_SCHEME OF INSTRUCTION AND EVALUATION

M.E. - Power Electronic Systems

S. No.	Type of course	Course Code	Course Name	Contact hours per week		Scheme of Examination		Credits
				L	P	CIE	SEE	
	SEMESTER-I							
1	Core-I	**EE 102**	Power Electronic Converters	3	-	40	60	3
2	Core-II	**EE 113**	Hybrid Electric Vehicles	3	-	40	60	3
3	Core-III	**EE 124**	Digital Control of Power Electronics	3	-	40	60	3
4	Programme Elective - I	**EE 111**	Special Electrical Machines	3	-	40	60	3
		EE112	Programmable Logic Controllers					
		EE 213	Power Quality Engineering					
5	Programme Elective - II	**EE 121**	Reliability Engineering	3	-	40	60	3
		EE 122	Digital Signal Processing					
		EE 123	Industrial Controllers					
6	Programme Elective - III	**EE 131**	Soft Computing Techniques in Electrical Engineering	3	-	40	60	3
		EE 132	Advanced Optimization Techniques					
		EE 133	Python Programming					
7	Laboratory - I	**EE 361**	Power Electronic System Laboratory - I	-	2	50	-	1
8	Seminar - I	**EE 371**	Seminar - I	-	2	50	-	1
	TOTAL			**18**	**4**	**340**	**360**	**20**

	SEMESTER-II							
1	Core-IV	**EE304**	Advanced Topics in Power Electronics	3	-	40	60	3
2	Core-V	**EE144**	Power Electronic Converters for Renewable Energy	3	-	40	60	3
3	Core-VI	**EE105**	Static Control Of A.C. Drives	3	-	40	60	3
4	Programme Elective-IV	**EE 141**	Modern Control Theory	3	-	40	60	3
		EE 142	Smart Grid Systems					
		EE 143	Grid Integration of Distributed Generation					
		EE 344	Industrial Electronic Systems					
5	Program Elective-V	**EE 151**	Power Electronic Applications to Power Systems	3	-	40	60	3
		EE 152	Digital Circuits and Logic Design					
		EE 153	Battery Management Systems and Charging Stations					
6	Open Elective	**OE 941 BM**	Medical Assistive Devices	3	-	40	60	3
		OE 942 BM	Medical Imaging Techniques					
		OE 941 CE	Green Building Technology					
		OE 942 CE	Cost Management of Engineering Projects					
		OE 941 CS	Business Analytics					
		OE 941 EC	Elements of Embedded Systems					
		OE 941 EE	Waste to Energy					
		OE 942 EE	Power Plant Control and Instrumentation					
		OE 941 ME	Operations Research					
		OE 942 ME	Composite Materials					
		OE 943 ME	Industrial Safety					

		OE 941 LA	Intellectual Property Rights					
7	Mini Project	**EE 372**	Mini Project	-	4	50		2
8	Laboratory - II	**EE 362**	Power Electronic system Laboratory - II	-	2	50	-	1
9	Laboratory - III	**EE 363**	Power Electronic system Laboratory - III	-	2	50	-	1
	TOTAL			**18**	**08**	**390**	**360**	**22**
	SEMESTER-III							
1	Audit Course – I (Online)	**AC030EE**	Engineering Research Methodology in Electrical Engineering	2	-	40	60	NC
2	Audit Course – II (Online)	**AC031**	English for Academic Research Writing	2	-	40	60	NC
		AC032	Disaster Mitigation & Management					
		AC033	Sanskrit for Technical Knowledge					
		AC034	Value Education					
		AC035	Stress Management by Yoga					
		AC036	Personality Development Through Life Enlightenment Skills					
		AC037	Constitution of India					
		AC038	Pedagogy Studies					
3		**EE381**	Major Project Phase – I Dissertation	-	20*	100		10
	TOTAL			**4**	**20**	**180**	**120**	**10**
	SEMESTER-IV							
1		**EE382**	Major Project Phase – II Dissertation	-	32*	100	100	16
	TOTAL			**40**	**64**	**1010**	**940**	**68**

S. No.	Type of course	Course Code	Course Name	Contact hours per week		Scheme of Examination		Credits
				L	P	CIE	SEE	
	SEMESTER-I							
1	Core-I	**EE 102**	Power Electronic Converters	3	-	40	60	3
2	Core-II	**EE 113**	Hybrid Electric Vehicles	3	-	40	60	3
3	Core-III	**EE 124**	Digital Control of Power Electronics	3	-	40	60	3
4	Programme Elective - I	**EE 111**	Special Electrical Machines	3	-	40	60	3
		EE112	Programmable Logic Controllers					
		EE 213	Power Quality Engineering					
5	Programme Elective - II	**EE 121**	Reliability Engineering	3	-	40	60	3
		EE 122	Digital Signal Processing					
		EE 123	Industrial Controllers					
6	Programme Elective - III	**EE 131**	Soft Computing Techniques in Electrical Engineering	3	-	40	60	3
		EE 132	Advanced Optimization Techniques					
		EE 133	Python Programming					
7	Laboratory - I	**EE 361**	Power Electronic System Laboratory - I	-	3	50	-	1.5
8	Seminar - I	**EE 371**	Seminar - I	-	3	50	-	1.5
	TOTAL			**18**	**5**	**340**	**360**	**21**

Course Code	POWER ELECTRONIC CONVERTERS						Course Type Core/PF/FE
EE102							core
Prerequisite if any:	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	3	-	-	3	40	60	3

Course Objectives

- To get insight into power semiconductor switching devices, switching characteristics and the concept of power electronic converters.
- To prepare the students for acquiring the knowledge of different types of power semiconductor devices, rectifier circuits, switched mode converters and pulse width modulated inverters.
- To develop the ability to comprehend, analyze, design various types of switched mode DC-DC converters and pulse width modulated inverters used in variable speed drives

Course Outcomes

After the completion of this course, students will be able to:

1. Select an appropriate power semiconductor device and design a power converter for the required application.
2. Select and design power electronic converters for broad range of energy conversion applications.
3. Design the control circuit and the power circuit for a given power converter.
4. Use power electronic simulation tools for analyzing and designing power electronic converter circuits.
5. Experimentally evaluate the performance of power electronic conversion systems for different types of electrical applications.

Course Articulation Matrix:

Course outcome	Programme outcome					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	3	3	2	2
CO2	3	-	3	3	2	2
CO3	3	-	3	3	2	2
CO4	3	-	3	3	2	2
CO5	3	-	3	3	2	2

UNIT-I

Power Switching Devices – Characteristics: Classification of switches-ideal switches and real switches; Practical power switching devices-uncontrolled switches, semi controlled switches and fully controlled switches; Power diodes, Thyristors, Power transistors - Power BJT, MOSFETS, IGBT static and dynamic characteristics and their applications; Firing circuit for thyristor; Voltage and current commutation of a thyristor; Gate drive circuits for MOSFET and IGBT.

UNIT-II

Rectifiers: Line commutated rectifiers-Diode and Thyristor Rectifiers-Single-phase half-wave, full-wave and semi controlled rectifiers with R-load and highly inductive load; Three-phase half-wave, full-wave and semi controlled bridge thyristor rectifier with R-load and highly inductive load; Input current wave shape and power factor.

PWM rectifiers- Single-phase PWM rectifiers, bridge-connected PWM rectifier: voltage-doubler PWM rectifier, three-phase voltage source PWM rectifier.

UNIT-III

DC-DC Converters: Elementary chopper with an active switch and diode, concepts of duty ratio and average voltage across an inductorand average current through a capacitor operating in periodic steady state, power circuit and operation of buck, boost, buck-boost, flyback, forward, push-pull, half-bridge and full-bridge converters in continuous conduction mode, duty ratio control of output voltage.

AC-AC Converter: Power circuit and operation of single-phase AC Voltage Controller with R & RL Load. Basic concepts of Cycloconverter and Matrix converter.

UNIT-IV

Single-phase inverter: Power circuit and operation of single-phase voltage source inverter in square wave mode, sinusoidal pulse width modulation (unipolar and bi-polar), relation between modulation index and output voltage. Calculation of performance parameters of inverter.

UNIT-V

Three-phase inverter: Power circuit and operation of three-phase voltage source inverter in 180^0 and 120^0 modes, Uni-polar sinusoidal pulse width modulation, relation between modulation index and output voltage and Space vector modulation technique; Elementary operation of CSI, comparison of voltage source inverter and current source inverter.

References

1. N. Mohan and T. M. Undeland, “Power Electronics: Converters, Applications and Design”, John Wiley & Sons, 2007.
2. R. W. Erickson and D. Maksimovic, “Fundamentals of Power Electronics”, Springer Science & Business Media, 2007.
3. L. Umanand, “Power Electronics: Essentials and Applications”, Wiley India, 2009.
4. Dr. P.S. Bhimbra, " Power Electronics", Khanna Publishers, 2009.
5. M. H. Rashid, “*Power electronics: circuits, devices, and applications*”, Pearson Education India, 2017.

Course Code	HYBRID ELECTRICAL VEHICLES						Course Type Core/PF/FE
EE113							core
Prerequisite if any:	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	3	-	-	3	40	60	3

Course Objectives

- To understand the basics of electric and hybrid electric vehicles and their working
- To understand the basics of batteries and their role for electric/hybrid vehicle applications
- To obtain the knowledge of various types of electric/hybrid vehicles
- To understand the real time challenges in the implementation of this technology

Course Outcomes

After the completion of this course, the students shall be able to:

1. Understand basics of electric and hybrid electric vehicles both conceptually and mathematically so that clear understanding from basics physics is achieved.
2. Have the knowledge of battery behavior for electric vehicle application.
3. Understand different types of Electric/Hybrid vehicles technologies available and their applications.
4. Analyze challenges in implementing electric/hybrid vehicle technology by looking into various charging topologies and their impact on distribution systems.
5. Analyze various electric drives suitable for hybrid electric vehicles.

Course Articulation Matrix:

Course outcome	Programme outcome					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	3	-	-	2
CO2	3	-	3	-	-	2
CO3	3	-	3	2	-	2
CO4	3	-	3	2	-	2
CO5	3	-	3	2	-	2

UNIT I

Introduction to Electric Vehicles: Sustainable Transportation - EV System – EV - Advantages - Vehicle Mechanics - Performance of EVs - Electric Vehicle drivetrain - EV Transmission Configurations and components-Tractive Effort in Normal Driving - Energy Consumption - EV Market - Types of Electric Vehicle in Use Today – Electric Vehicles for the Future.

UNIT II

Electric Vehicle Modelling - Consideration of Rolling Resistance – Transmission Efficiency - Consideration of Vehicle Mass - Tractive Effort - Modelling Vehicle Acceleration - Modelling Electric Vehicle Range -Aerodynamic Considerations - Ideal Gearbox Steady State Model - EV Motor Sizing - General Issues in Design.

UNIT III

Introduction to electric vehicle batteries - electric vehicle battery efficiency – electric vehicle battery capacity - electric vehicle battery charging - electric vehicle battery fast charging - electric vehicle battery discharging - electric vehicle battery performance – testing.

UNIT IV

Hybrid Electric Vehicles - HEV Fundamentals -Architectures of HEVs- Interdisciplinary Nature of HEVs - State of the Art of HEVs - Advantages and Disadvantages - Challenges and Key Technology of HEVs - Concept of Hybridization of the Automobile-Plug-in Hybrid Electric Vehicles - Design and Control Principles of Plug-In Hybrid Electric Vehicles - Fuel Cell Hybrid Electric Drive Train Design - HEV Applications for Military Vehicles.

UNIT V

Advanced Topics - Battery Charger Topologies, Charging Power Levels, and Infrastructure for Plug-In Electric and Hybrid Vehicles - The Impact of Plug-in Hybrid Electric Vehicles on Distribution Networks – Sizing Ultra capacitors for Hybrid Electric Vehicles.

References

1. Modern Electric, Hybrid Electric and Fuel Cell Vehicles –Fundamentals, Theory and Design – Mehrdad Ehsani, UiminGao and Ali Emadi - Second Edition - CRC Press, 2010.
2. Electric Vehicle Technology Explained - James Larminie, John Lowry – John Wiley & Sons Ltd, - 2003.
3. Electric Vehicle Battery Systems – Sandeep Dhameja – Newnes - 2002.
4. Hybrid electric Vehicles Principles and applications with practical perspectives Chris Mi, Dearborn - M. AbulMasrur, David WenzhongGao - A John Wiley & Sons, Ltd., - 2011.
5. Electric & Hybrid Vehicles – Design Fundamentals-IqbalHussain, SecondEdition, CRC Press, 2011.
6. Research Papers:

a. The Impact of Plug-in Hybrid Electric Vehicles on Distribution Networks: a Review and Outlook - Robert C. Green II, Lingfeng Wang andMansoorAlam - 2010 IEEE.

b. Sizing Ultracapacitors For Hybrid Electric Vehicles - H. Douglas P Pillay 2005 IEEE.

Course Code	DIGITAL CONTROL OF POWER ELECTRONICS						Course Type Core/PF/FE
EE124							core
Prerequisite if any:	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	3	-	-	3	40	60	3

Course Objectives

- To understand the concept of architecture and peripheral modules of microcontroller, digital signal processors and field programmable gate arrays
- To prepare the students for acquiring the knowledge of Implementing digital processor-based control systems for power electronics
- To know the use of microcontrollers for pulse generation in power converters
- To know the use of field programmable gate arrays for pulse generation in power converters

Course Outcomes

After the completion of this course, students will be able to:

1. Acquire knowledge in CPU details, addressing modes, interrupt structure, hardware multiplier
2. Implement numerical integration methods using digital processor-based control systems.
3. Design interfacing applications based on internal peripheral units of PIC microcontrollers and programming them using MPLAB and PICSTART plus
4. Write programs using DSP and FPGA boards
5. Implement DSP-based electromechanical motion control.

Course Articulation Matrix:

Course outcome	Programme outcome					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	3	2	-	2
CO2	3	-	3	2	-	2
CO3	3	-	3	2	2	2
CO4	3	-	3	2	2	2
CO5	3	-	3	2	2	2

UNIT I

Review of microcontrollers, digital signal processors, architecture and Field Programmable Gate Arrays, Data Representation Integers, Fixed and Floating-point numbers, and Characters. PIC Microcontrollers: Overview of PIC family, PIC Architecture, PIC Assembly Language Programming, RISC Architecture in PIC, Introduction to MPLAB IDE and PICSTART plus – Device Programming using MPLAB and PICSTART plus – generation of firing / gating pulses for typical power converters.

UNIT II

Introduction to the C2xx DSP core and code generation, The components of the C2xx DSP core, Mapping external devices to the C2xx core, peripherals and Peripheral Interface, System configuration registers, Memory, Types of Physical Memory, memory Addressing Modes, Assembly Programming using C2xx DSP, Instruction Set, Software Tools. Pin Multiplexing (MUX) and General Purpose I/O Overview, Multiplexing and General Purpose I/O Control Registers.

UNIT III

Enhanced Pulse Width Modulator (ePWM) Module-Time-Base (TB) Submodule, Counter-Compare (CC) Submodule, Action-Qualifier (AQ) Submodule, Dead-Band Generator (DB) Submodule, PWM-Chopper (PC) Submodule, Trip-Zone (TZ) Submodule, Event-Trigger (ET) Submodule, Applications to Power Topologies-Overview of Multiple Modules, Key Configuration Capabilities, Controlling Multiple Buck Converters With Independent Frequencies, Controlling Multiple Buck Converters With Same Frequencies, Controlling Multiple Half H-Bridge (HHB) Converters ,Controlling Dual 3-Phase Inverters for Motors (ACI and PMSM), Practical Applications Using Phase Control Between PWM Modules, Controlling a 3-Phase Interleaved DC/DC Converter, Controlling Zero Voltage Switched Full Bridge (ZVSFB) Converter.

UNIT IV

Analog-to-Digital Converter (ADC)- ADC Overview, Operation of the ADC, Auto conversion Sequencer Principle of Operation-Sequential Sampling Mode, Simultaneous Sampling Mode, Uninterrupted Auto sequenced Mode, ADC Clock Prescaler, ADC Registers.

UNIT V

Introduction to Field Programmable Gate Arrays – CPLD Vs FPGA – Types of FPGA, Xilinx XC3000 series, Configurable logic Blocks (CLB), Input/Output Block (IOB) – Programmable Interconnect Point (PIP) – Xilinx 4000 series – HDL programming – overview of Spartan 3E and Virtex II pro FPGA boards- case study.

References

1. PIC16F87X Datasheet 28/40 – pin 8 bit CMOS flash Microcontrollers, Microchip technology Inc., 2001. and MPLAB IDE Quick start guide, Microchip technology Inc., 2007
2. John B. Peatman, ‘Design with PIC Microcontrollers’, Prentice Hall, 2003.
3. MykePredko, ‘Programming and customizing the PIC Microcontroller’ Tata McGraw-Hill, 3rd Edition, 2008.
4. Hamid.A.Toliyat and Steven G.Campbell “DSP Based Electro Mechanical Motion Control“ CRC Press New York , 2004
5. XC 3000 series datasheets (version 3.1). Xilinx,Inc.,USA, 1998
6. XC 4000 series datasheets (version 1.6). Xilinx,Inc.,USA, 1999
7. D Wayne Wolf,” FPGA based system design “, Prentice hall, 2004

Course Code	SPECIAL ELECTRICAL MACHINES						Course Type Core/PF/FE
EE111							elective
Prerequisite	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	3	-	-	3	40	60	3

Course Objectives

- To understand the concepts and control strategies of permanent magnet synchronous motors and Brushless DC motors.
- To study the operating principles and control methods of switched reluctance motors.
- To introduce the concepts and control of different types of stepper motors and its applications.
- To analyze the working of linear induction and linear synchronous machines

Course Outcomes

After the completion of this course, the students shall be able to:

1. Optimally design magnetics required in special machines-based drive systems.
2. Develop new control strategies open and closed loop control for different types of special machines.
3. Design and conduct experiments towards research and to solve practical problems
4. Develop and analysis of the controllers for special electrical machine.
5. Analyze and Design Power converters and control techniques for control of special machines.

