PAAVAI ENGINEERING COLLEGE, NAMAKKAL – 637018
(AUTONOMOUS)
REGULATIONS 2019
CHOICE BASED CREDIT SYSTEM
B.E. – ELECTRICAL AND ELECTRONICS ENGINEERING

CURRICULUM

(Applicable to the candidates admitted during the academic year 2019-2020 onwards)

SEMESTER V

S. No	Category	Course Code	Course Title	L	T	P	C
Theory							
1	PC	EE19501	Design of Electrical Apparatus	3	1	0	4
2	PC	EE19502	Power Electronics	3	0	0	3
3	PC	EE19503	Control Systems	3	1	0	4
4	PC	EE19504	Measurements and Instrumentation	3	0	0	3
5	PC	EE19505	Power System Analysis	3	0	0	3
6	PE	EE1915*	Professional Elective I	3	0	0	3
Practical							
7	PC	EE19506	Power Electronics Laboratory	0	0	4	2
8	PC	EE19507	Control Systems Laboratory	0	0	2	1
9	EE	EN19501	Career Development Laboratory I	0	0	2	1
			Total	**18**	**2**	**8**	**24**

SEMESTER VI

S. No	Category	Course Code	Course Title	L	T	P	C
Theory							
1	PC	EE19601	Protection and Switchgear	3	0	0	3
2	PC	EE19602	Solid State Drives	3	0	0	3
3	PC	EE19603	Microprocessors and Microcontrollers	3	0	0	3
4	PC	EE19604	Wind and Solar Energy Systems	3	0	0	3
5	PE	EE1925*	Professional Elective II	3	0	0	3
6	OE	EE1990*	Open Elective I	3	0	0	3
Practical							
7	PC	EE19605	Electrical Drives Laboratory	0	0	2	1
8	PC	EE19606	Microprocessors and Microcontrollers Laboratory	0	0	2	1
9	EE	EN19601	Career Development Laboratory II	0	0	2	1
			Total	**18**	**0**	**6**	**21**

PROFESSIONAL ELECTIVE I

S. No	Category	Course Code	Course Title	L	T	P	C
1	PE	EE19151	Bio Medical Engineering	3	0	0	3
2	PE	EE19152	Nano Science	3	0	0	3
3	PE	EE19153	VLSI Design and Circuits	3	0	0	3
4	PE	EE19154	Communication Engineering	3	0	0	3

PROFESSIONAL ELECTIVE II

S. No	Category	Course Code	Course Title	L	T	P	C
1	PE	EE19251	Restructured Power Systems	3	0	0	3
2	PE	EE19252	Power System Dynamics	3	0	0	3
3	PE	EE19253	Flexible AC Transmission System	3	0	0	3
4	PE	EE19254	Programmable Logic Controllers	3	0	0	3

OPEN ELECTIVE I

S. No	Category	Course Code	Course Title	L	T	P	C
1	OE	EE19901	Power Electronic Systems	3	0	0	3
2	OE	EE19902	Basics of Power Systems Engineering	3	0	0	3

SEMESTER V

EE19501 DESIGN OF ELECTRICAL APPARATUS 3 1 0 4

COURSE OBJECTIVES

To enable the students to

- study about magnetomotive force (MMF) calculation and thermal rating of various types of electrical machines.
- know the design procedure of the armature field commutator, brushes for D.C. machines.
- understand about the core, yoke, windings, and cooling systems of transformers.
- acquire knowledge on dimensions of induction machine.
- gain knowledge on dimensions of synchronous machines.

UNIT I MAGNETIC CIRCUITS AND COOLING OF ELECTRICAL MACHINES 12

Concept of magnetic circuit - MMF calculation for various types of electrical machines, real and apparent flux density of rotating machines; Leakage reactance calculation -Transformers, induction, and synchronous machine; Thermal rating - Continuous, short time and intermittent short time rating of electrical machines; Introduction to computer aided design.

UNIT II D.C. MACHINES 12

Constructional details - output equation, main dimensions, choice of specific loadings, choice of number of poles, armature design, design of commutator and brushes, losses and efficiency calculations; Flowchart for computer-aided design of D.C. machines.

