	2	-	-	2	3	2
4	3	3	3	3	1	2	1	1	2	-	-	2	3	2
5	3	3	3	3	2	3	2	1	2	1	2	2	3	2
CO (w.A)	**3**	**3**	**2.8**	**3**	**1.6**	**2.6**	**2**	**1**	**2**	**1**	**1**	**2**	**3**	**2**

22EEC08 –DIGITAL LOGIC CIRCUITS *(For EEE Branch only)*					
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**
PRE REQUISITE : NIL					
Course Objectives		**Course Outcomes**			
1.0	To educate about the fundamentals of Boolean functions	**1.1**	The students will be able to study number systems and to simplify the mathematical expressions using Boolean functions		
2.0	To motivate the students to design combinational logic circuits	**2.1**	The students will be able to design combinational logic circuits		
3.0	To make the student to understand about the concepts of synchronous circuits	**3.1**	The students will be able to analyze and design various synchronous circuits		
4.0	To encourage the students to implement asynchronous circuits	**4.1**	The students will be able to implement the asynchronous circuits		
5.0	To motivate the students to know about logic families	**5.1**	The students will be able to expose the concept of memory devices and logic families		

UNIT I - BOOLEAN ALGEBRA AND LOGIC CIRCUITS	**(9)**
Number systems-Binary arithmetic– Logic gates- Binary codes–Boolean algebra and theorems-Boolean functions– Canonical and standard forms -Simplifications of boolean functions using Karnaugh map and Quine Mc-Clusky methods.	
UNIT II - COMBINATIONAL LOGIC CIRCUITS AND ITS APPLICATIONS	**(9)**
Introduction- Adder and subtractor circuits – Code converters(Binary to Gray, Gray to Binary, Binary to BCD,BCD to Binary and BCD to Excess 3) - Decoders and encoders -Multiplexers and demultiplexers.	
UNIT III - SEQUENTIAL LOGIC CIRCUITS	**(9)**
Synchronous sequential circuits – Flip flops – Shift registers – Counters - Analysis and design Procedures - State reduction and state assignment.	
UNIT IV - ASYNCHRONOUS SEQUENTIAL LOGIC CIRCUITS	**(9)**
Introduction to asynchronous sequential circuits-Classification of Asynchronous Sequential circuit-Analysis and Design procedure-Reduction of state flow table-Hazards and Fault Detection -Race free statement.	
UNIT V -PROGRAMMABLE LOGIC DEVICES AND MEMORIES	**(9)**
Programmable logic devices: PLA, PAL, CPLD and FPGA –Memories: RAM organization, ROM organization, PROM, EPROM, EEPROM- Logic families: RTL, DTL and TTL logic.	
TOTAL (L:45) = 45 PERIODS	

TEXT BOOKS:

1. Morris Mano M.,"Digital Design with an Introduction to Verilog HDL, VHDL, and System Verilog", 6th Edition, Pearson, New Delhi,2018.

REFERENCES:

1. Charles H.Roth Jr , Larry L. Kinney, "Fundamentals of Logic Design" ,7th ed.,Thomson Learning, 2014.
2. Charles H. Roth, Jr.,Lizy Kurian John, "Digital System Design using VHDL", CL Engineering/Cengage Learning India ,2012.
3. Nripendra N Biswas, "Logic Design Theory", PHI Learning, 2010.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	2	3	3	2	3					1	2	1	3
2	3	2	3	3	2	2					1	2	1	3
3	2	3	2	3	1	3						2	2	3
4	3	3	3	3	1	2						2	1	2
5	3	3	3	3	2	3					2	2	1	3
CO (w.A)	**2.8**	**2.6**	**2.8**	**3**	**1.6**	**2.6**	**-**	**-**	**-**	**-**	**0.8**	**2**	**1.2**	**2.8**

22EEP02 - ELECTRONIC DEVICES AND CIRCUITS LABORATORY

(For EEE Branch only)

L	T	P	C
0	0	4	2

PRE REQUISITE : NIL

Course Objectives		Course Outcomes	
1.0	To provide fundamentals concepts of unipolar and bipolar devices.	**1.1**	The students will be able to build different characteristics of unipolar and bipolar devices
2.0	To understand and analyze the basic concepts of diode.	**2.1**	The students will be able to know the applications of Diode
3.0	To understand the concept of bipolar devices.	**3.1**	The students will be able to acquire knowledge about the various configuration of BJT
4.0	To get an insig ht into solution of single phase rectifiers.	**4.1**	The students will be able to build different types of rectifiers and filter circuits.
5.0	To understand the concept of unipolar devices and use of regulator.	**5.1**	The students will be able to attain information about regulators.