***Matrix* Course Articulation Matrix:**

Course outcome	Programme outcome					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	3	-	-	2
CO2	3	-	3	-	-	2
CO3	3	-	3	-	3	2
CO4	3	-	3	-	3	2
CO5	3	-	3	-	-	2

UNIT I

Stepper Motors: Constructional features, Principle of operation, Variable Reluctance (VR) stepping motor-Single Stack, Multi-Stack, Permanent Magnet Step motor, Hybrid Step Motor, Torque Equation Open Loop Drive, Open loop and closed loop control of Step Motor, Applications.

UNIT II

Switched Reluctance Motors: Constructional features, Principle of Operation, Torque equation, Torque-speed characteristics, Power Converter for SR Motor-Asymmetrical converter, DC Split converter, Control of SRM, Rotor Position sensors, Current Controllers, Applications.

UNIT III

***Permanent Magnet Synchronous Motor*:** Permanent magnets and their characteristics, Machine Configurations-SPM, SIPM, IPM and Interior PM with circumferential, Sensorless control, Applications.

UNIT IV

Brushless DC Motor: Construction, Principle of Drive operation with inverter, Torque speed Characteristics, Closed loop control, Sensorless control, Applications.

UNIT V

***Linear Induction Motors and Linear Synchronous Motors*:** Linear induction motor, Construction details, LIM Equivalent Circuit, Steps in design of LIM, Linear Synchronous Motor: Principle and Types of LSM, LSM Control, Applications.

References

1. R.Krishnan, *Electric Motor Drives*, Pearson, 2007
2. B.K.Bose, *Modern Power Electronics and AC Drives*, PHI, 2005
3. Venkataratnam, *Special electrical Machines*, University Press, 2008
4. E.G.Janardanan, *Special Electrical Machines*, PHI, 2014
5. T.J.E.Miller, *Brushless Permanent Magnet and Reluctance Motor Drive*, Clarendon Press, Oxford, 1989

Course Code	PROGRAMMABLE LOGIC CONTROLLERS						Course Type Core/PF/FE
EE112							elective
Prerequisite if any:	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	3	-	-	3	40	60	3

Course Objectives

- To provide the knowledge of different components used in PLCs such as processor, input/output devices and programmer monitors
- To make the students thorough with ladder programming of PLC.
- To train them how to use timer, counter, register, arithmetic and different conversion systems.
- To give awareness about application of different PLC features in Process control industry and different data handling functions of PLC.

Course Outcomes After the completion of this course, the students shall be able to:

1. Understand different components of PLC.
2. Construct ladder diagrams for different industry applications.
3. Deal with applications like timer/counter, registers etc.
4. Understand the utility of different features of PLC in process industry.
5. Use data handling function in PLC programming.

Course Articulation Matrix:

Course outcome	Programme outcome					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	3	-	-	1
CO2	3	-	3	-	-	1
CO3	3	-	3	-	-	1
CO4	3	-	3	-	-	1
CO5	3	-	3	-	-	1

UNIT I

PLC Basics: Definition and History of PLC - PLC advantages and disadvantages - Over all PLC Systems - CPUs and Programmer Monitors - PLC input and output models - Printing PLC Information- Programming Procedures – Programming Equipment - Programming Formats- Proper Construction of PLC Diagrams – Devices to which PLC input and output modules are connected - Input on/off switching devices - Input analog devices - Output analog on/off devices and output analog devices.

UNIT II

Basic PLC Programming: Programming on/off inputs to produce on/off outputs - PLC input instructions - Outputs - Operational procedures - Contact and coil input/output programming examples - Relation of digital gate logic contact / coil logic - PLC programming and conversion examples - Creating ladder diagrams from process control descriptions - Sequence listings - Large process ladder diagram constructions.

UNIT III

Basic PLC Functions: General Characteristics of Registers - Module addressing - Holding registers - Input registers - output registers - PLC timer functions – examples of timer functions. Industrial applications - PLC counter functions.

UNIT IV

Intermediate Functions: PLC Arithmetic functions - PLC additions and subtractions - The PLC repetitive clock - PLC Multiplications, Division and Square Root – PLC trigonometric and log functions - Other PLC arithmetic functions - PLC number comparison functions. PLC basic comparison functions and applications – Numbering systems and number conversion functions - PLC conversion between decimal and BCD-Hexadecimals numbering systems.

UNIT V

***Data Handling Functions*:** The PLC skip and master control relay functions – Jump functions - Jump with non return - Jump with return. PLC data move Systems – The PLC functions and applications. PLC functions working with bits - PLC digital bit functions and applications - PLC sequence functions - PLC matrix functions.

References

1. John W. Weff, Ronald A. Reis, *Programmable Logic Controllers*, Prentice Hall of India Private Limited, Fifth edition, 2003.

Course Code	POWER QUALITY ENGINEERING						Course Type Core/PF/FE
EE213							elective
Prerequisite if any	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	3	-	-	3	40	60	3

Course Objectives

- The importance of power quality, different power quality issues and their effects in power system network.
- Different Methods of calculating the voltage sag magnitude and duration
- Understand the types of sags and characterize the voltage sags experienced by machines
- Know harmonics, locate sources of harmonics and mitigate harmonics
- Fundamental understanding of measuring equipment and assessment of PQ measuring data

Course Outcomes

After the completion of this course, the students shall be able to:

1. Understand the significance of power quality study and identify various power quality disturbances.
2. Write algorithms to calculate voltage sags magnitude and duration in power system.
3. Demonstrate the effect and analyze the characteristics of voltage sags experienced by ASDs.
4. Evaluate THD and mitigate harmonics in distribution system
5. Operate and use PQ measuring equipment for assessment of data

Course Articulation Matrix:

Course outcome	Programme outcome					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	3	-	2	3
CO2	3	-	3	-	2	3
CO3	3	-	3	-	2	3
CO4	3	-	3	-	2	3
CO5	3	-	3	-	2	3

UNIT I

Introduction: Power Quality (PQ), PQ problems, Sags, Swells, Transients, Harmonics, Interruptions, Flicker, Voltage fluctuations, Notch, Transient Overvoltages – Sources of Transient Over voltages. Wiring and Grounding: Resources, Definitions, Reasons for Grounding, Typical wiring and grounding problems, Solutions to wiring and grounding problems.

UNIT II

Voltage Sag Analysis: Voltage sag characteristics - Methodology for computation of voltage sag magnitude and occurrence, Accuracy of sag analysis, Duration & frequency of sags, Faults behind transformers, Effect of pre-fault voltage, Simple examples, Voltage dip problems, fast assessment methods for voltage sags in distribution systems.

UNIT III

PQ Consideration in Industrial Power Systems: Adjustable speed drive (ASD) systems and applications, Sources of power system harmonics, Mitigation of harmonics, Characterization of voltage sags experienced by three-phase ASD systems, Types of sags and phase angle jumps, Effects of momentary voltage dips on the operation of induction and synchronous motors.

UNIT IV

Harmonics: Harmonic distortion, Voltage versus current distortion, Harmonics versus Transients, Harmonic Indices, Harmonic sources from commercial loads, Harmonic sources from industrial loads, Locating Harmonic sources, System response characteristics, Effects of Harmonic distortion, inter harmonics, Devices for controlling harmonic distortion.

UNIT V

Power quality monitoring: Monitoring considerations, Historical Perspective of PQ Measuring Instruments, PQ measurement equipment, Assessment of PQ measurement data, Application of intelligent systems, PQ monitoring standards.

References

1. Math H.J. Bollen, *Understanding Power Quality Problems*, IEEE Press, 1999.
2. Roger C. Dugan, Mark F. Mc Granaghan, Surya Santoso, H. Wayne Beaty, *Electrical Power Systems Quality*, Second Edition, Tata McGraw-Hill Edition.
3. C. Sankaran, *Power Quality*, CRC Press, 2002.

Course Code	RELIABILITY ENGINEERING						Course Type Core/PF/FE
EE121							elective
Prerequisite if any:	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	3	-	-	3	40	60	3

Course Objectives

- To comprehend the basics of probability distributions & reliability models.
- To model systems with series-parallel block diagrams and state-space diagrams and to understand time dependent and limiting state probabilities using Markov models.
- To understand multi-mode failures of electrical & electronic circuits and their effect on reliability & availability.
- To understand reliability & availability models for generation, transmission and distribution systems and evaluate critical indices.

Course Outcomes

After the completion of this course, the students shall be able to:

1. Able to relate the probability concepts and distributions in reliability engineering studies
2. Able to draw reliability logic diagram and state-space diagram of engineering systems to evaluate reliability and availability
3. Apply multi-mode failures in electrical and electronic circuits
4. Model generation and transmission systems for reliability studies.
5. Evaluate various reliability indices related to generation, transmission and distribution systems

Course Articulation Matrix:

Course outcome	Programme outcome					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	3	-	-	1
CO2	3	-	3	-	-	1
CO3	3	-	3	-	-	1
CO4	3	-	3	-	-	1
CO5	3	-	3	-	-	1

UNIT I

Discrete & Continuous random variables – Binomial, Exponential &Weibull distributions – Causes of failure – Failure rate & Failure density – Bath tub curve – Reliability & MTTF – Maintainability & Availability – MTBF & MTTR – Reliability block diagram – Series & Parallel systems – Conditional probability - Minimal Cutset
& Tie-set methods

UNIT II

Continuous Markov models – State space diagram - Reliability models of single unit, two unit & standby systems – Reliability & Availability models with repair – Frequency of failures – State transition matrix and estimation of MTTF.

UNIT III

Multi-mode failures - Short circuit & open circuit failures - Resistors & capacitors in series & parallel - Diodes & MOSFETs in series & parallel - Quad system - Reliability Prediction - MIL standards - Parts count technique - Parts stress technique - Reliability, Availability and MTTF evaluation of Power electronic circuits & Drive Systems

UNIT IV

Outage definitions – Markov model of Generating plant with identical and non-identical units – Capacity Outage probability table – Cumulative frequency – LOLE & LOEE – Composite Generation & Transmission systems - Radial configuration – Conditional probability approach

UNIT V

Customer oriented, load oriented & energy oriented indices of distribution system – Application to radial systems – Effects of lateral distributer protection, disconnects, protection failures & transferring loads – Parallel & Mesh networks – Dual transformer feeder – Approximate, Network reduction & FMEA methods

References

1. Roy Billinton, R.N. Allan, ‘Reliability Evaluation of Engineering Systems’, Springer International Edition, Plenum Press, New York, 1992
2. E. Balaguruswamy, ‘Reliability Engineering’, Tata McGraw Hill Education Pvt. Ltd., 2012
3. Charles E. Ebeling, ‘An Introduction to Reliability and Maintainability Engineering’, McGraw Hill International Edition, 1997
4. L. Umanand, ‘Power Electronics: Essentials & Applications’, Wiley, 2009
6. Roy Billinton, R.N. Allan, ‘Reliability Evaluation of Power Systems’, Springer, 1st Edition, Plenum Press, New York , 1996.

Course Code	DIGITAL SIGNAL PROCESSING						Course Type Core/PF/FE
EE122							elective
Prerequisite if any:	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	3	-	-	3	40	60	3

Course Objectives

- To gain knowledge about discrete time signal and systems; their representation, operations and properties.
- To understand the importance of frequency domain representation of discrete time signals and calculating DTFT, DFT and FFT.
- To learn to represent discrete time signals and systems in Z-domain and finding solution of difference equations using z-transform.
- To design IIR and FIR filters.
- To familiarize with the digital signal processor TMS320C5X

Course Outcomes

After the completion of this course, the students shall be able to:

1. Produce discrete time signals and analyze them and determine discrete time system output for the given discrete time input signals.
2. Determine frequency domain representation DTFT, DFT and FFT.
3. Use z-transforms effectively in the analysis and solutions of discrete time systems.
4. Design IIR and FIR filters.
5. Explain the architecture, memory and peripherals of Digital Signal Processor.

Course Articulation Matrix:

Course outcome	Programme outcome					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	-	2	-	-	-
CO2	2	-	2	-	-	-
CO3	2	-	2	-	-	-
CO4	2	-	2	-	-	-
CO5	2	-	2	-	-	-

Syllabus Contents

UNIT I

Introduction to Digital Signal Processing: Discrete time signals & sequences - Linear shift Invariant systems - Stability and causality- Linear constant coefficient difference equations - Frequency domain representation of discrete time signals and systems.

UNIT II

Discrete Fourier Series: Properties of Discrete Fourier Series - DFS representation of periodic sequences - Discrete Fourier Transforms- Properties of DFT – Linear convolution of sequences using DFT - Computation of DFT - Fast Fourier Transforms (FFT) - Radix-2 decimation in time and decimation in frequency FFT Algorithms inverse FFT.

UNIT III

Applications of Z-Transforms: Solution of difference equations of digital filters - System function - Stability criterion - Frequency response of stable systems - Realization of digital filters - Direct, Canonic, Cascade & Parallel forms.

UNIT IV

IIR Digital Filters: Analog filter approximations - Butterworth and Chebyshev - Design of IIR Digital filters from analog filters - Bilinear transformation method - Step & Impulse invariance techniques - Spectral Transformations. FIR Digital Filters: Characteristics of FIR Digital Filters - Frequency response - Design of FIR filters using Window Techniques.

UNIT V

Introduction to digital signal processors: TMS320C5X architecture – CALU, ARAU, PLU, MMR, on chip memory, on chip peripherals, Digital signal processing applications.

References

1. Proakis & Manolakis, Digital Signal Processing Principles, P Pub. 1994.
2. Sahivahanam, Valtavaraj & Gnanapariya, Digital Sign Processing, TMGH Pub. 2001.
3. Oppenheim & Sehaffter, Digital Signal Processing, PHI Pub.
4. S.K.Mitra, Digital Signal Processing, TMH, 1996.

Course Code	INDUSTRIAL CONTROLLERS						Course Type Core/PF/FE
EE123							elective
Prerequisite if any:	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	3	-	-	3	40	60	3

Course Objectives

- To develop knowledge about 8051 Micro controller and its assembly language programming.
- To be familiarize with LF2407 DSP controller, its architecture, programming, GPIOs, Interrupts, ADC, Event Managers and learn how to produce PWM waveforms.
- To be aware of Programmable Logic Controller and how to develop ladder programs.

Course outcomes: After the completion of this course, the students shall be able to:

1. Understand the working of 8051 micro controller architecture and its programming.
2. Understand the functioning of Digital Signal Processor in LF2407 controller and programming of TMS320C2xx processor.
3. Understand the concept of GPIO, interrupts, ADC and programming them.
4. Use different resources available in even manager in the application of Electro mechanical motion control such as dead band generation, PWM generation, QEP circuitry etc.
5. Develop ladder programs for different industrial PLC applications.

Course Articulation Matrix:

Course outcome	Programme outcome					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	-	2	-	-	1
CO2	3	-	3	-	-	2
CO3	3	-	3	-	-	2
CO4	3	-	3	-	-	2
CO5	2	-	3	-	-	2

UNIT I

8051 Micro controller: Architecture, memory organization, timing and control, parallel ports, timer/counters, serial port and interrupts. Addressing modes and instruction set of 8051 micro controller and its usage.

UNIT II

TMSLF2407 DSP Controller: Introduction, brief introduction to peripherals, types of physical memory, software tools.

C2XX DSP CPU and instruction set:C2xx DSP Core and code generation, mapping external devices to the C2xx DSP core and the peripherals, memory, addressing modes, assembly programming using C2xx DSP instruction set.

UNIT III

GPIO functionality: Pin multiplexing (MUX) and GPIO Overview, multiplexing and GPIO control registers.

Interrupts on the TMS320LF2407: Introduction, Interrupt Hierarchy and its Control Registers.

UNIT IV

ADC: Overview, Operation and programming modes.

Event managers: Overview, Interrupts, Timers, Compare Units, Capture units and QEP circuitry PWM Signal Generation with Event Managers.

UNITV

Programmable Logic Controller (PLC) Basics: Definitions and history of PLCs – Advantages and disadvantage of PLC – overall PLC Systems, CPUs and Programmer/ Monitors – Programming procedures – programming equipment – Programming formats Ladder diagrams, Basic PLC programming and Basic PLC functions: Programming on / off inputs to produce on / off outputs, PLC programming examples.

References

1. Kenneth J.Ayala, The Micro Controllers - Architecture, Programming & Applications, Penram International Publishing (India).
2. Hamid A Toliyat, DSP based Electromechanical Motion Control, Steven Campbell 2004, CRC Press.
3. John W. Webb and Roland A. Reis, Programmable Logic Controllers, Prentice Hall India Ltd., Fifth edition, 2003.

Course Code	SOFT COMPUTING TECHNIQUES IN ELECTRICAL ENGINEERING						Course Type Core/PF/ FE
EE131							elective
Prerequisite if any:	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	3	-	-	3	40	60	3

Course Objectives:

- Introduction to different soft computing techniques such as Artificial Neural Networks, Fuzzy Logic, Genetic Algorithms and Particle swarm Optimization.
- To learn different Neural Network architecture and learning mechanisms.
- Introducing different components of Fuzzy Logic Controllers such as Fuzzification Rule base, Inference and defuzzification and their applications
- Different Genetic operators are introduced and how do they help to solve optimization problems is demonstrated.
- Introduction to PSO and its variants.

Course Outcomes:

1. Understand the how nature inspired algorithms such as Artificial Neural Networks, Fuzzy Logic and Genetic Algorithms, Particle swarm optimization (PSO) solve Engineering problems.
2. Develop Neural Networks and algorithms to train them.
3. Understand the concept of fuzzy logic, membership, fuzzification and defuzzification.
4. Design Fuzzy controllers for practical applications
5. Develop Genetic algorithm and PSO to solve optimization problems.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	2	3	-	-
CO2	3	-	2	3	-	-
CO3	3	-	2	3	-	-
CO4	3	-	2	3	-	-
CO5	3	-	3	3	-	-

UNIT- I

Artificial Neural Networks: Introduction, Benefits of Neural network, Biological Neuron. Models of Neuron, types of Activation functions, Network architectures. Learning process: Error correction learning, Hebbian learning, Competitive learning, Boltzmann learning, Supervised learning, Unsupervised learning, Reinforcement learning.

UNIT-II

ANN Paradigms: Single layer perceptron, Multi-layer perceptron using Back propagation Algorithm (BPA), SelfOrganizing Map (SOM), Radial Basis Function Network. Applications of ANN.