UNIT III TRANSFORMERS 12

Introduction - output rating of single phase and three phase transformers, optimum design of transformers; Design of core, yoke and windings for core and shell type transformers; Equivalent circuit parameter from designed data; Losses and efficiency calculations; Design of tank and cooling tubes of transformers; Flowchart for computer-aided design of transformer.

UNIT IV THREE PHASE INDUCTION MOTORS 12

Introduction- output equation, main dimensions, choice of specific loadings; Design of stator, design of squirrel cage and slip ring rotor, equivalent circuit parameters from designed data, losses and efficiency calculations; Flowchart for computer-aided design of three phase induction motors.

UNIT V SYNCHRONOUS MACHINES 12

Introduction - output equation, choice of specific loadings, main dimensions, short circuit ratio; Design of stator and rotor of cylindrical pole and salient pole machines; Design of field coil, performance calculation from designed data; Flowchart for computer-aided design of synchronous machines.

TOTAL PERIODS: 60

COURSE OUTCOMES

At the end of this course, students will be able to

- determine the MMF and thermal rating of electrical machines.
- analyze the dimension to design of D.C Machines.
- estimate the requirements and design the cooling system of transformer.
- examine the design parameters of induction machines.
- analyze the performance of synchronous machine using calculated data.

TEXT BOOKS

1. A.K. Sawhney, "A Course in Electrical Machine Design", Dhanpat Rai and Sons, New Delhi,2018.
2. S.K. Sen, "Principles of Electrical Machine Design with Computer Programmes", Oxford and IBH Publishing Co.Pvt Ltd., New Delhi, 2017.

REFERENCES

1. R.K. Agarwal, "Principles of Electrical Machine Design", S.K.Kataria and Sons, Delhi, 2014.
2. V.N. Mittle and A. Mittle, "Design of Electrical Machines", Standard Publications and Distributors, Delhi, 2018.
3. A.ShanmugaSundaram, G.Gangadharan, R.Palani "Electrical Machine Design Data Book", New Age International Pvt. Ltd., Reprint, 2017.
4. M.V.Deshpande —"Design and Testing of Electrical Machine Design" Wheeler Publications, 2018.

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's
(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

CO's	Programme Outcomes PO's												PSO's	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	3	-	-	1	1	1	-	1	-	1	3	3
CO2	3	1	3	-	-	1	1	1	-	1	-	1	3	3
CO3	3	2	3	-	-	1	1	1	-	1	-	1	3	3
CO4	3	1	3	-	-	1	1	1	-	1	-	1	3	3
CO5	3	2	3	-	-	1	1	1	-	1	-	1	3	3

EE19502 **POWER ELECTRONICS** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- impart knowledge on different types of power semi-conductor devices and their switching characteristics.
- know the controlling techniques of switching devices and protection of power semiconductor devices.
- understand the operation of Phase controlled converter and various chopper conversion techniques.
- study the mode of inverters and different modulation techniques.
- learn the types of AC voltage controllers and basics of matrix converters.

UNIT I POWER SEMICONDUCTOR DEVICES **9**

Study of switching devices and its static characteristics -Power diode, SCR, GTO, RCT, LASCR, TRIAC, BJT, power MOSFET, IGBT.

UNIT II GATE DRIVE AND PROTECTION CIRCUITS **9**

Gate triggering circuits- Firing circuit for the SCR, R, RC, UJT; Drive circuits for BJT, gate drive circuits for MOSFET and IGBT; Isolation of gate and base drives- Pulse transformer, optocouplers; Protection circuits- Snubber circuits, di/dt protection with the help of inductor, over current protection; Cooling of semiconductor devices, types of cooling.

UNIT III THYRISTOR RECTIFIERS AND CHOPPER **9**

Phase controlled converter- 2-pulse, 3-pulse and 6-pulseconverters; Effect of source inductance; Chopper- Step-down and step-up chopper, switched mode regulators, buck, boost, buck-boost converter; Introduction to resonant converters.

UNIT IV INVERTERS **9**

Single phase and three phase voltage source inverters (both 120^0mode and 180^0mode); PWM techniques- Sinusoidal PWM, modified sinusoidal PWM, multi PWM; Introduction to space vector modulation; Current source inverter; Multilevel inverter- Cascaded multilevel inverter, diode clamped multilevel inverter.