List of Experiments

1. Characteristics of PN Junction Diode.
2. Characteristics of Zener Diode.
3. Verification of Clipper and Clamper Circuits With its Characteristics.
4. Verify a Single Phase Half Wave & Full Wave Rectifiers With and Without Filters.
5. Verify a Shunt Voltage Regulator.
6. Characteristics of Common Emitter Configuration of transistor.
7. Characteristics of Common Base Configuration of transistor.
8. Characteristics of Common Collector Configuration of transistor.
9. Characteristics of JFET.
10. Characteristics of MOSFET.

ADDITIONAL EXPERIMENTS

1. Characteristics of PN Junction Diode using VLABS.
2. Wien bridge oscillator using VLABS.

TOTAL (P:60) = 60 PERIODS

Mapping of COs with POs / PSOs														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3	2	2	1	1	1	1	1	1	1	2	1	3	1
2	3	2	2	1	1	1	1	1	1	1	2	1	3	1
3	3	2	2	2	1	1	1	1	1	1	2	1	3	1
4	3	2	2	2	1	1	1	1	1	1	2	1	3	1
5	3	2	2	2	1	1	1	1	1	1	2	1	3	1
CO (w.A)	**3**	**2**	**2**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**1**	**3**	**1**

22EEP03 -ELECTRICAL MACHINES-I LABORATORY

(For EEE Branch only)

	L	T	P	C
	0	0	4	2

PRE REQUISITE : NIL

Course Objectives		Course Outcomes	
1.0	To get a basic practical knowledge on DC generators and DC motors	**1.1**	The students will be able to acquire knowledge on load characteristics of DC Generators and DC motors
2.0	To understand and analyze the uniqueness of each kind of DC machine	**2.1**	The students will be able to know the characteristics of the DC machines independently
3.0	To understand the concept of loads and speed control techniques	**3.1**	The students will be able to familiar to control and test the speed of DC motor under various loads
4.0	To get an insight into working and operation of a transformer under load condition	**4.1**	The students will be able to analyze the performance of single phase transformer under load condition
5.0	To understand the concept of withstanding capacity and rating of transformer using tests	**5.1**	The students will be able to understand the various tests performed on transformer to acquire its efficiency

LIST OF EXPERIMENTS

1. Open circuit characteristics of DC separately excited generator.
2. Load characteristics of DC compound generators with cumulative and differential connections.
3. Load characteristics of DC shunt motors.
4. Load characteristics of DC series motors.
5. Speed control of DC shunt motors.
6. Swinburne's test.
7. Load test on single phase transformer.
8. Open circuit and short circuit test on single phase transformer.
9. Parallel operation of single phase transformer.
10. Study of Scott connection of transformer.

ADDITIONAL EXPERIMENTS

1. Polarity test on single phase transformer.
2. Separation of no load losses in a single phase transformer.

TOTAL (P:60) = 60 PERIODS

Mapping of COs with POs / PSOs														
COs	**POs**												**PSOs**	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	2	3	2	2	3	2	1	2	1	-	3	3	-
2	2	3	3	3	2	3	2	1	2	1	-	2	3	-
3	2	3	3	3	2	3	2	1	2	1	-	2	3	-
4	2	3	3	3	2	3	2	1	2	2	-	2	3	-
5	3	3	2	3	2	2	2	2	2	1	-	3	3	-
CO (w.A)	**2.4**	**2.8**	**2.8**	**2.8**	**2**	**2.8**	**2**	**1.2**	**2**	**1.2**	**-**	**2.4**	**3**	**-**