UNIT- III

Fuzzy Logic: Introduction –Fuzzy versus crisp, Fuzzy sets - Membership function, Basic Fuzzy set operations, Properties of Fuzzy sets, Fuzzy cartesian Product, Operations on Fuzzy relations, Fuzzification methods and Defuzzification methods.

UNIT-IV

Fuzzy Logic Controller: Fuzzy inference system; Mamdani systems, Sugeno models, and Tsukamoto models- Rule based system - Fuzzy control systems - Applications of Fuzzy control systems.

UNIT-V

Genetic Algorithms: Introduction, different types of encoding, Fitness Function, Genetic Operators: selection - types of selection, Cross over- types of crossover, Mutation operator, Elitism, Algorithmic steps- Applications of GA. Economic Load Dispatch.

Particle swarm Optimization (PSO): Pbest, Gbest, parameter selection, convergence, PSO variants.

Suggested Reading:

1. Neural Netwroks – Simon Hykins, Pearson Education.
2. Timothy J Ross, "Fuzzy Logic with Engineering Applications" second edition, Jhon Wiley & sons Edition
3. D.E. Goldberg, Genetic Algorithms, Addison-Wesley1999.
4. S.Rajasekaran and G.A.V.Pai Neural Networks, Fuzzy Logic & Genetic Algorithms, PHI, New Delhi,2003.

Course Code	ADVANCED OPTIMIZATION TECHNIQUES						Course Type Core/PF /FE
EE132							elective
Prerequisite if any:	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	3	-	-	3	40	60	3

Course Objectives

- To understand the concepts of single variable and multivariable optimization with and without constraints
- To make the students understand about linear and nonlinear optimization problems.
- To make the students understand about Evolutionary computational techniques

Course Outcomes After the completion of this course, the students shall be able to:

- Formulate practical problems to mathematical models and solve single, multivariable methods with and without constraints
- Solve linear optimization problems
- Solve linear and nonlinear optimization problems
- Understand different Metaheuristics Algorithms
- Solve Multi-objective with pareto optimality

Course Articulation Matrix:

Course outcome	Programme outcome					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	2	-	-	-
CO2	3	-	3	-	-	-
CO3	3	-	3	-	-	-
CO4	2	-	3	2	-	2
CO5	2	-	3	2	-	2

UNIT I

Classical Optimization techniques*:* Introduction to optimization and design optimization, optimum design problem formulation, Single variable optimization- Multivariable optimization with and without constraints – Multi variable optimization with inequality constraints – Solution by Lagrangian multipliers - Kuhn-Tucker conditions.

UNIT II

Linear Programming: Formulation and standard form of LP problem, Basic definitions and theorems – Solution of a system of linear simultaneous equations – simplex method and its algorithm – Revised simplex method – Big-M method – Duality in LP and primal dual relations – Dual simplex method.

UNIT III

***Non-Linear Programming*:** One dimensional minimization methods – Introduction – Elimination methods – Unrestricted search, Exhaustive search, Dichotomous search, Fibonacci methods. Unconstrained optimization techniques- Univariate and Powell's pattern search method, steepest descent method.

UNIT IV

Metaheuristics Algorithms 1:

Science based Algorithms: Simulated annealing - metropolis criterion - algorithm - pseudo code- examples.

Human based Algorithms: Tabu search- different strategies - Algorithm- pseudo code- examples.

Evolution based Algorithms: Genetic algorithms – binary encoding, real encoding, permutation encoding - different selection process - crossover for different encodings - mutation for different encodings - Elitism - pseudo code -Genetic Algorithm examples.

UNIT V

Metaheuristics Algorithms 1:

Swarm intelligence-based algorithms: Particle Swarm Optimization - exploration - exploitation - parameters of PSO - personal best - global best-Algorithm - pseudo code - examples- Limitations of original PSO - PSO variants.

Introduction to Multi-objective optimization: Need of multi-objective approach-Pareto optimality - examples - Non dominated Sorting Genetic algorithm II- Algorithm - pseudo code - applications.

References

1. Engineering Optimization, Theory and Practice - Singiresu S. Rao, S. S. Rao – Fourth edition – New Age Internationals – 2009.
2. Introduction to Optimum design, Jasbir S. Arora, - Third Edition – Elsevier – 2013.
3. Optimization methods for Engineers, N.V.S. Raju – PHI – 2014.
4. Introduction to Genetic Algorithms, S.N.Sivanandam, S.N Deepa – Spinger – 2013.
5. 5. Search and Optimization by Metaheurstics-Techniques and algorithms inspired by nature, Ke-LinDu, M.N.S Swamy - Springer international publishing - 2016
6. Yang, Xin-She, Nature-Inspired Metaheuristic Algorithms, 2010/07/25
7. Link: https://www.researchgate.net/publication/235979455_Nature-Inspired_Metaheuristic_Algorithms
8. https://www.researchgate.net/publication/228346477_Tabu_Search
9. Alhammadi, H. Y., & Romagnoli, J. A. (2004). Process design and operation. Computer Aided Chemical Engineering, 264–305.
10. Ant Colony Optimization for Mixed-Variable Optimization Problems: IEEE Transactions on evolutionary computation, vol. 18, no. 4, august 2014.

Course Code	PYTHON PROGRAMMING						Course Type Core/PF/FE
EE133							elective
Prerequisite if any:	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	3	-	-	3	40	60	3

Course Objectives

The main objective is to teach Computational thinking using Python.

- To know the basics of Programming
- To convert an algorithm into a Python program
- To construct Python programs with control structures.
- To structure a Python Program as a set of functions
- To use Python data structures-lists, tuples, dictionaries.
- To do input/output with files in Python.
- To construct Python programs as a set of objects.

Course Outcomes

After completion of this course, the students shall be able to:

1. Develop algorithmic solutions to simple computational problems.
2. Develop and execute simple Python programs.
3. Develop simple Python programs for solving problems.
4. Structure a Python program into functions.
5. Represent compound data using Python lists, tuples, and dictionaries.
6. Read and write data from/to files in Python Programs

Course Articulation Matrix:

Course outcome	Programme outcome					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	-	2	-	-	-
CO2	2	-	2	-	-	-
CO3	2	-	2	-	-	-
CO4	2	-	2	-	-	-
CO5	2	-	2	-	-	-

UNIT-I

Introduction to Computing and Problem-Solving: Fundamentals of Computing — Computing Devices — Identification of Computational Problems — Pseudo Code and Flowcharts — Instructions — Algorithms — Building Blocks of Algorithms.

Introduction to Python Programming: Python Interpreter and Interactive Mode-Variables and Identifiers — Arithmetic Operators — Values and Types — Statements, Reading, Input, Print Output, Type Conversions, The type () Function and Is Operator, Dynamic and Strongly Typed Language.

Control Flow Statements: The if, The if...else, The if...else if...else Decision Control Statements, Nested if Statement, The while Loop, The for Loop. The continue and break Statements.

UNIT-II

Functions: Built-In Functions, Commonly Used Modules, Function Definition and Calling the Function, The return Statement and void Function, Scope and Lifetime of Variables, Default Parameters, Keyword Arguments, and Command Line Arguments.

Strings: Creating and Storing Strings, Basic String Operations, Accessing Characters in String by Index Number, String Slicing and Joining, String Methods, Formatting Strings.

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as a return value; Dictionaries: operations and methods; advanced list processing - list comprehension.

UNIT-III

Files and **Exception:** Text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file.

Strings: Basic String Operations, String Slicing, Testing, Searching, and Manipulating Strings

Dictionaries and Sets: Dictionaries, Sets, Serializing Objects.

UNIT-IV

Object-Oriented Programming: Classes and Objects, Creating Classes in Python, Creating Objects in Python, The Constructor Method, Classes with Multiple Objects, Class Attributes versus Data Attributes, Encapsulation, Inheritance the Polymorphism.

Functional Programming: Lambda. Iterators, Generators, List Comprehensions.

UNIT-V

GUI Programming: Graphical User Interfaces, Using the Tkinter Module, Display text with Label Widgets, Organizing Widgets with Frames, Button Widgets and Info Dialog Boxes, Getting Input with Entry Widget, Using Labels as Output Fields, Radio Buttons, Check Buttons.

Suggested Readings:

1. Richard L. Halterman, *"Learning To Program With Python",* Copyright fi 2011.
2. Dr Charles R, *"Pythonfor Everybody, Exploring Data Using Python 3",* Severance. 2016.
3. Gowrishankar S., Veena A, *"Introduction to Python Programming",* CRC Press, Taylor & Francis Group, 2019.
4. Allen B. Downey, *"Think Python: Howto Think Likea Computer Scientist",* 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016 (http://greenteapress.com/wp/think- python/)

Course Code	POWER ELECTRONIC SYSTEMS LABORATORY - I						Course Type Core/PF/FE
EE361							core
Prerequisite if any:	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	-	-	2	3	50	-	1

Course Objectives

- To design and observe Buck converter performance in closed and open loop control modes with MATLAB simulation.
- To design and observe Boost converter performance in closed and open loop control modes with MATLAB simulation.
- To design and observe Buck-Boost converter performance in closed and open loop control modes with MATLAB simulation.
- To analyse Inverter operation with unipolar and bipolar Sinusoidal PWM technique
- To understand SPWM and SVPWM implementation on a two level 3-Φ Inverter in MATLAB

Course Outcomes

After the completion of this course, students will be able to:

1. Design the buck converter parameters
2. Observe the impact of duty cycle on output voltage
3. Compare open and closed loop modes of operation
4. Design a two level 3- Φ inverter in MTALAB, Observe the switching pattern and calculate the phase and line voltages, calculate the % THD of current and voltage
5. Compare the unipolar and Bipolar switching methods, design a SPWM logic for 3-Φ PWM Inverter

Course Articulation Matrix:

Course outcome	Programme outcome					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	3	-	2
CO2	3	3	3	3	-	2
CO3	3	3	3	3	-	2
CO4	3	3	3	3	-	2
CO5	3	3	3	3	-	2

List of Experiments

- Buck Converter using MATLAB Simulation
- Buck Converter using MATLAB Software
- Boost Converter using MATLAB Simulation
- Boost Converter using MATLAB Software
- Buck-Boost Converter using MATLAB Simulation
- Buck-Boost Converter using MATLAB Software
- Three-phase three level Neutral Point clamped Converter using PWM
- 3-phase Inverter with Pulse width modulation

Course Code	SEMINAR – I						Course Type Core/PF /FE
EE371							core
Prerequisite if any	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	-	-	2	3	50	-	1

Course Objectives

- Identify appropriate topic of relevance.
- Update literature on technical articles of selected topic and develop comprehension.
- Prepare a technical report.
- Deliver presentation on specified technical topic.

Course Outcomes

After the completion of this course, the students shall be able to:

1. Develop the habit of referring the journals for literature review.
2. Understand the gist of the research paper.
3. Identify the potential for further scope.
4. Present the work in an efficient manner.
5. Write the documentation in standard format.

Course Articulation Matrix:

Course outcome	Programme outcome					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	3	3	-	-	2
CO2	2	3	3	-	-	2
CO3	2	3	3	-	-	2
CO4	2	3	3	-	-	2
CO5	2	3	3	-	-	2

Seminar topics may be chosen by the students with advice from the faculty members and the student shall read further relevant articles in the domain.

The seminar must be clearly structured and the power point presentation shall include following aspects:

1. Introduction to the field
2. Literature survey
3. Consolidation of available information
4. Summary and Conclusions
5. References

Each student is required to:

1. Deliver the seminar for a maximum duration of 30 minutes, where the presentation should be for 20 minutes in PowerPoint, followed by Question and Answers session for 10 minutes.

2. Submit the detailed report of the seminar in spiral bound in a précised format as suggested by the Department.

Guidelines for awarding marks		
S. No.	**Description**	**Max. Marks**
1	Contents and relevance, Report in a prescribed format	10
2	Presentation skills	05
3	Preparation of PPT slides	05
4	Questions and answers	05
	TOTAL	25

Note:

1. The seminar presentation should be a gist of at least five research papers from **Peer-reviewed** or **UGC recognised** journals.
2. **The seminar report should be in the following order:** Background of work, literature review, techniques used, prospective deliverables, discussion on results, conclusions, critical appraisal and reference.
3. At least two faculty members will be associated with the seminar presentation to evaluate and award marks.
4. Attendance of all the students for weekly seminar presentations is compulsory. If the student fails to secure minimum attendance as per O.U. rules, the marks awarded in the seminar presentation shall remain void.

	SEMESTER-II							
1	Core-IV	**EE304**	Advanced Topics in Power Electronics	3	-	40	60	3
2	Core-V	**EE144**	Power Electronic Converters for Renewable Energy	3	-	40	60	3
3	Core-VI	**EE105**	Static Control Of A.C. Drives	3	-	40	60	3
4	Programme Elective-IV	**EE 141**	Modern Control Theory	3	-	40	60	3
		EE 142	Smart Grid Systems					
		EE 143	Grid Integration of Distributed Generation					
		EE 344	Industrial Electronic Systems					
5	Program Elective-V	**EE 151**	Power Electronic Applications to Power Systems	3	-	40	60	3
		EE 152	Digital Circuits and Logic Design					
		EE 153	Battery Management Systems and Charging Stations					
6	Open Elective	**OE 941 BM**	Medical Assistive Devices	3	-	40	60	3
		OE 942 BM	Medical Imaging Techniques					
		OE 941 CE	Green Building Technology					
		OE 942 CE	Cost Management of Engineering Projects					
		OE 941 CS	Business Analytics					
		OE 941 EC	Elements of Embedded Systems					
		OE 941 EE	Waste to Energy					
		OE 942 EE	Power Plant Control and Instrumentation					
		OE 941 ME	Operations Research					
		OE 942 ME	Composite Materials					
		OE 943 ME	Industrial Safety					

		OE 941 LA	Intellectual Property Rights					
7	Mini Project	**EE 372**	Mini Project	-	4	50		2
8	Laboratory - II	**EE 362**	Power Electronic system Laboratory - II	-	3	50	-	1.5
9	Laboratory - III	**EE 363**	Power Electronic system Laboratory - III	-	3	50	-	1.5
	TOTAL			**18**	**10**	**390**	**360**	**23**

Course Code	ADVANCED TOPICS IN POWER ELECTRONICS						Course Type Core/PF /FE
EE304							core
Prerequisite if any:	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	3	-	-	3	40	60	3

Course Objectives

- To develop knowledge about advanced power semiconductor devices
- To be familiarize with ideal rectifier, near ideal rectifiers, bifurcation and Chaos
- To be aware of. Various State space modeling DC-DC converters and Soft-switching
- Analyze the operation of multi-level inverters and accessing appropriate applications.
- Design of optimal controllers for Power Electronic Systems and its modeling

Course outcomes: After the completion of this course, the students shall be able to:

1. Select an appropriate power semiconductor device and design a power converter for the required application
2. Develop and understand the near ideal rectifier for single phase and three-phase converter systems
3. Determine the power circuit configurations to fulfill the required power conversion with applicable constraints
4. Design multi-level inverters and DC-DC converters, z-source converters
5. Design the control circuit and the power circuit for a given power converter

Course Articulation Matrix:

Course outcome	Programme outcome					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	1	3	2
CO2	2	2	2	1	2	2
CO3	2	2	2	2	2	2
CO4	3	2	3	2	3	3
CO5	2	2	3	3	2	2

UNIT I

Introduction to switches - Advanced Silicon devices - Silicon HV thyristors, MCT, BRT &EST. SiC devices - diodes, thyristors, JFETs & IGBTs. Gallium nitrate devices - Diodes, MOSFETs.

UNIT II

Pulse Width Modulated Rectifiers: Properties of ideal rectifier, realization of near ideal rectifier, control of the current waveform, single phase and three-phase converter systems incorporating ideal rectifiers and design examples. Non-linear phenomena in switched mode power converters: Bifurcation and Chaos.

UNIT III

Control of DC-DC converters- State space modeling of Buck, Boost, Buck-Boost, Cuk Fly back, Forward, Push-Pull, Half & Full-bridge converters. Closed loop voltage regulations using state feedback controllers**.** Soft-switching DC - DC Converters: zero-voltage-switching converters, zero-current switching converters, Multi-resonant converters and Load resonant converters.

UNIT IV

Advance converter topologies - Multi level converters - Cascaded H-Bridge, Diode clamped, NPC, Flying capacitor. Modular Multi-level Converters (MMC), Multi-Input DC-DC Converters, Multi pulse PWM current source converters, Interleaved converters, Z-Source converters.

UNIT V

Control Design Techniques for Power Electronic Systems- Modeling of systems, Digital Controller Design, Optimal and Robust controller Design.

.

References

1. Andrzej M Trzynadlowski, ‘Introduction to Modern Power Electronics, John Wiley and sons. Inc, New York, 1998
2. L. Umanand, ‘Power Electronics Essentials &Applications’, Wiley publishing Company, 1st Edition, 2014
3. B. JayantBalinga, 'Advanced High Voltage Power Device Concepts', Springer New York 2011. ISBN 978-1-4614-0268-8
4. BIN Wu, 'High Power Converters and AC Drives', IEEE press Wiley Inderscience, a John wiley& sons Inc. publication 2006

Course Code	POWER ELECTRONIC CONVERTERS FOR RENEWABLE ENERGY						Course Type Core/PF/FE
EE144							core
Prerequisite If any:	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	3	-	-	3	40	60	3

Course Objectives

- To learn the types of renewable sources such as Wind, solar, hydro and geothermal sources.
- To understand the principle and operation of various DC-DC converters.
- To understand the concepts of grid connected inverters and grid connected issues.
- To understand the principle of operation of doubly fed induction generator with rotor side converter topologies.

Course Outcomes

After the completion of this course, students will be able to:

1. Understand P-V & I-V characteristics of solar PV and different MPPT Techniques.
2. Understands the maximum power point tracking for different Converters.
3. Analyze the grid connection issues and different types of transformer less topologies.
4. Understand the P-V and I-V characteristics and power extraction of wind energy systems.
5. Analyze the different types of wind generators for wind power applications.

Course Articulation Matrix:

Course outcome	Programme outcome					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	3	2	3	2
CO2	3	-	3	2	3	2
CO3	3	-	3	2	3	2
CO4	3	-	3	2	3	2
CO5	3	-	3	2	3	2

UNIT I

Introduction to renewable sources: world energy scenario, Wind, solar, hydro, geothermal, availability and power extraction. Introduction to solar energy: Photovoltaic effect, basics of power generation, P-V &IV characteristics, effect of insolation, temperature, diurnal variation, shading, Modules, connections, ratings, Power extraction (MPP) tracking and MPPT schemes; standalone systems, grid interface, storage, AC-DC loads.