UNIT V AC TO AC CONVERTERS **9**

Single phase AC Regulator – Sequence control of AC regulators, two stage sequence control, multistage sequence control; Three phase AC Regulator; Single phase cycloconverters- Mid-point configuration, Bridge configuration; Three phase cycloconverters, matrix converters.

TOTAL PERIODS: 45

COURSE OUTCOMES

At the end of this course, students will be able to

- identify and select the switching devices for different power converter applications.
- apply the different controlling techniques and protection schemes based on the load.
- design a suitable DC power supply for given load specification from AC and DC supply.
- describe and analyze the single and three phase inverters.
- explain an AC voltage controller electromagnetic compatibility of power converters.

TEXT BOOKS

1. M.H.Rashid, "Power Electronics: Circuits, Devices Applications", Pearson, 2016.
2. M.D. Singh and Khanchandani K.B., "Power Electronics", Tata Mc.Graw Hill., 2016

REFERENCES

1. L.Umanand, "Power Electronics Essentials and Applications", Wiley India Pvt Ltd, Reprint, 2015.
2. G.K. Dubey, S.R. Doradla, A. Joshi and R.M.K. Sinha, "Thyristorised Power Controllers", New Age,International Publishers, 2017.
3. Ned Mohan,Tore M. Undeland and William P.Robins, "Power Electronics – Converters, Applications and Design", Third Edition, John Wiley and Sons, 2018.
4. R.S. Ananda Murthy and V. Nattarasu, "Power Electronics: A Simplified Approach", Pearson/Sanguine Technical Publishers,2017 .

CO-PO MAPPING

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

CO's	Programme Outcomes PO's												PSO's	
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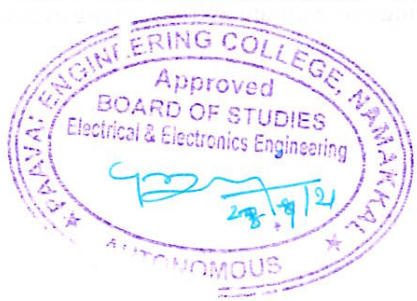
CO1	3	1	1	-	2	1	-	1	-	1	1	1	3	3
CO2	3	2	1	-	2	1	-	1	-	-	2	1	3	3
CO3	3	2	1	-	2	1	-	1	-	-	2	1	3	3
CO4	3	1	1	-	2	1	-	1	-	1	2	1	3	3
CO5	3	1	1	-	2	1	-	1	-	-	2	1	3	3



EE19503 **CONTROL SYSTEMS** **3 1 0 4**

COURSE OBJECTIVES

To enable the students to

- understand the methods of representation of systems and to obtain system transfer function models.
- provide knowledge on time response of systems and steady state error analysis.
- acquaint basic knowledge in obtaining the open loop and closed–loop frequency responses of systems.
- impart the concept of stability of control system and methods of stability analysis, design of compensators for a control system.
- study the concept of state variables, controllability, and observability.

UNIT I SYSTEMS AND THEIR REPRESENTATION 12

Basic elements in control systems - Open and closed loop systems, electrical analogy of mechanical and thermal systems; Transfer function; Synchros; AC and DC servomotors; Block diagram reduction techniques; Signal flow graphs.

UNIT II TIME RESPONSE 12

Time response - Time domain specifications, types of test input , I and II order system response ; Error coefficients - Generalized error series, steady state error, P, PI, PID models of feedback control.

UNIT III FREQUENCY RESPONSE 12

Frequency response - Bode plot, Polar plot, Nichol's chart; Determination of closed loop response from open loop response; Correlation between frequency domain and time domain specifications.

UNIT IV STABILITY AND COMPENSATOR DESIGN 12

Characteristics equation – Routh Hurwitz criterion, Nyquist stability criterion, performance criteria; Effect of lag, lead and lag-lead compensation on frequency response; Design of lag, lead and lag- lead compensator using bode plots.

UNIT V STATE VARIABLE ANALYSIS 12

Concept of state variables; State models for linear and time invariant systems; Solution of state and output equation in controllable canonical form; Concepts of controllability and observability.

TOTAL PERIODS: 60

COURSE OUTCOMES

At the end of this course, students will be able to

- model a control system using differential equations and transfer functions.
- analyze the transient response of control systems in using time domain.
- evaluate and analyze control systems using frequency domain methods.
- check the stability of systems and the effect of pole zero addition and design compensators for control systems
- formulate state models for linear and time invariant systems.