G.8

22EEC09 -ELECTRICAL MACHINES-II *(For EEE Branch only)*					
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**
PRE REQUISITE : 22EEC06					
Course Objectives		**Course Outcomes**			
1.0	To impart knowledge on construction and performance of salient and non – salient type synchronous generators.	1.1	The students will be able to understand the construction and working principle of Synchronous generator.		
2.0	To impart knowledge on Principle of operation and performance of synchronous motor.	2.1	The students will be able to understand the construction and working principle of Synchronous Motor.		
3.0	To impart knowledge on construction, principle of operation and performance of induction machines	3.1	The students will be able to understand the construction and working principle of Three Phase Induction Motor.		
4.0	To impart knowledge on Starting and speed control of three-phase induction motors.	4.1	The students will be able to acquire knowledge about the starting and speed control of induction motors.		
5.0	To impart knowledge on Construction, principle of operation and performance of single phase induction motors and special machines	5.1	The students will be able to gain knowledge about the basic principles and working of Single phase induction motors and Special Electrical Machines.		

UNIT I – SYNCHRONOUS GENERATOR	**(9)**
Constructional details – Types of rotors – EMF equation – Synchronous reactance – Armature reaction – Voltage regulation – EMF, MMF and ZPF methods – Synchronizing and parallel operation – Synchronizing torque - Capability curves– Salient pole Machine: Two reaction theory – Determination of direct and quadrature axis synchronous reactance using slip test.	
UNIT II – SYNCHRONOUS MOTOR	**(9)**
Principle of operation – Procedure for starting - Starting methods – Different torques - Synchronization torque - Effect ofchange in torque - Effect of change in excitation - V and inverted V curves – Power input and power developed equations – Hunting – Applications.	
UNIT III – THREE PHASE INDUCTION MOTOR	**(9)**
Constructional details – Types of rotors –- Principle of operation – Slip – Equivalent circuit – Torque-Slip characteristics - Condition for maximum torque – Losses and efficiency – Load test - No load and blocked rotor tests - Circle diagram – Separation of losses – Applications.	
UNIT IV – STARTING AND SPEED CONTROL OF THREE PHASE INDUCTION MOTOR	**(9)**
Need for starting – Types of starters – DOL, Star delta, Autotransformer and Rotor resistance starters – Speed control – Voltage control, Frequency control and pole changing – Cascaded Connection-V/f control – Slip power recovery Scheme.	

UNIT V – SINGLE PHASE INDUCTION MOTORS AND SPECIAL MACHINES	(9)
Single Phase Induction Motor: Constructional details– Double field revolving theory and operation – Equivalent circuit – Starting methods - Capacitor start and capacitor start and run induction motor, Shaded pole induction motor. Special Machines- Repulsion motor - Servo motor – Switched Reluctance motor – Universal Motor – BLDC motor.	
TOTAL(L:45) = 45 PERIODS	

TEXT BOOKS:

1. A.E. Fitzgerald, Charles Kingsley, Stephen. D. Umans, 'Electric Machinery', Mc Graw Hill publishing Company Ltd, 6th Education 2017.
2. D.P. Kothari and I.J. Nagrath, 'Electric Machines', McGraw Hill Publishing Company Ltd, 5th Edition 2017.

REFERENCES:

1. B.R.Gupta, 'Fundamental of Electric Machines' New age International Publishers, 3rd Edition, Reprint 2015.
2. Murugesh Kumar, 'Electric Machines', Vikas Publishing House Pvt. Ltd, First edition 2010.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	3	1	1	1							1	3	2
2	3	3	1	1	1							1	3	2
3	3	3	1	1	1							1	3	2
4	3	3	1	1	1							1	3	1
5	3	3	1	1	1							1	3	-
CO (w.A)	3	3	1	1	1							**1**	**3**	**1**

22EEC10 –ANALOG INTEGRATED CIRCUITS *(For EEE Branch only)*					
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**
PRE REQUISITE : 22EEC05					
Course Objectives		**Course Outcomes**			
1.0	To provide in-depth instructions on the characteristics of operational amplifiers	1.1	The students will be able to impart knowledge on characteristics of OP-AMP		
2.0	To educate about basic operation using OP-AMP	2.1	The students will be able to acquire knowledge about basic operation using OP-AMP		
3.0	To learn about the application of OP-AMP	3.1	The students will be able to known about application OP-AMP		
4.0	To make the student to understand about unique IC	4.1	The students will be able to analyze and construct various application circuits using 555 timer.		
5.0	To learn about applications ICs	5.1	The students will be able to acquire knowledge about application ICs		