UNIT II

DC-DC converters for solar PV: buck/boost/buck-boost/flyback /forward/cuk, bidirectional converters, Interleaved and multi-input converters.

UNIT III

Grid connected Inverters: 1ph, 3ph inverters with & without transformers, Heric, H6, Multilevel Neutral point clamp, Modular multilevel, CSI; Control schemes: unipolar, bipolar, PLL and synchronization, power balancing / bypass, Parallel power processing; Grid connection issues: leakage current, Islanding, harmonics, active/reactive power feeding, unbalance.

UNIT IV

Introduction to wind energy: P-V, I-V characteristic, wind power system: turbine generator-inverter, mechanical control, ratings; Power extraction (MPP) and MPPT schemes. Generators for wind: DC generator with DC to AC converters; Induction generator with & w/o converter.

UNIT V

Synchronous generator with back-to-back controlled/ uncontrolled converter; Doubly fed induction generator with rotor side converter topologies; permanent magnet-based generators. Battery: Types, charging discharging. Introduction to AC and DC micro grids.

References

1. SudiptaChakraborty, Marcelo G. Simes, and William E. Kramer. Power Electronics for Renewable and Distributed Energy Systems: A Sourcebook of Topologies, Control and Integration. Springer Science & Business, 2013.
2. Nicola Femia, Giovanni Petrone, Giovanni Spagnuolo, Massimo Vitelli, Power Electronics and control for maximum Energy Harvesting in Photovoltaic Systems,CRC Press,2013.
3. Chetan Singh Solanki, Solar Photovoltaics: fundamentals, Technologies and Applications, Prentice Hall of India, 2011.
4. N. Mohan, T.M. Undeland& W.P. Robbins, Power Electronics: Converter, Applications & Design, John Wiley & Sons, 1989
5. Muhammad H. Rashid, Power Electronics: Circuits, Devices, and Applications, Pearson Education India, 2004
6. E. Guba, P. Sanchis, A. Ursa, J. Lpez, and L. Marroyo, Ground currents in single-phasetransformer less photovoltaic systems, Progress in Photovoltaics: Research and Applications, vol. 15, no. 7, 2007.
7. Remus Teodorescu, Marco Liserre, Pedro Rodriguez, Grid Converters for Photovoltaic and Wind Power Systems, John Wiley and Sons, Ltd., 2011

Course Code	STATIC CONTROL OF A.C. DRIVES						Course Type Core/PF/FE
EE105							core
Prerequisite if any:	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	3	-	-	3	40	60	3

Course Objectives

- To understand the static control of Induction Motor Drives.
- To understand the performance of Inverter fed Induction Motor Drives.
- To understand the control of Induction Motor Drives using vector control.
- To understand the control of Synchronous Motor Drives using VSI, CSI and cycloconverter.
- To understand the control of Special Machines such as BLDC, PMSM, Stepper Motor and SRM

Course Articulation Matrix:

Course outcome	Programme outcome					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	3	-	-	2
CO2	3	-	3	-	-	2
CO3	3	-	3	-	-	2
CO4	3	-	3	-	2	2
CO5	3	-	3	-	2	2

Course Outcomes

After the completion of this course, students will be able to:

1. Understand slip power recovery schemes for static control of Induction Motor Drives.
2. Analyze VSI and CSI to achieve efficient performance of Induction motor drive using various waveforms.
3. Implement high performance Induction Motor Drives using principle of vector control.
4. Apply the modes of variable frequency control for Synchronous Motor Drives employing Inverters.
5. Analyze the control requirements and performance of Special Electrical Machines.

UNIT I

Static Control of Induction Motor Drives: Stator Voltage Control, Static rotor resistance control, Slip power recovery schemes – Static Krammer drive, Static Scherbius drive, Closed loop control of the above schemes.

UNIT II

Inverter Fed Induction Motor Drives: Voltage Source Inverter and Current Source Inverter fed Induction motors, Analysis of Stepped waveform and PWM waveform, Harmonic equivalent circuit and motor performance.

UNIT III

Vector Control: Principle of vector control, Direct vector control –Flux & Torque processor using terminal voltages and Induced emf, Principle of Space vector modulation, Indirect vector control – Flow chart and implementation.

UNIT IV

Static Control of Synchronous Drives: Self-control and Separate control of synchronous motor fed from VSI, Cyclo-converter fed self-control of synchronous motor, CSI fed synchronous motor drive, LCI self-controlled synchronous motor.

UNIT V

Special Machines: Brushless D.C Motor – Unipolar and Bipolar Brushless D.C motors, Applications, Stepper Motors – Variable reluctance and Permanent magnet stepper motors –Characteristics & Drive circuits, Switched reluctance motor.

References

1. R.Krishrian, *Electric Motor Drives*, Prentice Hall of India Pvt. Ltd., New Delhi, 2002.
2. G.K.Dubey, *Fundamentals of Electrical Drives*, Narosa Publishing House, New Delhi, 1999.
3. W.Shepard, LN.Hulley and D.T.W.Liang, *Power Electronics and Motor Control*, Cambridge University Press, 1995.
4. B.K.Bose, *Modern Power Electronics and A.C.Drives*, Prentice Hall, 2002.

Course Code	MODERN CONTROL THEORY						Course Type Core/PF/FE
EE141							elective
Prerequisite if any:	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	3	-	-	3	40	60	3

Course Objectives

- To provide the fundamentals required to model a control system in state space and check its controllability and observability.
- To educate the students about non-linear systems behavior and the methods to determine their stability.
- To make then students thorough with Lyapunov stability analysis.
- To familiarize the students with the concept of optimal control and how to determine optimum for functional using calculus of variations.
- To introduce the concept of Adaptive control and explain how to design a Model Reference Adaptive System.

Course Outcomes

After the completion of this course, students shall be able to:

1. Model any control system in state space.
2. Understand the behavior of nonlinear system and methods of determining stability.
3. Determine stability of nonlinear system using Liapunov method.
4. Formulate optimal control problem and determine optimum of functionals.
5. Understand and design adaptive control problem.

Course Articulation Matrix:

Course outcome	Programme outcome					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	3	-	-	2
CO2	3	-	3	-	-	2
CO3	3	-	3	-	-	2
CO4	3	-	3	-	-	2
CO5	3	-	3	-	-	2

UNIT I

Review of state variable representation of systems - Controllability and Observability – Model control of single input – single output systems (SISO), Controllable and Observable companion forms – Effect of state feedback on Controllability and Observability, Pole placement by state feedback.

UNIT II

Classification of Non-linearities: Phenomenon exhibited by the nonlinearities – Limit cycles – Jump resonance,Sub-harmonic oscillations – Phase plane analysis – Singular points – Construction of phase plane trajectories – Isocline method – Delta method – Measurement of time on phase plane trajectories.

UNIT III

Concept and definition of stability - Lyapunov stability - Lyapunov's first and second methods - Stability of linear time invariant systems by Lyapunov's second method - Generation of Lyapunov functions- Variable gradient method - Krasooviski's method.

UNIT IV

Formulation of optimal control problems - Calculus of variations – Fundamental concepts –Functionals – Variation of functionals – Fundamental theorem of calculus of variations - Boundary conditions – Constrained minimization – Dynamic programming – Hamilton Principle of optimality, Jacobi Bellman equation – Potryagins minimum principle.

UNIT V

Introduction to adaptive control, types of adaptive control systems. Design of model reference adaptive control systems using M/T rule and Lyapunov stability theorem.

References

1. I.J Nagarath ,M.Gopal *Control Systems Engineering,* fifth edition , New Age International Publishers, 1984 Wiley Eastern Ltd.
2. Ogata K, *Modern Control Engineering,* Prentice Hall, 1997. Donald E Kirk, optimal control theryAn introduction
3. Karl J AstromBjronwihenmark, *Adaptive control* second edition – Pearson education.

Course Code	SMART GRID SYSTEMS						Course Type Core/PF/FE
EE142							elective
Prerequisite if any:	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	3	-	-	3	40	60	3

Course Objectives

1. To understand the differences, motivations, and vision behind the transition to smart grids.
2. To identify explain the key enabling technologies and architectural components that constitute a smart grid system.
3. To evaluate communication infrastructure, architectures, and protocols in enabling smart grid functionalities and data exchange.
4. To analyze Microgrid dynamics, control strategies, and associated protection challenges.
5. To operational and management concepts and the functions of modern Energy and Distribution Management Systems.

Course Outcomes

After the completion of this course, students will be able to:

1. Analyze the conceptual architecture of a smart grid, identifying its key domains, layers, and enabling technologies.
2. Explain the Advanced Metering Infrastructure, Wide Area Measurement Systems in enhancing grid visibility and control.
3. Evaluate the functionality and application of key communication protocols relevant to smart grid.
4. Analyze the operational modes of microgrids and the implications of seamless transitions between them.
5. Formulate strategies for Demand Side Management (DSM) and explain the concepts related to outage management and system restoration (FLISR).

Course Articulation Matrix

Course Outcome	Program Outcome					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	-	2	2	1	1
CO2	2	-	3	2	1	2
CO3	2	-	3	2	1	2
CO4	3	-	3	3	2	3
CO5	3	-	3	3	2	3

UNIT-I

Introduction to Smart Grid: Conventional Power Systems vs. Smart Grid, Smart Grid Architecture, Enablers of Smart Grid, Smart Grid Standards and Regulations, Global and Indian Smart Grid Initiatives

UNIT-II

Smart Grid Components: Advanced Metering Infrastructure (AMI)- Smart meters, Automatic Meter Reading (AMR), Meter Data Management Systems (MDMS), benefits and challenges. Phasor Measurement Units (PMUs) and Wide Area Measurement Systems (WAMS)**.**

UNIT-III

Smart Grid Communications: Communication Architectures for Smart Grid: Two-way digital communications, network topologies, IP-based systems. Communication Protocols-Standards and protocols relevant to smart grid applications (e.g., Modbus, DNP3, IEC 61850). Power Line Communications (PLC): Technology and applications.

UNIT-IV

Microgrids*:* Definition, characteristics, and distinguishing features, benefits and challenges, architecture (AC, DC, Hybrid), operation modes (grid-connected, islanded), control strategies (hierarchical control), Major protection issues of stand-alone Microgrid.

UNIT-V

Smart Grid Operation, Control, and Management**:** Demand Side Management (DSM) and Demand Response (DR) Strategies. Self-Healing Grids - Concepts and technologies for automated outage management and system restoration. Energy Management Systems (EMS) and Distribution Management Systems (DMS) in Smart Grid Context.

References

1. Janaka Ekanayake, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, Nick Jenkins, “Smart Grid: Technology and Applications”- Wiley, 2012.
2. James Momoh, “Smart Grid: Fundamentals of Design and Analysis” - Wiley, IEEE Press, 2012.
3. Nikos Hatziargyriou, Microgrids Architecture and control, Wiley, IEEE Press, 2014.
4. A Keyhani, M Marwali, “Smart power grids”, Wiley, IEEE Press, 2011.

Course Code	GRID INTEGRATION OF DISTRIBUTED GENERATION						Course Type Core/PF/FE
EE143							elective
Prerequisite if any:	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	3	-	-	3	40	60	3

Objectives:

- To study about various types of power generation resources to be connected in distributed generation system.
- To know the architecture of smart grid with integrated distribution generation with various plants.
- To get the knowledge on smart grid and how will gain the efficient power to the distributed end.
- To get the knowledge of Smart grid to evolve a perfect power system

Course Outcomes:

After completion of the course the student will able to:

1. Understand about the distribution generation system connected with various power generation plants.
2. Gain the knowledge on smart grid by various techniques for better efficiency in transmitting the power.
3. Know about the integration of distribution generation with various plants to the smart grid.
4. Overview of the perfect power system configurations.
5. Analyze the impact of generation on the distributed system.

Course Articulation Matrix:

Course outcome	Programme outcome					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	3	3	3	-
CO2	3	-	3	3	3	-
CO3	3	-	3	3	3	-
CO4	3	-	3	3	3	-
CO5	3	-	3	3	3	-

UNIT- I

Introduction to Distributed Generation: The development of the electrical power system - Value of distributed generation and network pricing – Reasons for distributed generation - The future development of distributed generation - Distributed generation and the distribution system - Technical impacts of generation on the distribution system - Economic impact of distributed generation on the distribution system - Impact of distributed generation on the transmission system - Impact of distributed generation on central generation.

UNIT-II

Distributed generation plant Combined heat and power plants - Renewable energy generation - Small-scale hydro generation - Wind power plants - Offshore wind energy - Solar photovoltaic generation

UNIT-III

Distributed generators and their connection to the system - Distributed generators - Synchronous generators - Induction generators - Doubly fed induction generator - Full power converter (FPC) connected generators - System studies - Load flow studies in a simple radial system - Load flow studies in meshed systems - Symmetrical fault studies - Unbalanced (asymmetrical) fault studies - Case studies - Steady-state voltages under peak and minimum loading - Electromagnetic transient studies.

UNIT-IV

DC Distribution - AC vs DC sources-Benefits of and drives of DC power delivery systems-Powering equipment and appliances with DC-Data centers and information technology loads-Future neighborhood - Potential future work and research.

UNIT-V

Smart Grid to Evolve a Perfect Power System - Electricity Network-Local energy networks-Electric transportation- Low carbon central generation-Attributes of the smart grid-Alternate views of a smart grid. Overview of the perfect power system configurations-Device level power system- Building integrated power systems- Distributed power systems-Fully integrated power system-Nodes of innovation.

References

1. “Distributed Generation” by N.Jenkins, J.B. Ekanayake & G. Strbac
2. Clark W Gellings, “The Smart Grid, Enabling Energy Efficiency and Demand Side Response”- CRC Press, 2009.
3. Janaka Ekanayake, Kithsiri Liyanage,Jianzhong.Wu, Akihik Yokoyama, Nick Jenkins, “Smart Grid: Technology and Applications”- Wiley, 2012.
4. IEEE 1547. IEEE Standard for Interconnecting Distributed Resources with Electric Power Systems; 2003.
5. James Momoh, “Smart Grid : Fundamentals of Design and Analysis”- Wiley, IEEE Press, 2012.
6. Horlock J.H. Cogeneration: Combined Heat and Power Thermodynamics and Economics. Oxford: Perga

Course Code	INDUSTRIAL ELECTRONIC SYSTEMS						Course Type Core/PF/FE
EE344							elective
Prerequisite	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	3	-	-	3	40	60	3

Course Objectives

- *To prepare the students as per Industry standard tools to analyze design and develop the Industrial Electronics based systems.*
- *To provide the students the deeper knowledge in the area related with Industrial Electronics as well as the Automation.*
- *To develop the ability to exhibit creative skills to comprehend, analyze, design and implement solutions for problems in Industrial applications.*

Course Outcomes:

After the completion of this course, students will be able to:

1. *Acquire the knowledge of various types of power supply systems like UPS, power conditioners switched mode supplies.*
2. *Acquire deeper knowledge in the area related with Industrial Electronics as well as the Automation in automatic welding system.*
3. *Apply innovative skills to model design and develop various control systems for Industrial applications.*
4. *Design analyzes various types of switched mode power supplies for different types of renewable energy generation topologies and for various electrical applications.*
5. *Analyze, design and develop reactive power compensation techniques in Arc furnace.*

Course Articulation Matrix:

Course outcome	Programme outcome					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	3	-	-	1
CO2	3	-	3	-	-	1
CO3	3	-	3	-	-	1
CO4	3	-	3	-	-	1
CO5	3	-	3	-	-	1

UNIT I

Power Supplies: UPS- Offline, Online & Hybrid types of UPS, Parallel redundancy, Dual redundancy, AC Power conditioner- power supply noise-servo system – servo-controlled voltage stabilizer- AC generator voltage regulator– Constant voltage transformer SMPS -Fly back, feed forward, Push pull and Bridge types.

UNIT II

Automatic Welding System: Physical Description of a wheel welding system Sequence of Operations – Sequence initiation –Interval triggering and gating circuit Interval stepping circuit –Interval time counter –Heat -cool counter –Weld power circuit.

UNIT III

Closed loop Industrial Systems: Thermistor control of quench oil temperature Proportional mode pressure control system Strip tension controller – Edge guide control for a strip recorder –Control of relative humidity in a textile moisturizing process. Closed loop industrial systems warehouse humidity controller.

UNIT IV

High Frequency Heating**:** Merits of Induction Heating–Applications of Induction Heating–High Frequency Power Source for Induction Heating–Principle of Dielectric Heating–Theory of Dielectric Heating–Dielectric Properties of a few typical materials–Electrodes used in Dielectric Heating–Method of Coupling of Electrodes to the R.F. Generator–Thermal Losses in Dielectric Heating–Applications of Dielectric Heating.

UNIT V

Reactive Compensation in Electric Arc Furnace**:** The arc Furnace an Electrical Load – Flicker and Principles of its compensation Thyristor controlled compensators –Saturable Reactor Compensator.

References

1. Maloney Timothy. J, *Industrial Solid-State Electronics*, Prentice Hall International,1986.
2. Krishna Kant, *Computer Based Industrial Control*, Prentice Hall of India, 1997.
3. G.K. Mithal, Dr. Maneesha Gupta, Industrial and Power Electronics, Khanna Publishers, 2007.
4. M.D Singh &Kanchandani.K.B.,*Power Electronics*, Tata McGraw Hill.,1998.
5. P.C Sen, *Modern Power Electronics*, S. Chand & Co.

Course Code	POWER ELECTRONIC APPLICATIONS TO POWER SYSTEMS						Course Type Core/PF/FE
EE151							elective
Prerequisite if any:	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	3	-	-	3	40	60	3

Course Objectives

- To understand the issues involved in existing Power Transmission system
- To be familiar with the Techniques to overcome the problems associated with AC Power Transmission system
- To Understand the control of active and reactive power control using Power electronic converters

Course Outcomes

After the completion of this course, the students shall be able to:

1. Know the application of FACTS devices in Power Transmission system.
2. Study and apply the power transmission schemes – HVDC Transmission
3. Implement the control circuits based on the Controlling parameters of HVDC system
4. Select appropriate FACTS controllers depending on application.
5. Understand various types of HVDC systems and their advantages.