TEXT BOOKS

1. I.J. Nagrath& M. Gopal, "Control Systems Engineering", New Age International Publishers, 2017.
2. S.Palani, "Control Systems Engineering", Vijay Nicole Imprints, 3rd edition 2016.

REFERENCES

1. B.C. Kuo, "Automatic Control Systems", Prentice Hall of India Ltd., 2017.
2. M. Gopal, "Control Systems, Principles & Design", Tata McGraw Hill, 2017.
3. K. Ogata, "Modern Control Engineering", Pearson Education, 2015.
4. S.K.Bhattacharya, "Control System Engineering", Pearson, 2018.

CO-PO MAPPING

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
CO's	**Programme Outcomes PO's**												**PSO's**	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	2	-	-	1	1	-	-	1	-	1	1	3	3
CO2	3	2	-	2	3	1	1	-	-	-	1	1	3	3
CO3	3	2	-	2	1	1	-	-	-	1	1	1	3	3
CO4	3	2	3	-	2	1	-	-	1	-	1	1	3	3
CO5	3	2	-	2	1	1	-	-	-	-	1	1	3	3

EE19504 MEASUREMENTS AND INSTRUMENTATION 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- acquire the basic functional elements of instrument and bridges.
- learn the use of different types of meters for measuring electrical and electronics quantities using measuring instruments.
- gain knowledge on instrumentational equipment concepts such as signal generators and analyzer.
- study about the working of transducer and devices used for display.
- attain basic ideas about digital measuring instrument.

UNIT I BASIC MEASUREMENT CONCEPTS AND BRIDGES 9

Functional elements of an instrument; Static and dynamic characteristics; Standards and Calibration of measurements; Errors in measurement; Statistical evaluation of measurement data; Bridges- Wheatstone bridge, Kelvin double bridge, Maxwell's bridge, Anderson bridge, Schering bridge, Wien bridge and Hay's Bridge.

UNIT II ELECTRICAL AND ELECTRONIC INSTRUMENTS 9

Classification of instruments; Working Principle of potentiometer; Design of analog voltmeter, ammeter using permanent magnet moving coil (PMMC)and moving iron (MI) and its loading effect; Principle of working power factor meter; Single phase wattmeter, analog energy meter; Use of Instrument transformers.

UNIT III SIGNAL GENERATORS AND ANALYZERS 9

Function generators – pulse and square wave generators, RF signal generators, sweep generators; Frequency synthesizer- wave analyzer, harmonic distortion analyzer, spectrum analyzer, digital spectrum analyzer; Digital L, C, R measurements and digital RLC Meters.

UNIT IV TRANSDUCERS AND DISPLAY DEVICES 9

Classification of transducers – Selection of transducers, resistive, capacitive, and inductive transducers, Piezoelectric and digital transducers; Working principle and specifications of the analog and digital cathode ray oscilloscope (CRO), light emitting diode (LED) and liquid crystal display (LCD).

UNIT V DIGITAL INSTRUMENTS 9

Comparison of analog and digital techniques , digital voltmeter, millimeter's , energy meter , frequency counters; Measurement of frequency and time interval , extension of frequency range; Automation in digital instruments, automatic polarity indication, automatic ranging, automatic zeroing, fully automatic digital instruments; Computer controlled test systems; Virtual instruments.

TOTAL PERIODS: 45

COURSE OUTCOMES

At the end of this course, students will be able to

- analyze the measurement parameters and bridges.
- use different types of meters for measuring electrical and electronics quantities.
- implement the concepts of signal generators and analyzer.
- handle different types of transducer and display devices.
- use digital measuring instruments.

TEXT BOOKS

1. Albert D. Helfrick and William D. Cooper – "Modern Electronic Instrumentation and Measurement Techniques", Pearson / Prentice Hall of India, Reprint 2018
2. Sawhney A K, "A Course in Electrical and Electronic Measurement and Instrumentation", Dhanpat Rai&Sons, New Delhi, 18th Edition, Reprint 2019.