UNIT I – AMPLIFIER CHARACTERISTICS	**(9)**
Introduction-Advantages of negative feedback Amplifier – Voltage / current, series, Shunt feedback –Ideal OP -AMP characteristics -DC Performance - Bias currents, Offset currents, Offset voltage,AC characteristics - Frequency response, Slew rate.	
UNIT II – BASIC OPERATIONS USING OP-AMP	**(9)**
Differential amplifier–Inverting and Non-inverting Amplifiers - Voltage to current converter, current to voltage converter, differentiator and integrator, Summing, subtracting, averaging amplifier, Peak detector, Sample and hold circuit.	
UNIT III - APPLICATIONS OF OP-AMP	**(9)**
Instrumentation amplifier -Comparators – Multivibrators - Clippers – Clampers - D/A converter (R-2R ladder and weighted resistor types) - A/D converters using op amps.	
UNIT IV - SPECIAL ICS	**(9)**
Functional block, characteristics of Astable and Monostable multivibrators using 555 timers and its PWM application - IC566 voltage controlled oscillator- IC 565 phase locked loop IC.	
UNIT V - APPLICATION ICS	**(9)**
AD623 Instrumentation Amplifier and its application (load cell weight measurement)- IC voltage regulators – 78XX, 79XX, 317 Adjustable voltage regulators, 723 Precision voltage regulators.	
TOTAL(L:45) = 45 PERIODS	

TEXT BOOKS:
1. D. Roy Choudhury, Shail B. Jain, "Linear Integrated Circuits" , Fifth Edition New Age International,2018. 2. Ramakant A.Gayakward, "Op-amps and Linear Integrated Circuits", IV edition, Pearson Education, PHI 2021.
REFERENCES:
1. David A. Bell, 'Op-amp & Linear ICs', Oxford, Third Edition, 2011 2. Jacob Millman, Christos C.Halkias, 'Integrated Electronics - Analog and Digital circuits system', McGraw Hill, 2nd Edition, 2017.

Mapping of COs with POs / PSOs														
COs	**POs**												**PSOs**	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	3	3	2	1	1	1	1	1	1	2	2	3	1
2	3	3	3	1	1	1	1	1	1	1	2	2	3	1
3	3	2	3	1	1	1	1	1	1	1	2	2	3	1
4	3	3	3	2	1	1	1	1	1	1	2	2	3	1
5	3	3	3	2	1	1	1	1	1	1	2	2	3	1
CO (w.A)	**3**	**3**	**3**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**2**	**3**	**1**

22EEC11 - *POWER GENERATION, TRANSMISSION AND DISTRIBUTION* *(For EEE Branch only)*					
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**
PRE REQUISITE : 22EEC03					
Course Objectives		**Course Outcomes**			
1.0	To know the structure of electric power system and classifications of power generation.	1.1	The students will be able to understand the concepts of various conventional power generation systems.		
2.0	To impart knowledge on computation of transmission line parameters	2.1	The students will be able to estimate the line parameters for transmission line		
3.0	To obtain the equivalent circuits for the transmission lines based on distance and to determine voltage regulation and efficiency.	3.1	The students will be able to design electrical equivalent models and analyze the performance of transmission systems.		
4.0	To study the types, construction of cables and methods to improve the efficiency	4.1	The students will be able to calculate the sag of transmission line and predict voltage distribution in insulators		
5.0	To study about distribution systems, types of substations, methods of grounding.	5.1	The students will be able to explain about the importance of distribution of the electric power in power system.		