Course Articulation Matrix:

Course outcome	Programme outcome					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	3	-	-	3
CO2	3	-	3	-	-	3
CO3	3	-	3	-	-	3
CO4	3	-	3	-	-	3
CO5	3	-	3	-	-	3

UNIT I

***Facts concepts*:** Reactive power control in electrical power transmission, principles of conventional reactive power compensators. Introduction to FACTS, flow of power in AC parallel paths, meshed systems, basic types of FACTS controllers, definitions of FACTS controllers, brief description of FACTS controllers.

UNIT II

Static shunt and series compensators: Shunt compensation - objectives of shunt compensation, methods of controllable VAR generation, static VAR compensators - SVC, STATCOM, SVC and STATCOM comparison. Series compensation - objectives of series compensation, thyristor switched series capacitors (TCSC), static series synchronous compensator (SSSC), power angle characteristics, and basic operating control schemes.

UNIT III

Combined Compensators: Unified power flow controller (UPFC) - Introduction, operating principle, independent real and reactive power flow controller and control structure. Interline power flow controller (IPFC), Introduction to Active power filtering, Concepts relating to Reactive power compensation and harmonic current compensation using Active power filters.

UNIT IV

HVDC transmission: HVDC Transmission system: Introduction, comparison of AC and DC systems, applications of DC transmission, types of DClinks, Layout of HVDC Converter station and various equipment. HVDC Converters, analysis of bridge converters with and without overlap, inverter operation, equivalent circuit
representation of rectifier and inverter configurations

UNIT V

Control of HVDC system: Principles of control, desired features of control, converter control characteristics, power reversal, Ignition angle control, current and extinction angle control. Harmonics-introduction, generation, ac filters and dc filters. Introduction to multiterminal DC systems and applications, comparison of series and parallel MTDC systems.

References

1. Song, Y.H. and Allan T. Johns, 'Flexible AC Transmission Systems (FACTS)', Institution of Electrical Engineers Press, London, 1999.
2. Hingorani, L.Gyugyi, 'Concepts and Technology of Flexible AC Transmission System', IEEE Press New York, 2000 ISBN –078033 4588.
3. Padiyar, K.R., 'HVDC transmission systems', Wiley Eastern Ltd., 2010.
4. Mohan Mathur R. and Rajiv K.Varma, 'Thyristor - based FACTS controllers for Electrical transmission systems', IEEE press, Wiley Inter science , 2002.
5. Padiyar K.R., 'FACTS controllers for Transmission and Distribution systems' New Age International Publishers, 1st Edition, 2007.
6. Enrique Acha, Claudio R.Fuerte-Esqivel, Hugo Ambriz-Perez, Cesar Angeles Camacho 'FACTS –Modeling and simulation in Power Networks' John Wiley & Sons, 2002.

Course Code	DIGITAL CIRCUITS AND LOGIC DESIGN						Course Type Core/PF/FE
EE152							elective
Prerequisite if any:	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	3	-	-	3	40	60	3

Course Objectives

- To understand the concepts of contact networks and combinational circuit design.
- To distinguish between melay model and moore model and analyze the sequential circuits.
- To simplify the sequential circuits.
- To assess the asynchronous sequential circuits.
- To analyze races, cycles, hazards and test sequential circuits.

Course Outcomes

The students will

1. Create the contact networks and identify symmetric functions and acquire the knowledge of combinational circuit design with PLA, PROM and PAL.
2. Design the completely specified and incompletely specified synchronous sequential circuits.
3. Apply the simplification techniques for state reduction in completely specified and incompletely specified synchronous sequential circuits.
4. Design the pulse mode and fundamental mode asynchronous sequential circuits.
5. Design the circuits to avoid race conditions and test the sequential logic circuits using transfer tree and homing tree.

Course Articulation Matrix:

Course outcome	Programme outcome					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	3	2	2	1
CO2	3	-	3	2	2	1
CO3	3	-	3	2	-	-
CO4	3	-	3	2	2	1
CO5	3	-	3	2	2	1

UNIT I

Contact networks: Relay contacts and their symbols- Analysis of series-parallel networks, Analysis of non-series-parallel networks, Synthesis of contact networks-Symmetric networks –Synthesis of symmetric networks-Identification of symmetric functions.

Combinational circuit design with Programmable Logic Devices: Realizing logic functions with Programmable Logic Array, Programmable Read-Only Memory and Programmable Array Logic.

UNIT II

Synchronous sequential circuits: Block diagram, Mealy model and Moore model, Flip-Flop input tables, Analysis of synchronous sequential circuit logic diagrams, Synthesis of synchronous sequential circuits, Design of Incompletely specified synchronous sequential circuits.

UNIT III

Simplification of Sequential Circuits: State equivalence, State reduction in completely specified circuits using Inspection, Partitioning and Implication table, State reduction in incompletely specified sequential circuits using Merger diagrams.

UNIT IV

Asynchronous sequential circuits: Types of Asynchronous Circuits, Pulse-mode circuit model and Fundamental-mode circuit model, Analysis of Pulse-mode asynchronous circuits, Synthesis of pulse-mode asynchronous circuits, Analysis of fundamental-mode circuits and Synthesis of fundamental-mode circuits.

UNIT V

Introduction to Races, Cycles and Hazards: Races- critical race and non-critical race, Cycle, Hazards- static hazard, dynamic hazard and essential hazard, realization of circuits with races, Avoidance of race conditions, Race-free state assignments, critical race-free realization.

Sequential logic circuit testing: test sequence, initialization sequence, observation sequence, transfer sequence, homing sequence, pre-set homing sequence, Implementation of transfer tree and homing tree.

References

1. Z.Kohavi, *Switching and Finite Automata Theory*, Tata McGraw Hill, 48th Reprint 2010.
2. Victor P.Nelson, H.Troy Nagle, Bill D Caroll, J.David Irwin, *Digital Logic Circuit Analysis and Design*, Prentice Hall International, 1996.

Course Code	BATTERY MANAGEMENT SYSTEMS AND CHARGING STATIONS						Course Type Core/PF/FE
EE153							elective
Prerequisite	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	3	-	-	3	40	60	3

Course objectives:

- Able to understand the working of different batteries for EV applications
- Able to know the fundamentals of battery charging methods and their advantages
- Able to know the different kinds of equipment in charging station
- Able to know the requirements of battery management.
- Able to know method of modelling batteries and their simulation studies.

Course Outcomes:

After the completion of the course the student should be able to:

1. Describe the construction and operation of different batteries for EV applications
2. Describe charging algorithms of different batteries and balancing methods of battery packs
3. Describe the different kinds of infrastructure needed in the charging stations
4. Describe the requirements of battery management and their maintenance.
5. Obtain the modelling of batteries and develop their simulation models..

Course Articulation Matrix:

Course outcome	Programme outcome					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	3	3	-	2
CO2	3	-	3	3	-	2
CO3	3	-	3	3	-	2
CO4	3	-	3	3	-	2
CO5	3	-	3	3	-	2

UNIT - I:

EV Batteries Cells & Batteries, Nominal voltage and capacity, C rate, Energy and power, Cells connected in series, Cells connected in parallel. Lead Acid Batteries: Lead acid battery basics, special characteristics of lead acid batteries, battery life and maintenance, Li-ion batteries. Nickel-based Batteries: Nickel cadmium, Nickel metal hydride batteries. Sodium-Based Batteries: Introduction, sodium sulphur batteries, sodium metal chloride (Zebra) batteries. Lithium Batteries: Introduction, the lithium polymer battery, lithium ion battery.

UNIT - II:

Battery charging strategies Charging algorithms for a single battery: Basic terms for charging performance evaluation and characterization, CC charging for NiCd/NiMH batteries, CV charging for lead acid batteries, CC/CV charging for lead acid and Li-ion batteries, MSCC charging for lead acid, NiMH and Li-ion batteries, TSCC/CV charging for Li-ion batteries, CVCC/CV charging for Li-ion batteries, Pulse charging for lead acid, NiCd/NiMH and Li-ion batteries, Charging termination techniques, Comparisons of charging algorithms and new development; Balancing methods for battery pack charging: Battery sorting Overcharge for balancing, Passive balancing, Active balancing.

UNIT -III:

Charging Infrastructure Domestic Charging Infrastructure, Public charging Infrastructure, Normal Charging Station, Occasional Charging Station, Fast Charging Station, Battery Swapping Station, Move-and-charge zone.

UNIT - IV:

Battery-Management-System Requirements Battery-pack topology, BMS design requirements, Voltage sense, Temperature sense, Current sense, Contactor control, Isolation sense, Thermal control, Protection, Charger control, Communication via CAN bus, Log book, SOC estimation, Energy estimation, Power estimation, Diagnostics .

UNIT - V:

Battery Modelling General approach to modelling batteries, simulation model of rechargeable Li-ion battery, simulation model of a rechargeable NiCd battery, Parameterization of NiCd battery model, Simulation examples.

References

1. *Electric Vehicles Technology Explained by James Larminie Oxford Brookes University, Oxford, UK John Lowry Acenti Designs Ltd., Uk.*
6. *Energy Systems for Electric and Hybrid Vehicles by K.T. Chau, IET Publications, First edition, 2016.*
7. *Modern Electric Vehicles Technology by C.C.Chan, K.T Chau, Oxford University Press Inc., New york , 2001.*
8. *Battery Management Systems Vol. – II Equivalent Circuits and Methods, by Gregory L.Plett, Artech House publisher, First edition 2016.*
9. *3. Battery Management Systems: design by Modelling by Henk Jan Bergveld, Wanda S. Kruijt, Springer Science & Business Media, 2002.*

Course Code	MEDICAL ASSISTIVE DEVICES						Course Type Core/PF/FE
OE 941 BM							elective
Prerequisite if any:	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	3	-	-	3	40	60	3

Course Objectives :

The course is taught with the objectives of enabling the student to:

- To extend knowledge of the amputee, of lost and remaining functions affecting
- locomotion, and to collect information on the best possible medical treatment.
- To improve fitting techniques and practices, including training, so that existing
- devices might be used with greater comfort and function.
- To develop improved lower-extremity devices

Course Outcomes :

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

1. Apply fundamental knowledge of engineering in rehabilitation
2. Apply analytical skills to assess and evaluate the need of the end-user
3. Develop self-learning initiatives and integrate learned knowledge for problem
4. solving
5. Understand the basics of robotics and apply their principles in developing
6. prosthetics
7. Apply the knowledge of computers in solving rehabilitation problems

Course Articulation Matrix

Course outcome	Program Outcome					
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CO-1	2	1	3	2	1	1
CO-2	3	2	1	1	2	-
CO-3	2	2	2	3	2	1
CO-4	1	3	1	2	1	1
CO-5	1	1	2	3	2	3

UNIT – I

Introduction to Rehabilitation Engineering, Measurement and analysis of human movement, Disability associated with aging in the workplace and their solutions, clinical practice of rehabilitation engineering.

UNIT – II

Assistive Technology, Seating Biomechanics and systems. Wheeled Mobility: Categories of Wheelchairs. Wheelchair Structure and Component Design. Ergonomics of Wheel chair propulsion. Power Wheelchair Electrical Systems. Control. Personal Transportation. Auxiliary devices and systems.

UNIT – III

Sensory augmentation and substitution: Visual system: Visual augmentation. Tactual vision substitution, Auditory vision substitution; Auditory system: Auditory augmentation. Cochlear implantation, Visual auditory substitution, Tactual auditory substitution, Tactual system: Tactual augmentation. Tactual substitution. Measurement tools and processes: fundamental principles, structure, function; performance and behavior. Subjective and objective measurement methods.

UNIT – IV

Rehabilitation Robotics, Major Limb Prosthetic Devices, Orthotic Devices, Types of orthotics and prosthetics, Intelligent prosthetic Knee, Prosthetic Hand, Controlled orthotics and prosthetics FES system, Restoration of Hand function, Restoration of standing and walking, Myo-electric Hand.

Unit – V

Augmentative and Alternative communication technology, Computer applications in Rehabilitation Engineering, telecommunications, and Web Accessibility.

***Suggested Reading**:*

1 Robinson C.J., *Rehabilitation Engineering*, CRC Press, 1995.

2 Ballabio E., et al., *Rehabilitation Technology*, IOS Press, 1993.

3 Rory A Cooper, Hisaichi Ohnabe, Douglas A. Hobson, *Series in medical physis and biomedical engineering: An introduction to rehabilitation engineering*, Taylor and Francis Group, London, 2007.

4 Joseph D. Bronzino *The biomedical engineering handbook -biomedical engineering fundamentals*, 3rdEd., CRC Press, Taylor & Francis Group, London, 2006.

Course Code	MEDICAL IMAGING TECHNIQUES						Course Type Core/PF/FE
OE 942 BM							elective
Prerequisite if any:	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	3	-	-	3	40	60	3

Course Objectives :

The course is taught with the objectives of enabling the student to:

- To familiarize the students with various medical imaging modalities.
- To make learners understand the principles, detectors and operating procedures of
- X-ray, CT, MRI, ultrasound, PET and SPECT.
- To make the students learn the advantages, disadvantages and hazards of various
- medical imaging equipment.

Course Outcomes :

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

1. Interpret the working principle and operating procedure and applications of X-
2. ray equipment.
3. Understand the image reconstruction techniques and applications of CT.
4. Summarize the image acquisition and reconstruction techniques in MRI.
5. Comprehend the working principle, modes and medical applications of
6. ultrasound imaging.
7. Examine the operation and applications of PET, SPECT and radio nuclide
8. instrumentation.

Course Articulation Matrix

Course outcome	Program Outcome					
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CO-1	2	1	3	2	1	1
CO-2	3	2	1	1	2	-
CO-3	2	2	2	3	2	1
CO-4	1	3	1	2	1	1
CO-5	1	1	2	3	2	3

UNIT – I

X ray Imaging: Electromagnetic spectrum, Production of X-rays, X-ray tubes- Stationary and Rotating Anode types, Block diagram of an X-Ray Machine, Collimators and Grids, Timing and Exposure controls. X-Ray Image visualization-Films, Fluorescent screens, Image Intensifiers.

Dental X-Ray machines, Portable and mobile X-Ray units, Mammographic X-Ray equipment,

Digital Radiography and flat panel detectors.

Radiation safety, ALARA principle, Dose units and dose limits, Radiation dosimeters and detectors.

UNIT – II

Computed Tomography: Basic principles, CT number scale, CT Generations. Major sub systems- Scanning system, processing unit, viewing unit, storage unit. Need and Principle of sectional imaging, 2D image reconstruction techniques - Iteration and Fourier methods. Applications of CT - Angio, Osteo, Dental, Perfusion (Body & Neuro), Virtual Endoscopy, Coronary Angiography.

UNIT – III

Magnetic Resonance Imaging: Principles of NMR imaging systems, Image reconstruction techniques-Relaxation processes, imaging/ pulse sequences. Sub systems of an NMR imaging system, NMR detection system, types of coils, biological effects and advantages of NMR imaging.

Functional MRI - The BOLD effect, intra and extra vascular field offsets, source of T2* effects, Creating BOLD contrast sequence optimization sources and dependences of physiological noise in fMRI.

UNIT – IV

Ultrasound Imaging: - Principles of image formation -Imaging principles and instrumentation of A-mode, B-Mode, Gating Mode, Transmission mode and M-mode.

Basics of multi-element linear array scanners, Digital scan conversion.

Doppler Ultrasound and Colour Doppler imaging, Image artifacts, Biological effects, Ultrasound applications in diagnosis, therapy and surgery.

UNIT – V

Nuclear Medicine–Radioisotopes in medical diagnosis, Basic instrumentation- Radiation detectors, Pulse height analyzer, Rectilinear scanner, Gamma camera.

Emission Computed Tomography (ECT), Principle and instrumentation of Single Photon Emission Computed Tomography(SPECT) and Positron Emission Tomography (PET).

Comparison of SPECT, PET and combined PET/ X-ray CT.

***Suggested Reading**:*

1. Khandpur R.S., *Handbook of Biomedical Instrumentation*, Tata McGraw Hill, 2016.
2. S Webb, "*The Physics of Medical Imaging*", Adam Highler, Bristol Published by CRC Press, 1988.
3. A C Kak, "*Principle of Computed Tomography*", IEEE Press New York, 1988.
4. Hykes, Heorick, Starchman, *Ultrasound physics and Instrumentation* MOSBY year book, 2nd Ed. 1992.
5. Stewart C. Bushong, *Magnetic Resonance Imaging- physical and biological principles*, MOSBY, 2nd Ed., 1995.

Course Code	GREEN BUILDING TECHNOLOGY						Course Type Core/PF/FE
OE941CE							elective
Prerequisite if any:	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	3	-	-	3	40	60	3

Course Objectives :

The course is taught with the objectives of enabling the student to:

1 Exposure to the green building technologies and their significance.
2 Understand the judicial use of energy and its management.
3 Educate about the Sun-earth relationship and its effect on climate.
4 Enhance awareness of end-use energy requirements in the society.
5 Develop suitable technologies for energy management

Course Outcomes :

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

CO-1 Understand the fundamentals of energy use and energy processes in building.
CO-2 Identify the energy requirement and its management.
CO-3 Know the Sun-earth relationship vis-a-vis its effect on climate.
CO-4 Be acquainted with the end-use energy requirements.
CO-5 Be familiar with the audit procedures of energy

Course Articulation Matrix:

Course outcome	Program Outcome					
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CO-1	3	3	3	2	1	2
CO-2	3	2	3	2	1	1
CO-3	3	2	3	2	1	2
CO-4	3	2	3	2	1	2
CO-5	3	2	3	2	1	1

UNIT – I

Overview of the significance of energy use and energy processes in building - Indoor activities and environmental control - Internal and external factors on energy use and the attributes of the factors - Characteristics of energy use and its management - Macro aspect of energy use in dwellings and its implications.

UNIT – II

Indoor environmental requirement and management - Thermal comfort - Ventilation and air quality – Air-conditioning requirement - Visual perception - Illumination requirement - Auditory requirement.

UNIT – III

Climate, solar radiation and their influences - Sun-earth relationship and the energy balance on the earth's surface - Climate, wind, solar radiation, and temperature - Sun shading and solar radiation on surfaces - Energy impact on the shape and orientation of buildings.