REFERENCES

1. D.V.S. Moorthy, "Transducers & Instrumentation",2nd edition Reprint, Prentice Hall of India Pvt Ltd, 2017.
2. H.S. Kalsi, „Electronic Instrumentation", 3rd edition, Tata McGraw Hill, 2015.
3. Golding E.W and Widdis F.G., "Electrical Measurements and Measuring Instruments", Fifth Edition, AH Wheeler and Co., New Delhi, Reprint 2017.
4. David A. Bell, "Electronic Instrumentation, and Measurements", Prentice Hall of India Pvt Ltd, 2016.

CO-PO MAPPING

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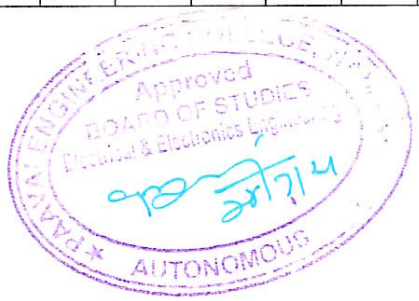
CO's	Programme Outcomes PO's												PSO's	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	-	1	-	1	1	-	1	-	1	-	2	3	3
CO2	3	-	2	-	1	1	1	-	-	-	-	2	3	3
CO3	3	-	1	-	2	1	-	-	-	1	-	2	3	3
CO4	3	-	1	-	1	1	-	-	1	-	2	2	3	3
CO5	3	-	1	-	2	1	-	-	-	-	2	2	3	3



EE19505 **POWER SYSTEM ANALYSIS** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- familiarize the different aspects of modeling of power system components.
- know about the power flow problems using efficient simulation and numerical methods.
- understand the concept of symmetrical faults analysis using algorithms in power system studies.
- study about symmetrical components and unsymmetrical fault analysis.
- know about the power system stability concepts and methods of solving stability problem.

UNIT I THE POWER SYSTEM – AN OVERVIEW AND MODELING **9**

Modern power system; Basic components of a power system; Per phase analysis; Generator model - Transformer model; line model; Per unit system; Change of base.

UNIT II POWER FLOW ANALYSIS **9**

Introduction - Bus admittance matrix, Bus Classification; Solution of non-linear Algebraic equations - Gauss-Seidal method, Newton-Raphson method, Fast decoupled method; Flow charts and comparison of the three methods.

UNIT III SYMMETRICAL FAULT ANALYSIS **9**

Assumptions in short circuit analysis - Symmetrical short circuit analysis using Thevenin's theorem; Bus Impedance matrix building algorithm (without mutual coupling); Symmetrical fault analysis through bus impedance matrix; Post fault bus voltages,current.

UNIT IV UNSYMMETRICAL FAULT ANALYSIS **9**

Symmetrical components - Sequence impedances, sequence networks; Analysis of unsymmetrical faults at generator terminals- LG, LL and LLG; Unsymmetrical fault occurring at any point in a power system; Computation of post fault currents in symmetrical component and phasor domains.

UNIT V POWER SYSTEM STABILITY ANALYSIS **9**

Importance of stability analysis in power system planning and operation; Classification of power system stability - angle and voltage stability; Single machine infinite bus (SMIB) system; Development of swing equation - equal Area criterion, determination of critical clearing angle and time, solution of swing equation by modified Euler method and Runge-Kutta fourth order method.

TOTAL PERIODS: 45

COURSE OUTCOMES

At the end of this course, students will be able to

- model the analytical concepts of power system components in power systems.
- solve power flow problems by using various methods.
- solve problems on fault analysis under balanced fault conditions in power system.
- compute unsymmetrical faults in power system using bus impedance matrix.
- analyze the stability of power system using modified Euler's method and Runge-Kutta method.

TEXT BOOKS

1. I.J.Nagrath and D.P.Kothari, "Modern Power System Analysis", Tata McGraw-Hill publishing company, New Delhi, 2019.
2. P.Kundur, "Power System Stability and Control", Tata McGraw Hill Publishing Company,New Delhi, 2018.

REFERENCES

1. Olle. I. Elgerd, "Electric Energy Systems Theory – An Introduction", Tata McGraw Hill Publishing Company Limited, New Delhi, Second Edition, 2017.
2. Pai M A, "Computer Techniques in Power System Analysis", Tata McGraw-Hill Publishing Company Ltd., New Delhi, Second Edition, 2018.
3. J. Duncan Glover, Mulukutla S. Sarma, Thomas J. Overbye, "Power System Analysis & Design",CengageLearning, Fifth Edition, 2018.
4. William D Stevenson, "Elements of power system analysis" 5th edition Reprint 2017.