UNIT I – CLASSIFICATIONS OF POWER GENERATION	**(9)**
Structure of power system- Classification of power generation systems- Thermal, hydel, nuclear, wind and solar.	
UNIT II - TRANSMISSION LINE PARAMETERS	**(9)**
Parameters of single and three phase transmission lines with single circuits -Resistance, inductance and capacitance of solid, stranded and bundled conductors, Symmetrical and unsymmetrical spacing and transposition - Application of self and mutual GMD- Skin and proximity effects -Typical configurations, conductor types and electrical parameters of EHV lines	
UNIT III – MODELLING AND PERFORMANCE OF TRANSMISSION LINES	**(9)**
Performance of Transmission lines - Short line, medium line and long line - Equivalent circuits, phasor diagram, attenuation constant, phase constant, surge impedance - Transmission efficiency and voltage regulation, real and reactive power flow in lines – Ferranti effect - Formation of Corona	
UNIT IV – DESIGN OF OVERHEAD TRANSMISSION LINES	**(9)**
Design of OH lines – Line Supports –Types of towers – Stress and Sag Calculation – Effects of Wind and Ice loading. Insulators- Types, voltage distribution in insulator string, improvement of string efficiency. Comparison between overhead line and underground cables, types of underground cables and its construction.	

UNIT V - DISTRIBUTION SYSTEMS AND SUBSTATIONS	(9)
Distribution Systems: General Aspects – Kelvin's Law – DC 2-wire distributor – Radial and ring main distribution. Substations: Types of Substations - Key diagram of 11 kV/415 V substation, Methods of Grounding.	
TOTAL(L:45) = 45 PERIODS	

TEXT BOOKS:

1. D. P. Kothari, I. J. Nagrath, Power System Engineering, 2019, 3rd edition, McGraw Hill Education
2. CL Wadhwa, Electrical Power Systems, 2017,7th Edition, New Age publication
3. S.N. Singh, 'Electric Power Generation, Transmission and Distribution', Prentice Hall of India Pvt. Ltd, New Delhi, Second Edition, 2011.

REFERENCES:

1. Arun Ingole, "power transmission and distribution" Pearson Education, 2017.
2. G.Ramamurthy, "Handbook of Electrical power Distribution," Universities Press, 2013.
3. V.K.Mehta, Rohit Mehta, 'Principles of power system', S.Chand & Company Ltd, New Delhi, 2013.

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	3	3	3	2	3	2	1	2	2	1	3	3	2
2	3	3	3	3	2	3	2	1	2	1	1	3	3	2
3	3	3	3	3	2	3	2	1	2	1	1	3	3	2
4	3	3	3	3	2	3	2	1	2	1	1	3	3	2
5	3	3	3	3	2	3	2	3	2	2	2	3	3	2
CO (w.A)	**3.0**	**3.0**	**3.0**	**3.0**	**2.0**	**3.0**	**2**	**1.4**	**2**	**1.4**	**1.2**	**3.0**	**3.0**	**2.0**

22EEC12 – MEASUREMENTS AND INSTRUMENTATION *(For EEE Branch only)*					
		L	**T**	**P**	**C**
		3	**0**	**0**	**3**
PRE REQUISITE : NIL					
Course Objectives		**Course Outcomes**			
1.0	To educate the fundamental concepts and characteristics of measurement and errors	1.1	The students will be able to understand the fundamental art of measurement in engineering		
2.0	To assimilate the operating principle of various measuring instruments	2.1	The students will be able to apply their knowledge to measure electrical quantities using analog instruments		
3.0	To impart the importance of various bridge circuits used with measuring instruments.	3.1	The students will be able to measure resistance, inductance and capacitance using various bridge circuits.		
4.0	To perceive knowledge on the fundamental working of transducers and display devices	4.1	The students will be able to analyze and apply various transducers for measurement process		
5.0	To emphasize the need of digital instrumentation principles	5.1	The students will be able to understand the concept of digital instrumentation		