UNIT – IV

End-use, energy utilization and requirements - Lighting and day lighting - End-use energy requirements - Status of energy use in buildings Estimation of energy use in a building. Heat gain and thermal performance of building envelope - Steady and non-steady heat transfer through the glazed window and the wall - Standards for thermal performance of building envelope - Evaluation of the overall thermal transfer.

UNIT – V

Nuclear Medicine–Radioisotopes in medical diagnosis, Basic instrumentation- Radiation Energy management options - Energy audit and energy targeting - Technological options for energy management.

Suggested Reading:

1 Bryant Edwards (2005): Natural Hazards, Cambridge University Press, U.K.
2 Carter, W. Nick, (1991): Disaster Management, Asian Development Bank, Manila.
3 Sahni, Pardeep et.al. (eds.) (2002), Disaster Mitigation Experiences and Reflections, Prentice Hall of India, New Delhi.
4 Bryant Edwards (2005): Natural Hazards, Cambridge University Press, U.K.

Course Code	COST MANAGEMENT OF ENGINEERING PROJECTS						Course Type Core/PF/FE
OE942CE							elective
Prerequisite if any:	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	3	-	-	3	40	60	3

Course Objectives :

The course is taught with the objectives of enabling the student to:

1 Introduce the concepts of cost management

2 Fundamentals of cost overruns

3 Introduce the concepts of Quantitative techniques for cost management Linear Programming, PERT/CPM.

Course Outcomes :

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

CO-1 Understanding of strategic cost management process, control of cost and decision making based on the cost of the project.

CO-2 Ability to appreciative detailed engineering activities of the project and execution of projects

CO-3 Preparation of project report and network diagram

CO-4 Able to plan Cost Behavior , Profit Planning , Enterprise Resource Planning, Total Quality Management.

CO-5 Applications of various quantitative techniques for cost management

Course Articulation Matrix:

Course outcome	Program Outcome					
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CO-1	2	1	3	2	1	1
CO-2	3	2	1	1	2	-
CO-3	2	2	2	3	2	1
CO-4	1	3	1	2	1	1
CO-5	1	1	2	3	2	3

UNIT - I

Introduction and Overview of the Strategic Cost Management Process-Cost concepts in decision-making; relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System- Inventory valuation- Creation of a Database for operational control; Provision of data for Decision-Making.

UNIT – II

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning- Project execution as conglomeration of technical and non- technical activities- Detailed Engineering activities.

UNIT – III

Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process.

UNIT – IV

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems- Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector- Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints- Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets- Performance budgets- Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

UNIT – V

Quantitative techniques for cost management, Linear Programming, PERT/CPM,- Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

Suggested Reading:

1 Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi

2 Charles T. Horngren and George Foster, Advanced Management Accounting

3 Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting

4 Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher

5 N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

Course Code	BUSINESS ANALYTICS						Course Type Core/PF/FE
OE941CS							elective
Prerequisite if any:	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	3	-	-	3	40	60	3

Course Objectives :

The course is taught with the objectives of enabling the student to:

1 Understanding the basic concepts of business analytics and applications

2 Study various business analytics methods including predictive, prescriptive and prescriptive analytics

3 Prepare the students to model business data using various data mining, decision making methods

Course Outcomes :

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

CO-1 To understand the basic concepts of business analytics

CO-2 Identify the application of business analytics and use tools to analyze business data

CO-3 Become familiar with various metrics, measures used in business analytics

CO-4 Illustrate various descriptive, predictive and prescriptive methods and techniques

CO-5 Model the business data using various business analytical methods and techniques

Course Articulation Matrix:

Course outcome	Program Outcome					
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CO-1	2	1	3	2	1	1
CO-2	3	2	1	1	2	-
CO-3	2	2	2	3	2	1
CO-4	1	3	1	2	1	1
CO-5	1	1	2	3	2	3

UNIT – I

Introduction to Business Analytics: Introduction to Business Analytics, need and science of data driven (DD) decision making, Descriptive, predictive, prescriptive analytics and techniques, Big data analytics, Web and Social media analytics, Machine Learning algorithms, framework for decision making, challenges in DD decision making and future.

UNIT – II

Descriptive Analytics: Introduction, data types and scales, types of measurement scales, population and samples, measures of central tendency, percentile, decile and quadrille, measures of variation, measures of shape-skewness, data visualization.

UNIT – III

Forecasting Techniques: Introduction, time-series data and components, forecasting accuracy, moving average method, single exponential smoothing, Holt's method, Holt-Winter model, Croston's forecasting method, regression model for forecasting, Auto regression models, auto-regressive moving process, ARIMA, Theil's coefficient

UNIT – IV

Decision Trees: CHAID, Classification and Regression tree, splitting criteria, Ensemble and method and random forest. **Clustering**: Distance and similarity measures used in clustering, Clustering algorithms, K-Means and Hierarchical algorithms, **Prescriptive Analytics**-Linear Programming(LP) and LP model building.

UNIT – V

Six Sigma: Introduction, introduction, origin, 3-Sigma Vs Six-Sigma process, cost of poor quality, sigma score, industry applications, six sigma measures, DPMO, yield, sigma score, DMAIC methodology, Six Sigma toolbox.

Suggested Reading:

1 U Dinesh Kumar, "Data Analytics", Wiley Publications, 1st Edition, 2017

2 Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, "Business analytics Principles, Concepts, and Applications with SAS", Associate Publishers, 2015

3 S. Christian Albright, Wayne L. Winston, "Business Analytics - Data Analysis and Decision Making", 5th Edition, Cengage, 2015

Web Resources:

1 https://onlinecourses.nptel.ac.in/noc18-mg11/preview

2 https://nptel.ac.in/courses/110105089/

Course Code	ELEMENTS OF EMBEDDED SYSTEMS						Course Type Core/PF/FE
OE941EC							elective
Prerequisite	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	3	-	-	3	40	60	3

Course Objectives :

The course is taught with the objectives of enabling the student to:

1 Understanding various Embedded Design strategies

2 Designing Micro controller based Embedded Systems

3 Designing FPGA Based Embedded Systems

Course Outcomes :

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

CO-1 Understand Embedded Design Strategies and architecture of Arduino Board

CO-2 Program using various onboard components of Arduino

CO-3 Design real time interfacing with Arduino

CO-4 Understand Design Flow of FPGA, programming FPGA using Verilog HDL

CO-5 Implement combinational and sequential circuits using verilog HDL

Course Articulation Matrix:

Course outcome	Program Outcome					
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CO-1	2	1	3	2	1	1
CO-2	3	2	1	1	2	-
CO-3	2	2	2	3	2	1
CO-4	1	3	1	2	1	1
CO-5	1	1	2	3	2	3

UNIT – I

Embedded Systems Design Strategies: Micro Controller, DSP, FPGA, Introduction to Arduino (Micro controller Board), Components of Arduino, Architecture and Pin Configuration of ATMega328, Ports of ATMega328.

UNIT – II

Interfacing: Interfacing Switches, LEDs, Analog to Digital Converter, Digital to Analog Converter, Interfacing and Programming I2C, SPI

UNIT – III

Real Time Programming: Interfacing Key Pad, 7-segment display, LCD, Interfacing Sensors, Interfacing Stepper Motor**,** USB programming

UNIT – IV

FPGA Based Embedded Design: FPGA Design flow, Introduction to Verilog HDL**,** Basic building blocks, Data types of Verolog HDL, Behavioral Modelling, Data Flow Modelling, Structural Modelling, Hierarchal Structural Modelling, Case Studies on Verilog HDL descriptions of Basic Circuits

UNIT – V

Modelling of Circuits: Verilog HDL Implementation of Combinational MSI Circuits, Verilog HDL Implementation of Sequential MSI Circuits, Finite Sate Machine Design, Tasks and Functions, Introduction to Test Benches

Suggested Reading:

1 Ming-Bo Lin, Digital System Designs and Practices Using Verilog HDL and FPGAs, Wiley India, 2008
2 Samir Palnitkar, Verilog HDL: A Guide to Digital Design and Synthesis, Pearson Education, 2005
3 Simon Monk, Programming Arduino: Getting Started with sketches, Mc.Hill, 2016

Web Resources:

1 www.arduino.cc
2 www.learn.sparkfun.com/tutorials/arduino

Course Code	WASTE TO ENERGY						Course Type Core/PF/FE
OE941EE							elective
Prerequisite	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	3	-	-	3	40	60	3

Course Objectives :

The course is taught with the objectives of enabling the student to:

1 To know the various forms of waste

2 To understand the processes of Biomass Pyrolysis.

3 To learn the technique of Biomass Combustion.

Course Outcomes :

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

CO-1 Understand the concept of conservation of waste

CO-2 Identify the different forms of wastage.

CO-3 Chose the best way for conservation to produce energy from waste.

CO-4 Explore the ways and means of combustion of biomass.

CO-5 Develop a healthy environment for the mankind.

Course Articulation Matrix:

Course outcome	Program Outcome					
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CO-1	3	-	3	2	3	1
CO-2	3	-	3	2	3	1
CO-3	3	-	3	2	3	1
CO-4	3	-	3	2	3	1
CO-5	3	-	3	2	3	1

UNIT – I

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

UNIT – II

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNIT – III

Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation

UNIT – IV

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

UNIT – V

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

Suggested Reading:

1 Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.

2 Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.

3 Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.

4 Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

Course Code	POWER PLANT CONTROL AND INSTRUMENTATION						Course Type Core/PF/FE
OE942EE							elective
Prerequisite if any:	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	3	-	-	3	40	60	3

Course Objectives :

The course is taught with the objectives of enabling the student to:

1 The operation of different types of power plants.

2 The basic working principle of instruments for measurement of electrical and non-electrical quantities like Temperature Pressure flow level measurements.

3 The instrumentation and protection systems applied in thermal power plant.

4 The control techniques employed for the operation of modern power generation plant

Course Outcomes :

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

CO-1 Explain the different methods of power generation. Along with Piping and Instrumentation diagram of boiler.

CO-2 Select various measurements involved in power generation for measuring electrical and non-electrical parameters.

CO-3 Identify the different types of analyzers used for scrutinizing boiler steam and water.

CO-4 Model different types of controls and control loops in boilers.

CO-5 Illustrate the methods of monitoring and control of different parameters like speed, vibration of turbines

Course Articulation Matrix:

Course outcome	Program Outcome					
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CO-1	3	1	-	-	-	2
CO-2	3	1	-	-	-	2
CO-3	3	1	-	-	-	2
CO-4	3	1	-	-	-	2
CO-5	3	1	-	-	-	2

UNIT – I

Brief survey of methods of power generation, hydro, thermal, nuclear, solar and wind power, importance of instrumentation in power generation, thermal power plants, block diagram, details of boiler processes, Piping and Instrumentation diagram of boiler, cogeneration.

UNIT – II

Electrical measurements, current, voltage, power, frequency, power factor etc, non-electrical parameters, flow of feed water, fuel, air and steam with correction factor for temperature, steam pressure and steam temperature, drum level measurement, radiation detector, smoke density measurement, dust monitor.

UNIT – III

Flue gas oxygen analyzer: Analysis of impurities in feed water and steam, dissolved oxygen analyzer. Chromatography, pH meter, fuel analyzer, pollution monitoring instruments.

UNIT – IV

Combustion control, air / fuel ratio control, furnace draft control, drum level control, main steam and reheat steam temperature control, super heater control, air temperature, distributed control system in power plants, interlocks in boiler operation.

UNIT – V

Speed, vibration, shell temperature monitoring and control, steam pressure control, lubricant oil temperature control, cooling system.

Suggested Reading:

1. Sam G. Dukelow, The Control of Boilers, Instrument Society of America, 2nd Edition, 2010.
2. P.K. Nag, „Power Plant Engineering‟, Tata McGraw-Hill, 1st Edition, 2001.
3. S.M. Elonka and A.L. Kohal, “Standard Boiler Operations”, Tata McGraw-Hill, 1st Edition, 1994.
4. R K Jain, “Mechanical and Industrial Measurements”, Khanna Publishers, 1st Edition, 1995.
5. E Al Wakil, “Power Plant Engineering”, Tata McGraw-Hill, 1st Edition, 1984.

Course Code	OPERATIONS RESEARCH						Course Type Core/PF/FE
OE941ME							elective
Prerequisite if any:	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	3	-	-	3	40	60	3

Course Objectives:

The course is taught with the objectives of enabling the student to:

1 To understand the dynamic programming to solve problems of discrete and continuous variables

2 To apply the concept of non-linear programming and carry out sensitivity analysis

3 To understand deterministic and probabilistic inventory control models.

Course Outcomes:

After the completion of this course, the students shall be able to:

CO-1 To understand the basics of OR, including mathematical modeling, feasible solutions and optimization.

CO-2 Able to carry out sensitivity analysis.

CO-3 Apply PERT/CPM in project management.

CO-4 Select appropriate inventory control model.

CO-5 Able to apply dynamic programming and understand the concept of non-linear programming.

Course Articulation Matrix:

Course Outcome	Program Outcome					
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CO-1	1	1	3	2	1	2
CO-2	3	1	2	3	2	-
CO-3	1	3	3	1	2	2
CO-4	3	2	1	3	1	1
CO-5	2	1	3	2	2	2

UNIT–I

Development, Different Phases, Characteristics, Operations Research models and applications. Linear
Programming Problem: Introduction, Basic Assumptions, Formulation, graphical method, simplex method: Big M and Two Phase method.

UNIT–II

DUALITY: Duality theory, primal-dual relationships, Economic interpretation, Dual simplex method,
Post optimal or sensitivity analysis.

UNIT–III

Project Management: Introduction to PERT and CPM, critical Path calculation, float calculation and its importance. Cost reduction by Crashing of activity.
Inventory models – Economic order quantity models – Quantity discount models – Stochastic inventory models – Multi product models – Inventory control models in practice.

UNIT–IV

Sequencing Models: Introduction, General assumptions, processing n jobs through 2 machines, processing 'n' jobs through m machines.
Game Theory: Introduction, Characteristics of Game Theory, Dominance theory, Mixed strategies (2 x 2, m x 2), Algebraic and graphical methods.
Nonlinear programming problem: - Kuhn-Tucker conditions.

UNIT–V

Queuing models - Queuing systems and structures – Notation parameter – Single server and multi server models – Poisson arrivals – Exponential service times – with finite population – Infinite population. Dynamic Programming: Characteristics, principle of optimality, deterministic problems.

Suggested Reading:

1 H.A. Taha, OperationsResearch,AnIntroduction,PHI,2008
2 H.M. Wagner, Principles of Operations Research, PHI,Delhi,2010
3 J.C.Pant,IntroductiontoOptimization:OperationsResearch,JainBrothers,Delhi, 2008.
4 Frederick S. Hillier, Gerald J. Lieberman, Operations Research, 10thEdition, McGraw Hill
Pub. 2017.
5 Pannerselvam, Operations Research: Prentice Hall of India, 2010.
6 Ronald L. Rardin, Optimization in Operations Research, First Indian Reprint, Pearson Education Asia. 2002,

Course Code	COMPOSITE MATERIALS						Course Type Core/PF/FE
OE942ME							elective
Prerequisite	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	3	-	-	3	40	60	3

Course Objectives :

The course is taught with the objectives of enabling the student to:

1 Study the concepts of composite construction.

2 Learn analysis and designs of composite beams, floors, columns and trusses as per the recommendations of IS codes of practice.

3 Apply the concepts for design of multi-storey composite buildings.

4 Scope of analysis is restricted to skeletal structures subjected to prescribed dynamic loads.

Course Outcomes :

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

CO-1 Understand the fundamentals of composite construction, and analysis and designs of composite beams.

CO-2 Analyse and design the composite floors

CO-3 Select suitable materials for composite columns,

CO-4 Analyse composite trusses and understand connection details.

CO-5 Analyse and design the multi-storey composite buildings

Course Articulation Matrix:

Course outcome	Program Outcome					
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CO-1	2	1	3	2	1	1
CO-2	3	2	1	1	2	-
CO-3	2	2	2	3	2	1
CO-4	1	3	1	2	1	1
CO-5	1	1	2	3	2	3

UNIT – I

Introduction of composite constructions: Benefits of composite construction - Introduction to IS - BS and Euro codal provisions. Composite beams: Elastic behaviour of composite beams - No and full interaction cases - Shear connectors - Ultimate load behaviour - Serviceability limits - Effective breadth of flange - Interaction between shear and moment - Basic design consideration and design of composite beams.

UNIT – II

Composite floors: Structural elements - Profiled sheet decking - Bending resistance - Shear resistance - Serviceability criterion - Analysis for internal forces and moments - Design of composite floors.

UNIT – III

Composite columns: Materials - Concrete filled circular tubular sections - Non-dimensional slenderness - Local buckling of steel sections - Effective elastic flexural stiffness - Resistance of members to axial compressions - Composite column design - Fire resistance.

UNIT – IV

Composite trusses: Design of truss - Configuration - Truss members - Analysis and design of composite trusses and connection details.

UNIT – V

Design of multi-storey composite buildings: Design basis - Load calculations - Design of composite slabs with profile decks - Composite beam design - Design for compression members - Vertical cross bracings - Design of foundation.

Suggested Reading:

1. R.P. Johnson, "Composite Structures of Steel and Concrete - Beams, Slabs, Columns and Frames in Buildings", Blackwell Publishing, Malden, USA, 2004.
2. "INSDAG Teaching Resources for Structural Steel Design", Vol-2, Institute for Steel Development and Growth Publishers, Calcutta, India.
3. "INSDAG Handbook on Composite Construction – Multi-Storey Buildings", Institute for Steel Development and Growth Publishers, Calcutta, India.
4. "INSDAG Design of Composite Truss for Building", Institute for Steel Development and Growth Publishers, Calcutta, India.
5. "INSDAG Handbook on Composite Construction – Bridges and Flyovers", Institute for Steel Development and Growth Publishers, Calcutta, India.
6. IS: 11384-1985, "Code of Practice for Composite Construction in Structural Steel and Concrete", Bureau of Indian Standards, New Delhi, 1985.