UNIT I – CHARACTERISTICS AND CONCEPTS OF MEASUREMENT	**(9)**
Instruments- Classification-applications -Elements of a generalized measurement system - Static and dynamic characteristics - Errors in measurement -Statistical evaluation of measurement data- Standards and calibration.	
UNIT II - MEASURING INSTRUMENTS	**(9)**
Classification of measuring instruments-Essential requirements of an instrument-Construction, working principle of PMMC, MI type instruments -Electro-dynamometer type Wattmeter-Energy Meter-Determination of B–H curve and measurement of iron loss- Instrument transformers (CT & PT).	
UNIT III – DC AND AC BRIDGES	**(9)**
DC Bridges: Wheatstone bridge, Kelvin bridge, Kelvin double bridge and their merits and demerits. AC Bridges: Maxwell bridge, Anderson bridge, Schering Bridge and their Merits and Demerits.	
UNIT IV – TRANSDUCERS AND DISPLAY DEVICES	**(9)**
Classification of transducers- Selection of transducers- Resistive (Thermistor & Thermocouple) , capacitive and Linear Variable Differential Transducer, Piezoelectric and Hall effect Transducer-Working principle of Analog CRO, LED and LCD.	
UNIT V – DIGITAL INSTRUMENTS & INTRODUCTION TO VIRTUAL INSTRUMENTATION	**(9)**
Comparison of analog and digital techniques-Digital voltmeter- Multimeters- Smart meters- Measurement of frequency and phase- A/D converters: types and characteristics – D/A converters: types and characteristics-DSO- Introduction to Virtual Instrumentation	
TOTAL(L:45) = 45 PERIODS	

TEXT BOOKS:
1. A.K. Sawhney, Puneet Sawhney 'A Course in Electrical & Electronic Measurements & Instrumentation', Dhanpat Rai and Co, New Delhi, 29th Edition 2021. 2. H.S. Kalsi, 'Electronic Instrumentation', Tata McGraw-Hill, New Delhi, 2010
REFERENCES:
1. David A. Bell, Electronic Instrumentation and Measurements, 2013, Oxford University Press 2. Jennings, Richard, and Fabiola De La Cueva. LabVIEW graphical programming, 2020, McGraw-Hill Education 3. E. O. Doebelin and D. N. Manik, "Measurement Systems – Application and Design", Tata McGraw-Hill, New Delhi, 6th Edition 2017.

Mapping of COs with POs / PSOs														
COs	**POs**												**PSOs**	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	2	2	1	3	1						3	3	2
2	3	2	3	2	2	1			2			2	3	2
3	3	2	3	2	3							2	3	3
4	3	3	3	2	2							1	3	2
5	3	3	3	2	3				2			3	3	3
CO (w.A)	**3**	**2**	**3**	**2**	**3**				**1**			**2**	**3**	**2**

22EEC13-MICROPROCESSOR & MICROCONTROLLER *(For EEE Branch only)*					
			L	**T**	**P**	**C**
			3	**0**	**0**	**3**
PRE REQUISITE : 22EEC08					
Course Objectives		**Course Outcomes**			
1.0	To impart knowledge on functional blocks and programming of 8085 Microprocessor	1.1	The students will be able to explain the architecture of 8085 Microprocessor		
2.0	To understand the concepts of 8051 architecture & instruction set of 8051.	2.1	The students will be able to develop skills in writing assembly language program		
3.0	To gain knowledge on microcontroller associated peripheral interface devices	3.1	The students will be able to recognize the knowledge on interfacing the external devices to the processor according to the user requirements		
4.0	To make the students understand ARM architecture	4.1	The students will be able to gain knowledge about architectures of RISC and ARM processor		
5.0	To convey the skills to know about PIC microcontroller	5.1	The students will be able to develop systems using PIC microcontroller		

UNIT I -8085 ARCHITECTURE INSTRUCTION SET AND PROGRAMMING	**(9)**
Functional block diagram-Interrupt Structure-Instruction format and addressing modes-Assembly language format-Data transfer, data manipulation and control instructions-Simple programming with 8085.	
UNIT II-8051 INSTRUCTION SET & PROGRAMMING	**(9)**
Functional block diagram-Instruction format and addressing modes-Interrupt structure-Timer-I/O Port-Serial Communication-Simple programming.	
UNIT III -APPLICATIONS OF 8051 MICROCONTROLLER	**(9)**
Interfacing LCD- Stepper motor control-Interfacing A/D converter- D/A Converter-DC Motor interfacing, sensor interfacing.	
UNIT IV-INTRODUCTION TO PIC MICROCONTROLLER	**(9)**
Introduction to PIC microcontrollers-Overview and features-PIC 16FXX architecture- Memory organization - Register File Structure-Timer module-CCP module – Addressing Modes-Classification of instructions.	
UNIT V - ARM ARCHITECTURE AND PROGRAMMING	**(9)**
Introduction to RISC processors-Comparison between CISC and RISC-Overview of 16XX ARM v7-Features-Pin Configuration-Architecture-Register configuration and instruction set.	
TOTAL(L:45) = 45 PERIODS	

TEXT BOOKS:

1. Muhammad Ali Mazidi & Janice Gilli Mazidi, R.D.Kinely 'The 8051 Micro Controller and Embedded Systems', PHI Pearson Education, 5th Indian reprint, 2003.
2. R. S. Gaonkar, ", Microprocessor Architecture: Programming and Applications with the 8085", Penram International Publishing, 1996
3. Peatman,J.B., Design with PIC Micro Controllers PearsonEducation,3rdEdition, 2004
4. Jonathan W Valvano Introduction to Am(r) Cortex-M Microcontrollers Createspace Independent Publisher 2012

REFERENCES:

1. Krishna Kant, "Microprocessor and Microcontrollers", Eastern Company Edition, Prentice Hall of India, New Delhi, 2007.
2. Subrata Ghoshal, "8051 Microcontrollers, 2/e: Internals, Instructions, Programming &Interfacing", 2nd Edition,Pearson Education, 2014

Mapping of COs with POs / PSOs

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2	1	2	3	1					1	1	3	3	2
2	2	1	2	3	2					1	1	2	3	2
3	2	1	2	3	2					2	2	2	3	3
4	2	2	2	3	1					1	1	1	3	2
5	2	1	2	3	2					1	1	3	3	3
CO (w.A)	**2**	**1**	**2**	**3**	**2**					**1**	**1**	**2**	**3**	**2**

22EEP04 -ELECTRICAL MACHINES-II LABORATORY

(For EEE Branch only)

L	T	P	C
0	0	4	2

PRE REQUISITE : 22EEP03

	Course Objectives		Course Outcomes
1.0	To expose the students to the operation of synchronous generator non-salient pole type and give them experimental skill.	**1.1**	Students will be able to understand and analyze EMF and MMF methods.
2.0	To expose the students to the operation of synchronous generator salient pole type and give them experimental skill.	**2.1**	Students will be able to acquire hands on experience of conducting various tests on alternators and obtaining their performance indices using standard analytical as well as graphical methods. to understand the importance of Synchronous machines.
3.0	To expose the students to the operation of synchronous motor and give them experimental skill.	**3.1**	Students will be able to analyze the characteristics of V and Inverted V curves
4.0	To expose the students to the operation of thee phase induction motors and gives them experimental skill.	**4.1**	Students will be able to acquire hands on experience of conducting various tests on alternators and obtaining their performance indices using standard analytical as well as graphical methods. to understand the importance of single and three phase Induction motors
5.0	To expose the students to the operation of single phase induction motors and gives them experimental skill.	**5.1**	Students will be able to acquire knowledge on separation of losses

LIST OF EXPERIMENTS

1. Regulation of Alternator by EMF and MMF Methods.
2. Regulation of Alternator by ZPF Method.
3. Regulation of Salient Pole Alternator.
4. Load Test on three phase alternator.
5. V and inverted V curve of three phase synchronous motor.
6. Load Test on three phase induction motor.
7. Performance evaluation of three phase induction motor from circle diagram.
8. Separation of no load losses of three phase induction motor.
9. Load Test on single phase induction motors.
10. No load and blocked rotor test on single-phase induction motor.

ADDITIONAL EXPERIMENTS

1. Synchronization of alternators by using dark and bright lamp method.
2. Study of Induction Motor Starters.

TOTAL (P:60) = 60 PERIODS

Mapping of COs with POs / PSOs														
COs	**POs**												**PSOs**	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	3	1	1					1			3	3	2
2	3	3	1	1					1			3	3	2
3	3	3	1	1					1			3	3	2
4	3	3	1	1					1			3	3	2
5	3	3	1	1					1			3	3	2
CO (w.A)	3	3	1	1					1			**3**	**3**	**2**