Course Code	INDUSTRIAL SAFETY						Course Type Core/PF/FE
OE943ME							elective
Prerequisite if any:	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	3	-	-	3	40	60	3

Course Objectives :

The course is taught with the objectives of enabling the student to:

1 Causes for industrial accidents and preventive steps to be taken.
2 Fundamental concepts of Maintenance Engineering.
3 About wear and corrosion along with preventive steps to be taken
4 The basic concepts and importance of fault tracing.
5 The steps involved in carrying out periodic and preventive maintenance of various equipments used in industry

Course Outcomes :

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

CO-1 Identify the causes for industrial accidents and suggest preventive measures.
CO-2 Identify the basic tools and requirements of different maintenance procedures.
CO-3 Apply different techniques to reduce and prevent Wear and corrosion in Industry.
CO-4 Identify different types of faults present in various equipments like machine tools, IC Engines, boilers etc.
CO-5 Apply periodic and preventive maintenance techniques as required for industrial equipments like motors, pumps and air compressors and machine tools etc

Course Articulation Matrix:

Course outcome	Program Outcome					
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CO-1	2	1	3	2	1	1
CO-2	3	2	1	1	2	-
CO-3	2	2	2	3	2	1
CO-4	1	3	1	2	1	1
CO-5	1	1	2	3	2	3

UNIT – I

Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes, Fire prevention and firefighting, equipment and methods.

UNIT – II

***Fundamentals of Maintenance Engineering*:** Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

UNIT – III

Wear and Corrosion and their Prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications of Screw down grease cup, Pressure grease gun, Splash lubrication, Gravity lubrication, Wick feed lubrication, Side feed lubrication, Ring lubrication, Definition of corrosion, principle and factors affecting the corrosion, Types of corrosion, corrosion prevention methods.

UNIT – IV

Fault Tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, any one machine tool, Pump, Air compressor, Internal combustion engine, Boiler, Electrical motors, Types of faults in machine tools and their general causes.

UNIT – V

Periodic and Preventive Maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of Machine tools, Pumps, Air compressors, Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance.

Course Code	INTELLECTUAL PROPERTY RIGHTS						Course Type
OE 941 LA							elective
Prerequisite if any:	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	3	-	-	3	40	60	3

Course Objectives :

The course is taught with the objectives of enabling the student to:

1 Acquaint the students with basics of intellectual property rights with special reference to Indian Laws and its practices.

2 Compare and contrast the different forms of intellectual property protection in terms of their key differences and similarities.

3 Provide an overview of the statutory, procedural, and case law underlining these processes and their interplay with litigation.

Course Outcomes :

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

CO-1 Understand the concept of intellectual property rights.

CO-2 Develop proficiency in trademarks and acquisition of trade mark rights.

CO-3 Understand the skill of acquiring the copy rights, ownership rights and transfer.

CO-4 Able to protect trade secrets, liability for misappropriations of trade secrets.

CO-5 Apply the patents and demonstration of case studies.

Course Articulation Matrix:

Course outcome	Program Outcome					
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
CO-1	2	1	3	2	1	1
CO-2	3	2	1	1	2	-
CO-3	2	2	2	3	2	1
CO-4	1	3	1	2	1	1
CO-5	1	1	2	3	2	3

UNIT – I

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patentingand Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT – II

Trade Marks: Purpose and function of trademarks, acquisition of trade mark rights, protectable matter, selecting, and evaluating trade mark, trade mark registration processes.

UNIT – III

Law of copy rights: Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right, international copy right law. Law of patents: Foundation of patent law, patent searching process, ownership rights and transfer**.**

UNIT – IV

Trade Secrets: Trade secrete law, determination of trade secrete status, liability for misappropriations of trade secrets, protection for submission, trade secrete litigation. Unfair competition: Misappropriation right of publicity, false advertising.

UNIT – V

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

Suggested Reading:

1 Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd, 2007.
2 “Mayall, “Industrial Design”, McGraw Hill,1992
3 “Niebel, “Product Design”, McGraw Hill,1974.
4 “Asimov, “Introduction to Design”, Prentice Hall,1962.
5 “Robert P. Merges, Peter S. Menell, Mark A. Lemley, “Intellectual Property in New Technological Age”,2016.
6 T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand,2008

Course Code	MINI PROJECT						Course Type Core/PF/FE
EE372							core
Prerequisite if any:	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
		-	4	3	50	-	2

Course Objectives

- To review available literature and formulate structural engineering problems
- To learn the technique of writing reports and prepare presentation

Course Outcomes

After the completion of this course, the students shall be able to:

1. Formulate a specific problem and give solution
2. Develop model/models either theoretical/practical/numerical form
3. Solve, interpret/correlate the results and discussions
4. Conclude the results obtained
5. Write the documentation in standard format

Guidelines

- As part of the curriculum in the II- semester of the programme each student shall do a mini project, generally comprising about three to four weeks of prior reading, twelve weeks of active research, and finally a presentation of their work for assessment.
- Each student will be allotted to a faculty supervisor for mentoring.
- Mini projects should present students with an accessible challenge on which to demonstrate competence in research techniques, plus the opportunity to contribute something more original.
- Mini projects shall have inter-disciplinary/ industry relevance.
- The students can select a mathematical modelling based/Experimental investigations or Numerical modelling
- All the investigations should be clearly stated and documented with the reasons/explanations.
- The mini-project shall contain a clear statement of the research objectives, background of work, literature review, techniques used, prospective deliverables, and detailed discussion on results, conclusions and reference

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Course Articulation Matrix:

Course outcome	Programme outcome					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	2	-	-	2
CO2	3	3	2	-	-	2
CO3	3	3	2	-	-	2
CO4	3	3	2	-	-	2
CO5	3	3	2	-	-	2

Departmental committee: Supervisor and a minimum of two faculty members

Guidelines for awarding marks in CIE (Continuous Internal Evaluation): Max. Marks: 50		
Evaluation by	**Max. Marks**	**Evaluation Criteria / Parameter**
Supervisor	20	Progress and Review
	05	Report
Departmental Committee	05	Relevance of the Topic
	05	PPT Preparation
	05	Presentation
	05	Question and Answers
	05	Report Preparation

Course Code	POWER ELECTRONIC SYSTEMS LABORATORY - II						Course Type Core/PF/FE
EE362							core
Prerequisite if any:	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
		-	2	3	50	-	1

Course Objectives

- To design the parameters of Rectifier circuits.
- To understand the requirements of solar panels for a given load.
- To work out the specifications of wind turbines to cater to a particular load
- To learn the usage of DSP controllers in power electronic circuits
- To implement control strategies for power electronic circuits using DSP controllers

Course Outcomes

After the completion of this course, students will be able to:

1. Design the basic design of L and C parameters in rectifier circuits
2. Design the solar panels required for a given rating of the system/load
3. Calculate the rating of wind turbine based on the given load parameters
4. Load the code using DSP Controller into a power electronic circuit
5. Understand the various components used in implementation of power electronic circuit and their basic design.

Course Articulation Matrix:

Course outcome	Programme outcome					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	2	3	-	2
CO2	3	3	2	3	-	2
CO3	3	3	2	3	-	2
CO4	3	3	2	3	-	2
CO5	3	3	2	3	-	2

List of Experiments

- Half-controlled Rectifier
- Power flow Controller
- Solar PV characteristicsWind Turbine characteristics

- 3-phase Inverter using DSP Controller TMS320F28335 in 180° mode of operation
- 3-phase Inverter using DSP Controller TMS320F28335 in 120° mode of operation
- Implementation of sinusoidal PWM technique using DSP Controller TMS320F28335

Course Code	POWER ELECTRONIC SYSTEMS LABORATORY - III						Course Type Core/PF/FE
EE363							core
Prerequisite if any:	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
		-	2	3	50	-	1

Course Objectives

- To Understand the utilization MATLAB Fuzzy Logic tool box
- To learn the to implement MPPT algorithms
- To learn to train Artificial Neural Network using MATLAB tool box
- To test GA on benchmark functions using GA tool box.
- To reduce the THD in Multilevel inverters

Course Outcomes

After the completion of this course, students will be able to:

- Implementation of MATLAB Fuzzy Logic tool box to built the controllers
- Implement Fuzzy based MPPT algorithms
- Implement Artificial Neural Network using MATLAB tool box for Speed Control of Solar Powered DC Motor
- Could able to test the benchmark functions using GA tool box.
- Could able to minimize the THD in Multilevel inverters using GA/PSO/LP/NLP

Course Articulation Matrix:

Course outcome	Programme outcome					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	2	3	-	3
CO2	3	3	2	3	-	3
CO3	3	3	2	3	-	3
CO4	3	3	2	3	-	3
CO5	3	3	2	3	-	3

List of Experiments

1. Implementation of Fuzzy Logic: developing membership functions, fuzzification, defuzzification and rule base processes

2. Implementation of Fuzzy Logic controller using tool box

3. Implementation of Fuzzy based MPPT

4. Implementation of Artificial Neural Network: data generation, training and validation

5. Implementation of ANN using tool box. ANN Based Speed Control of Solar Powered DC Motor

6. Developing program for Genetic algorithm process: population generation, selection, cross over and mutation.

7. Testing GA on benchmark functions using GA tool box.

8. Conventional LP and NLP using optimization tool box and testing on benchmark functions.

9. Developing program for Particle swarm Optimization and testing on benchmark functions.

10. THD minimization in Multilevel inverters using GA/PSO/LP/NLP

	SEMESTER-III							
1	Audit Course – I (Online)	**AC030EE**	Engineering Research Methodology in Electrical Engineering	2	-	40	60	NC
2	Audit Course – II (Online)	**AC031**	English for Academic Research Writing	2	-	40	60	NC
		AC032	Disaster Mitigation & Management					
		AC033	Sanskrit for Technical Knowledge					
		AC034	Value Education					
		AC035	Stress Management by Yoga					
		AC036	Personality Development Through Life Enlightenment Skills					
		AC037	Constitution of India					
		AC038	Pedagogy Studies					
3		**EE381**	Major Project Phase – I Dissertation	-	20*	100		10
	TOTAL			**4**	**20**	**180**	**120**	**10**

Course Code	ENGINEERING RESEARCH METHODOLOGY IN ELECTRICAL ENGINEERING						Course Type Core/PF/FE
AC030EE							Audit course
Prerequisite if any:	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	2	-	-	3	40	60	NC

Course Objectives

- To learn the research types, methodology and formulation.
- To know the sources of literature, survey, review and quality journals.
- To understand the research design for collection of research data.
- To understand the research data analysis, writing of research report and grant proposal.

Course Outcomes:

After the completion of this course, students shall be able to:

1. Know the importance of research, the method and the methodology adopted.
2. Do a proper research design for a given research topic.
3. Do the literature survey and the review.
4. Analyze and solve the statistical methods used for the research.
5. Write technical report, research proposals.

Course Articulation Matrix:

Course outcome	Programme outcome					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	-	-	-	2
CO2	3	3	-	-	-	2
CO3	3	3	-	-	-	2
CO4	3	3	-	-	-	2
CO5	3	3	-	-	-	2

UNIT - I

Research Methodology: Objectives and Motivation of Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Importance of Research Methodology, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India, Benefits to the society in general.

Defining the Research Problem: Definition of Research Problem, Problem Formulation, Necessity of Defining the Problem, Techniques involved in Defining a Problem.

UNIT - II

Literature Review: Importance of Literature Survey, Sources of Information, Assessment of Quality of Journals and Articles, Information through Internet, Need of Review, Guidelines for Review, Record of Research Review. A review of the smart grid concept for electrical power system, Multilevel Inverters for High Power Applications, Direct Torque Control of Induction Machine: A Review.

UNIT - III

Research Design: Meaning of Research Design, Need of Research Design, Feature of a Good Design, Important concepts related to Research Design, Different Research Designs, Basic Principles of Experimental Design, Developing a Research Plan, Design of Experimental Set-up, Use of Standards and Codes.

UNIT - IV

Data Collection and Analysis: Collection of primary data, Secondary data, Data organization, Methods of data grouping, Diagrammatic representation of data, Graphic representation of data. Sample Design, Need for sampling, some important sampling definitions, Estimation of population, Role of Statistics for Data Analysis, Parametric V/s Non-Parametric methods, Descriptive Statistics, Processing and Analysis of Data.

UNIT - V

Research Report Writing, Publishing: Format of the Research report, Style of writing report, References/Bibliography/Webliography, Preparing the List of Works, Cited, Technical paper writing/Journal report writing. Considerations when selecting a target journal, submitting a manuscript, how to respond to editors and referees, A process for preparing a manuscript. Plagiarism and Academic Integrity.

Research Proposal Preparation: Funding agencies in India and across the Globe, writing a Research Proposal and Research Report, Writing Research Grant Proposal: Minor and Major Research proposals (UGC and AICTE).

References

1. C.R Kothari, Research Methodology, Methods & Technique; New Age International Publishers, 2004
2. R. Ganesan, Research Methodology for Engineers, MJP Publishers, 2011
3. Vijay Upagade and AravindShende, Research Methodology, S. Chand & Company Ltd., New Delhi, 2009
4. P.Ramdass and Wilson Aruni; Research and Writing across the disciplines; MJP Publishers, Chennai, 2009.
5. Margaret Cargill and Patrick O'Connor: Writing Scientific Research Articles Strategy and Steps, A John Wiley & Sons, Ltd., Publication, 2009.
6. MLA Handbook for Writers of Research Papers, The modern language association of America, New York 2009.
7. Dr. CH. Siva Kumar, Dr. G. Mallesham, Engineering Research Methodology: Principles and Practices, Publishers: Amazon Kindle, February 1, 2025.

Course Code	ENGLISH FOR ACADEMIC AND RESEARCH WRITING						Core / Elective
AC031							Humanities and Social Sciences
Prerequisite if any:	Contact Hours per Week				CIE	SEE	Audit course
	L	T	D	P			Credits
NC	2				40	60	0 (audit course)

Course Objectives: To expose the students to...

- features of Academic writing; different kinds of Academic writing
- some academic writing skills; the research process; the structure of a research document

Course Outcomes: At the end of the course, the students would be equipped with the knowledge and skills relating to ...

- Academic writing features; Academic writing kinds; Important academic writing skills

The process of research; general research document structure

Unit I: Features of Academic Writing

Language: Clear, Correct, Concise, Inclusive; **Tone**: Formal, Objective, Cautious; **Style**: Appropriate, Accurate, Organized; **Ethics**: Honesty, Integrity, Responsibility, Accountability

Unit II: Kinds of Academic Writing

Essays, Reports, Reviews, Abstracts, Proposals

Unit III: Academic Writing Skills

Paraphrasing; Summarizing; Quoting; Rewriting; Expansion

Unit IV: **Research Process**

Selection of Topic, Formulation of Hypothesis, Collection of Data, Analysis of Data, Interpretation of Data, Presentation of Data

Unit V: Structure of a Research Document

Title, Abstract, Introduction, Literature Survey, Methodology, Discussion, Findings/Results,
Conclusion, Documenting Sources (IEEE style)

Suggested Reading

Bailey, S. (2014). *Academic writing: A handbook for international students*. Routledge.

Gillett, A., Hammond, A., &Martala, M. (2009). *Inside track: Successful academic writing*. Essex: Pearson Education Limited.

Griffin, G. (2006). *Research methods for English studies*. Edinburgh: Edinburgh University Press.

Silyn-Roberts, Heather. (2013). *Writing for Science and Engineering: Papers, Presentations and Reports*(2nd ed.). Elsevier.

Lipson, Charles (2011). *Cite right: A quick guide to citation styles; MLA,APA, Chicago, the sciences, professions, and more* (2nd ed.). Chicago[u.a.]: University of Chicago Press.

Course Code	DISASTER MITIGATION & MANAGEMENT						Course Type Core/PF/FE
AC032							Audit course
Prerequisite if any:	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	2	-	-	3	40	60	NC

Course Objectives

- To impart knowledge in students about the nature, causes, consequences and mitigation measures of the various natural disasters
- To enable the students to understand risks, vulnerabilities and human errors associated with human induced disasters
- To enable the students to understand and assimilate the impacts of any disaster on the affected area depending on its position/ location, environmental conditions, demographic, etc.

Course Outcomes

After the completion of this course, the students shall be able to:

1. Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and Humanitarian response
2. Critically evaluate disaster risk reduction and humanitarian response policy and Practice from multiple perspectives.
3. Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
4. Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in**.**

Course Articulation Matrix:

Course outcome	Programme outcome					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	3	-	-	2
CO2	3	-	3	-	-	2
CO3	3	-	3	-	-	2
CO4	3	-	3	-	-	2

UNIT I

Introduction: Disaster Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

UNIT II

Repercussions of Disasters and Hazards: Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem.

Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, industrial accidents, oil slicks and spills, outbreaks of disease and epidemics, war and conflicts

UNIT III

Disasters Prone Areas in India: Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics

UNIT IV

Disaster Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT V

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival.

Disaster Mitigation: Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation in India.

References

1 R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies", New Royal Book Company.

2 Sahni, Pardeep et al. (Eds.), "Disaster Mitigation Experiences and Reflections", Prentice Hall ofIndia, New Delhi.

3 Goel S. L., "Disaster Administration and Management Text and Case Studies", Deep & Deep Publication Pvt. Ltd., New Delhi.

Course Code	SANSKRIT FOR TECHNICAL KNOWLEDGE						Course Type Core/PF/FE
AC033							Audit course
Prerequisite	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	2	-	-	3	40	60	NC

Course Objectives

- To get a working knowledge in illustrious Sanskrit, the scientific language in the world
- To learn Sanskrit to improve brain functioning and enhancing the memory power
- To learn Sanskrit to develop the logic in mathematics, science & other subjects
- The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient Indian literature

Course Outcomes

After the completion of this course, the students shall be able to:

1. Understand basic Sanskrit language
2. Understand ancient Sanskrit literature about science & technology
3. Develop logic in students, Sanskrit being a logical language

Course Articulation Matrix:

Course outcome	Programme outcome					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	-	3	-	-	-	2
CO2	3	3	-	-	-	2
CO3	3	3	-	-	-	2

Syllabus Contents

UNIT-I

- Alphabets in Sanskrit, Past/Present/Future Tense,Simple Sentences

UNIT-II

- Order Introduction of roots, Technical information about Sanskrit Literature

UNIT-III

- Technical concepts of Engineering-Electrical, Mechanical,Architecture, Mathematics

References:

1 "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi

2 "Teach Yourself Sanskrit" Prathama Deeksha-VempatiKutumbshastri, RashtriyaSanskritSansthanam, New Delhi Publication

3 "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

Course Code	VALUE EDUCATION						Course Type Core/PF/FE
AC034							Audit course
Prerequisite	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	2	-	-	3	40	60	NC

Course Objectives

- Understand the need for and importance of Values for self-development and for National development.
- Imbibe good human values and Morals
- Cultivate individual and National character.