22EEP05- ANALOG AND DIGITAL INTEGRATED CIRCUITS LABORATORY
(For EEE Branch only)

	L	T	P	C
	0	0	4	2

PRE REQUISITE : 22EEP02

Course Objectives		Course Outcomes	
1.0	To implement the basic circuits using OP-AMP.	**1.1**	The students will be able to analyze about the characteristics of OP-AMP
2.0	To implement the timer IC application.	**2.1**	The students will be able to know the applications of OP-AMP and 555 IC
3.0	To verify the expressions using Boolean functions	**3.1**	The students will be able to acquire knowledge about the various types of logic gates
4.0	To verify the Combinational circuits	**4.1**	The students will be able to understand about the code converters
5.0	To understand the concept of conversions in various applications.	**5.1**	The students will be able to acquire knowledge about checker and generator

LIST OF EXPERIMENTS

1. Implementation of Inverting and Non-Inverting amplifier using OP-AMP.
2. Implementation of Differentiator and integrator using OP-AMP.
3. Implementation of Monostable multivibrator using 555 IC.
4. Implementation of Astable multivibrator using 555 IC.
5. Verification of logic gates.
6. Verification of Half subtractor and Half adder.
7. Verification of binary to gray code and gray to binary code converter.
8. Verification of Multiplexer and Demultiplexer.
9. Verification of encoder and decoder.
10. Verification of Parity checker and Parity generator.

ADDITIONAL EXPERIMENTS

1. Design and implementation of precision rectifier using op-amp
2. Design and implementation of triangular wave generator using op-amp

TOTAL (P:60) = 60 PERIODS

Mapping of COs with POs / PSOs														
COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	3	3	3	2	-	1	1	1	1	-	2	2	2	1
2	3	3	3	1	-	1	1	1	1	-	2	2	2	1
3	3	2	3	1	-	1	1	1	1	-	2	2	2	1
4	3	3	3	2	-	1	1	1	1	-	2	2	2	1
5	3	3	3	2	-	1	1	1	1	-	2	2	2	1
CO	**3**	**3**	**3**	**2**	**-**	**1**	**1**	**1**	**1**	**-**	**2**	**2**	**2**	**1**

22EEP06- MICROPROCESSORS AND MICROCONTROLLERS LABORATORY
(For EEE Branch only)

	L	T	P	C
	0	0	4	2

PRE REQUISITE : NIL

Course Objectives		Course Outcomes	
1.0	To understand the basic programming of Microprocessor and microcontroller.	**1.1**	The students will be able to apply fundamental of assembly language programming for microprocessor and microcontroller
2.0	To inscribe the interfacing of assembly language programs	**2.1**	The students will be able to apply computing platform for various engineering applications
3.0	To provide solid foundation on interfacing the external devices to the processor according to the user requirements	**3.1**	The students will be able to work with standard microcontroller real time interfaces including stepper motor, LED
4.0	To familiarize and develop programs for ARM and PIC	**4.1**	The students will be able to design circuits for various applications using microcontroller and microprocessor
5.0	To develop the quality of analyzing and assessing obtained data	**5.1**	The students will be able to demonstrate the basic instructions with processor and controller based on its architecture and instruction set

LIST OF EXPERIMENTS

1. Simple arithmetic operations: multiplication, division using 8085.
2. Traffic Light Controller using 8085.
3. Displaying a moving/rolling message in the trainer kit's output using 8085.
4. Simple arithmetic operations: multiplication, division using 8051.
5. Interfacing of Stepper Motor using 8051.
6. Flashing of LED using ARM.
7. Simple arithmetic operations: Addition/Subtraction using PIC and ARM
8. Analog to Digital conversion using PIC Microcontroller.

ADDITIONAL EXPERIMENTS

1. Interfacing of keypad and LCD using PIC 16FXX for Security System.
2. Implementing zigbee protocol using ARM.

TOTAL (P:60) = 60 PERIODS

Mapping of COs with POs / PSOs														
COs	**POs**												**PSOs**	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2	1	2	3								3	3	2
2	2	1	2	3								2	3	2
3	2	1	2	3								2	3	3
4	2	2	2	3								1	3	2
CO (w.A)	**2**	**1**	**2**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**3**	**2**