Course Outcomes

After the completion of this course, the students shall be able to:

1. Gain necessary Knowledge for self-development
2. Learn the importance of Human values and their application in day-to-day professional life.
3. Develop overall personality.

Course Articulation Matrix:

Course outcome	Programme outcome					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	3	-	-	-	2
CO2	2	3	-	-	-	2
CO3	2	3	-	-	-	2

UNIT I

Values and self-development –Social values and individual attitudes. Work ethics Indian vision of humanism. Moral and non- moral valuation. Standards and principles.Value judgments.

UNIT II

Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration.Truthfulness, Cleanliness.Honesty, Humanity. Power of faith, National Unity. Patriotism.

.**UNIT III**

Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour. Universal brotherhood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits.Association and Cooperation.

UNIT IV

Doing best for saving nature Character and Competence –Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control.Honesty, Studying effectively.

References

1 Chakroborty, S.K., *"Values & Ethics for organizations Theory and practice*", Oxford University Press, New Delhi, 1998.

Course Code	STRESS MANAGEMENT BY YOGA						Course Type Core/PF/FE
AC035							Audit course
Prerequisite if any:	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	2	-	-	3	40	60	NC

Course Objectives

- Creating awareness about different types of stress and the role of yoga in the management of stress.
- Promotion of positive health and overall wellbeing (Physical, mental, emotional, social and spiritual).
- Prevention of stress related health problems by yoga practice.

Course Outcomes

After the completion of this course, the students shall be able to:

1. Understand yoga and its benefits.
2. Enhance Physical strength and flexibility.
3. Learn to relax and focus.
4. Relieve physical and mental tension through asanas.
5. Improve work performance and efficiency.

Course Articulation Matrix:

Course outcome	Programme outcome					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	-	2	-	-	-	1
CO2	-	2	-	-	-	1
CO3	-	2	-	-	-	1
CO4	-	2	-	-	-	1
CO5	-	2	-	-	-	1

UNIT I

Introduction: Definition of **Stress** – Types of stress: Acute and chronic - Stressors – Definition of **Yoga** from various sources – Types of yoga – Karma yoga, Gnana yoga, Bhakti yoga and Raja yoga – Concept of Bhagavad Geeta - Yoga versus exercise –Basics of Physiology and Psycholoy – Brain and its parts – CNS and PNS – HPA axis – Sympethetic and Para sympethetic nervous systems – Fight and Flight mechanism - Relationship between stress and yoga.

UNIT II

Ashtanga Yoga: Do`s and Don'ts in life: (i) **Yam** - Ahinsa, satya, astheya, bramhacharya and aparigraha (ii) **Niyam**-Shaucha, santosh, tapa, swadhyay, ishwarpranidhan (iii) **Asana** (iv) **Pranayama (**v) **Prathyahara (**vi) **Dharana** (vii) **Dhyana (**viii) **Samadhi** – Illustrations of eight steps of Ashtanga yoga.

UNIT III

Asana and Stress: Definition of Asana from Pathanjali – Origin of various names of asanas - Various yoga poses and their benefits for mind & body – Sequence of performing asanas: Standing, sitting, lying down on stomach, lying down on back and inverted postures – Activation of Annamayakosha – Effect on various chakras, systems and glands thereby controlling the stress levels through the practice of asanas.

UNIT IV

Pranayama and Stress: Definition of pranayama from Shankaracharya - Regularization of breathing techniques and its effects - Types of pranayama – Heat generating and cold generating techniques – Pranayama versus chakras and systems – Breathing techniques versus seasons - Anger and breathing rate – Activation of pranamayakosha – Pranayama as the bridge between mind and body – Stress control through pranayama.

UNIT V

Dhyana and Stress: Distinction between Dhyana and Dharana– Preparation for Dhyana through prathyahara and dharana – Activation of Vignanamayakosha – Types of mind: conscious, superconscious and subconscious – Activation of manomayakosha through Dhyana – Silencing the mind thereby controlling the stress levels.

References

1 '*Yogic Asanas for Group Tarining-Part-I*" : Janardan Swami YogabhyasiMandal, Nagpur

2 "*Rajayoga or Conquering the Internal Nature*" by Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata

3 *"Light on Yoga"* by BKS Iyengar

4 "*The search for happiness and bliss*" by Swami Sarvapriyananda on you tube – https://youtu.be/xfywJTPkw7Y

5 "*Mastering the mind*" by SwaminiVimalananda on you tube - https://youtu.be/EXniWH9DMF8

Course Code	PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS						Course Type Core/PF/FE
AC036							Audit course
Prerequisite if any:	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	2	-	-	3	40	60	NC

Course Objectives

- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

Course Outcomes

After the completion of this course, the students shall be able to:

1. Develop their personality and achieve their highest goal of life.
2. Lead the nation and mankind to peace and prosperity.
3. Practice emotional self-regulation.
4. Develop a positive approach to work and duties.
5. Develop a versatile personality.

Course Articulation Matrix:

Course outcome	Programme outcome					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	-	2	-	-	-	1
CO2	-	2	-	-	-	1
CO3	-	2	-	-	-	1
CO4	-	2	-	-	-	1
CO5	-	2	-	-	-	1

UNIT I

Neetisatakam-Holistic development of personality Verses- 19,20,21,22 (wisdom), Verses-29,31,32 (pride & heroism), Verses- 26,28,63,65 (virtue),Verses- 52,53,59 (dont's),Verses-71,73,75,78 (do's)

UNIT II

Approach to day-to-day work and duties. Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48, Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35, Chapter 18-Verses 45, 46, 48.

UNIT III

Statements of basic knowledge. Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 Chapter 12 -Verses 13, 14, 15, 16, 17, 18 Personality of Role model. Shrimad Bhagwad Geeta: Chapter2-Verses 17, Chapter 3-Verses 36, 37, 42, Chapter 4-Verses 18, 38, 39 Chapter18 – Verses 37, 38, 63

References

1 Swami SwarupanandaAdvaita Ashram "*Srimad Bhagavad Gita",* (Publication Department), Kolkata

2 P.Gopinath, *"Bhartrihari's Three Satakam (Niti-sringar-vairagya*)", Rashtriya Sanskrit Sansthanam, New Delhi

Course Code	CONSTITUTION OF INDIA						Course Type Core/PF/FE
AC036							Audit course
Prerequisite if any:	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	2	-	-	3	40	60	NC

Course Objectives

- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role
- Entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.

Course Outcomes

After the completion of this course, the students shall be able to:

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru
4. The eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
5. Discuss the passage of the Hindu Code Bill of 1956.

Course Articulation Matrix:

Course outcome	Programme outcome					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	-	2	-	-	-	-
CO2	-	2	-	-	-	-
CO3	-	2	-	-	-	-
CO4	-	2	-	-	-	-
CO5	-	2	-	-	-	-

UNIT I

History of Making of the Indian Constitution: History, Drafting Committee, (Composition & Working)

UNIT II
Philosophy of the Indian Constitution: Preamble**,** Salient Features

UNIT III
Contours of Constitutional Rights & Duties: Fundamental Rights**,** Right to Equality**,** Right to Freedom, Right against Exploitation, Right to Freedom of Religion**,** Cultural and Educational Rights**,** Right to Constitutional Remedies**,** Directive Principles of State Policy**,** Fundamental Duties.

UNIT IV
Organs of Governance: Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions

UNIT V
Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CE of Municipal Corporation. Panchayati raj: Introduction, PRI: ZilaPanchayat. Elected officials and their roles, CEO ZilaPanchayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.

UNIT VI
Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

References

1 *"The Constitution of India",* 1950 (Bare Act), Government Publication.

2 Dr. S. N. Busi, *"Dr. B. R. Ambedkar framing of Indian Constitution",* 1st Edition, 2015.

3 M. P. Jain, "*Indian Constitution Law",* 7th Edn., Lexis Nexis, 2014.

Course Code	PEDAGOGY STUDIES						Course Type Core/PF/FE
AC038							Audit course
Prerequisite if any:	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	2	-	-	3	40	60	NC

Course Objectives

- To present the basic concepts of design and policies of pedagogy studies.
- To provide understanding of the abilities and dispositions with regard to teaching techniques, curriculum design and assessment practices and familiarize various theories of learning and their connection to teaching practice.
- To create awareness about the practices followed by DFID, other agencies and other researchers and provide understanding of critical evidence gaps that guides the professional development

Course Outcomes

After the completion of this course, the students shall be able to:

1. Illustrate the pedagogical practices followed by teachers in developing countries both in formal and informal classrooms.
2. Examine the effectiveness of pedagogical practices.
3. Understand the concept, characteristics and types of educational research and perspectives of research.
4. Describe the role of classroom practices, curriculum and barriers to learning.
5. Understand Research gaps and learn the future directions.

Course Articulation Matrix:

Course outcome	Programme outcome					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	-	2	-	-	-	1
CO2	-	2	-	-	-	1
CO3	-	2	-	-	-	1
CO4	-	2	-	-	-	1
CO5	-	2	-	-	-	1

UNIT I

Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions, Overview of methodology and Searching.

UNIT II

Thematic Overview: Pedagogical practices followed by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education

UNIT III

Evidence on the Effectiveness of Pedagogical Practices: Methodology for the in-depth stage: quality assessment of included studies - How can teacher education (curriculum and Practicum) and the school curriculum and guidance material best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches – Teachers attitudes and beliefs and pedagogic strategies.

UNIT IV

Professional Development: Alignment with classroom practices and follow up support - Support from the head teacher and the community – Curriculum and assessment - Barriers to learning: Limited resources and large class sizes.

UNIT V

Research Gaps and Future Directions: Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment – Dissemination and research impact.

References

1 Ackers J, Hardman F, *"Classroom Interaction in Kenyan Primary Schools, Compare*", 31 (2): 245 – 261, 2001.

2 2. Agarwal M, *"Curricular Reform in Schools: The importance of evaluation*", Journal of Curriculum Studies, 36 (3): 361 – 379, 2004.

3 Akyeampong K, "*Teacher Training in Ghana – does it count? Multisite teacher education research project (MUSTER)",* Country Report 1. London: DFID, 2003.

4 Akyeampong K, Lussier K, Pryor J, Westbrook J, *"Improving teaching and learning of Basic Maths and Reading in Africa: Does teacher Preparation count?"*International Journal Educational Development, 33 (3): 272- 282, 2013.

5 Alexander R J, *"Culture and Pedagogy: International Comparisons in Primary Education",* Oxford and Boston: Blackwell, 2001.

6 Chavan M, Read India: *"A mass scale, rapid, learning to read campaign",* 2003

7 *www.pratham.org/images/resource%20working%20paper%202.pdf.*

Course Code	MAJOR PROJECT PHASE - I						Course Type Core/PF/FE
EE381							core
Prerequisite if any:	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	20	-	-	-	100		10

Course Objectives

- To identify the research problem.
- To perform literature survey.

Course Outcomes

After the completion of this course, the students shall be able to:

1. Exposed to self-learning of various topics.
2. Learn to survey the literature such as books, journals and contact resource persons for the selected topic of research.
3. Learn to write technical reports.
4. Develop oral and written communication skills to present.
5. Defend their work in front of technically qualified audience

Course Articulation Matrix:

Course outcome	Programme outcome					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	2	-	-	2
CO2	3	3	2	-	-	2
CO3	3	3	2	-	-	2
CO4	3	3	2	-	-	2
CO5	3	3	2	-	-	2

Guidelines

- The Project work will preferably be a problem with research potential and should involve scientific research, design, generation/collection and analysis of data, determining solution and must preferably bring out the individual contribution.
- Seminar should be based on the area in which the candidate has undertaken the dissertation work.
- The CIE shall include reviews and the preparation of report consisting of a detailed problem statement and a literature review.

- The preliminary results (if available) of the problem may also be discussed in the report.
- The work must be presented in front of the committee consists of Chairperson-BoS, Osmania University and Head, Supervisor & Project coordinator from the respective Department of the Institute.

- The candidate must be in regular contact with his supervisor and the topic of dissertation must be mutually decided by the guide and student.

Guidelines for awarding marks in CIE (Continuous Internal Evaluation): Max. Marks: 100		
Evaluation by	**Max. Marks**	**Evaluation Criteria / Parameter**
Supervisor	30	Problem formulation
	10	Literature review
	10	Proposed methodology
	10	Documentation
	50	Total
Departmental Committee (Chairperson BoS, Osmania University and Head, Supervisor & Project coordinator from the respective department of the institution)	15	Relevance of the Topic
	15	PPT Preparation
	10	Documentation
	10	Question and Answers
	50	Total

Note: The Supervisor has to assess the progress of the student regularly.

***The student has to work a minimum of 20 hours/week at Dissertation – I**

	SEMESTER-IV							
1		**EE382**	Major Project Phase – II Dissertation	-	32*	100	100	16

Course Code	MAJOR PROJECT PHASE - II						Course Type Core/PF/FE
EE282							core
Prerequisite if any:	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	32	-	-	-	100	100	16

Course Objectives

- To identify the research problem.
- To perform literature survey.

Course Outcomes

1. Use different experimental techniques and will be able to use different software/ computational /analytical tools.
2. Design and develop an experimental set up/ equipment/test rig.
3. Conduct tests on existing set ups/equipment's and draw logical conclusions from the results after analysing them.
4. Either work in a research environment or in an industrial environment.
5. Conversant with technical report writing and will be able to present and convince their topic of study to the engineering community.

Course Articulation Matrix:

Course outcome	Programme outcome					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	2	-	-	2
CO2	3	3	2	-	-	2
CO3	3	3	2	-	-	2
CO4	3	3	2	-	-	2
CO5	3	3	2	-	-	2

Guidelines:

- It is a continuation of Major Project Phase – I started in semester - III.
- The student has to submit the report in prescribed format and also present a seminar.
- The dissertation should be presented in standard format as provided by the department.
- The candidate must prepare a detailed project report consisting of introduction of the problem, problem statement, literature review, objectives of the work, methodology

(experimental set up or numerical details as the case may be) of solution and results and discussion.

- The report must bring out the conclusions of the work and future scope for the study. The work must be presented in front of the examiners panel consisting of an approved external examiner and Chairperson BoS, & Head of the department and Supervisor from the Institute.
- The candidate must be in regular contact with his/her Supervisor / Co- Supervisor

Guidelines for awarding marks in CIE : Max. Marks: 100		
Evaluation by	**Max. Marks**	**Evaluation Criteria / Parameter**
Supervisor	30	Problem formulation
	10	Literature review
	10	Proposed methodology
	10	Documentation
	50	Total
Departmental Committee (Chairperson BoS, Osmania University and Head, Supervisor & Project coordinator from the respective department of the institution)	15	Relevance of the Topic
	15	PPT Preparation
	10	Documentation
	10	Question and Answers
	50	Total

Guidelines for awarding marks in SEE (Semester End Examination): Max. Marks: 100		
Evaluation by	**Max. Marks**	**Evaluation Criteria / Parameter**
External Examiner and Chairperson, BoS & Head of the department (All together)	**100**	Proposed methodology, Literature review, Documentation, Power Point Presentation, Quality of thesis and evaluation Innovations, application to society and Scope for future study, Viva-Voce

***The student has to work a minimum of 32 hours/week at Dissertation – II.**

DEPARTMENT OF ELECTRICAL ENGINEERING, UNIVERSITY COLLEGE OF ENGINEERING (AUTONOMOUS), OSMANIA UNIVERSITY, HYDERABAD

Overall Scheme for M.E PES (EEE.) I-Sem to IV-Sem, the students admitted in the college during the Academic Year 2025-2026

	I-Sem					II-Sem		
S. No	**Theory**		**Credits**		**S. No**	**Theory**		**Credits**
1	Core-I	Power Electronic Converters	3		1	Core-IV	Advanced Topics in Power Electronics	3
2	Core-II	Hybrid Electric Vehicles	3		2	Core-V	Power Electronic Converters for Renewable Energy	3
3	Core-III	Digital Control of Power Electronics	3		3	Core-VI	Static Control of A.C. Drives	3
4	Programme Elective – I	Special Electrical Machines	3		4	**Programme Elective – IV**	Modern Control Theory	3
		Programmable Logic Controllers					Smart Grid Systems	
		Power Quality Engineering					Grid Integration of Distributed Generation	
							Industrial Electronic Systems	
5	Programme Elective – II	Reliability Engineering	3		5	**Programme Elective – V**	Power Electronic Applications to Power Systems	3
		Digital Signal Processing					Digital Circuits and Logic Design	
		Industrial Controllers					Battery Management Systems and Charging Stations	
6	Programme Elective - III	Soft Computing Techniques in Electrical Engineering	3		6	**Open Elective**	Medical Assistive Devices	3
							Medical Imaging Techniques	
							Green Building Technology	
							Cost Management of Engineering Project	
		Advanced Optimization Techniques					Business Analytics	
							Elements of Embedded Systems	
							Waste to Energy	
							Power Plant Control and Instrumentation	
		Python Programming					Operations Research	
							Composite Materials	
							Industrial Safety	
							Intellectual Property Rights	
7	Laboratory - I	Power Electronic System Laboratory - I	1		7	Mini Project	Mini Project	2
8	Seminar - I	Seminar - I	1		8	Laboratory - II	Power Electronic system Laboratory - II	1
					9	Laboratory - III	Power Electronic system Laboratory - III	1
	Total		**20**			**Total**		**22**
	III-Sem					**IV-Sem**		
S. No	**Theory**		**Credits**		**S. No**	**Theory**		**Credits**

1	Audit Course – I (Online)	Engineering Research Methodology in Electrical Engineering	NC		1	Major Project Phase – II Dissertation	16
2	Audit Course – II (Online)	English for Academic Research Writing	NC				
		Disaster Mitigation & Management					
		Sanskrit for Technical Knowledge					
		Value Education					
		Stress Management by Yoga					
		Personality Development Through Life Enlightenment Skills					
		Constitution of India					
		Pedagogy Studies					
3	Major Project Phase – I Dissertation		10				
	Total		**10**			**Total**	**16**

Credit Summary

Semester	I	II	III	IV	TOTAL
Credits	**20**	**22**	**10**	**16**	**68**