CO-PO MAPPING

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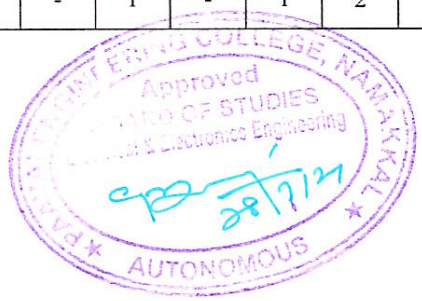
CO1	3	1	1	-	-	1	-	-	2	-	1	2	3	3
CO2	3	3	1	2	-	1	-	-	-	1	1	2	3	3
CO3	3	2	1	2	-	1	-	1	-	2	1	2	3	3
CO4	3	2	1	1	-	1	-	-	-	-	1	2	3	3
CO5	3	3	1	2	-	1	-	-	1	-	1	2	3	3



EE19506 POWER ELECTRONICS LABORATORY 0 0 4 2

COURSE OBJECTIVES

To enable the students to

- study the characteristics of switching devices.
- learn the applications of rectifiers.
- know the performance of inverters and choppers.
- train with the design concepts of AC voltage controllers, and it's controlling techniques.

LIST OF EXPERIMENTS

1. Characteristics of SCR and MOSFET
2. Gate Pulse Generation (Firing angle and PWM Pulse)
3. AC to DC Half and fully controlled converter.
4. Step-down and step-up choppers.
5. IGBT based (1ϕ and 3ϕ) PWM inverter.
6. AC Voltage controller.
7. Simulation of Half and fully controlled converter (1ϕ and 3ϕ)
8. Simulation of 1ϕ and 3ϕ inverter.
9. Simulation of Chopper (Step down, Step up)
10. Simulation of AC Voltage controller (1ϕ and 3ϕ)

TOTAL PERIODS: 60

COURSE OUTCOMES

At the end of this course, students will be able to

- analyze the performance characteristics and applications of various power semi converter devices.
- design the various phase-controlled rectifiers with different loads.
- analyze performance of inverters and choppers using MOSFET, IGBT and PWM inverters.
- evaluate the performance of controlling circuits using AC voltage controllers.

CO-PO MAPPING

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	2	1	2	-	1	-	1	-	-	2	2	3	3
CO2	2	2	1	2	-	2	1	-	-	1	2	2	3	3
CO3	2	2	1	2	-	2	-	-	1	-	2	2	3	3
CO4	2	2	1	2	-	1	-	-	-	-	2	2	3	3

EE19507 **CONTROL SYSTEMS LABORATORY** **0 0 2 1**

COURSE OBJECTIVES

To enable the students to

- acquire simulation programming skills in the analysis of control systems.
- gain the knowledge for deriving transfer function and to analyze the stability of systems.
- study control techniques for controllers and compensators through simulation.
- learn the performance of transfer functions.

LIST OF EXPERIMENTS

1. Frequency response of lead/lag compensator.
2. Digital control of P, PI, PID.
3. Effect of feedback on DC servomotor
4. Temperature controller using RTD.
5. Study of DC position control system
6. Flow measurement.
7. Transfer function of DC Motor.
8. Transfer function of DC generator

TOTAL PERIODS: 30

COURSE OUTCOMES

At the end of this course, students will be able to

- simulate results for first and second order systems.
- analyze the stability of linear systems by various plots.
- examine the simulation of controllers and compensators
- test performance of transfer functions.

CO-PO MAPPING

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
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CO2	2	2	1	2	-	2	-	1	-	-	2	2	3	3
CO3	2	2	1	2	1	2	-	-	-	-	2	2	3	3
CO4	2	2	1	2	-	1	-	-	1	-	2	2	3	3

EN19501 **CAREER DEVELOPMENT LABORATORY I** **0 0 2 1**

COURSE OBJECTIVES

To enable the students to

- enhance their own potential strength and reduce weakness to survive in corporate world
- evaluate their own personality skills to face the interviews in a successful way.
- solve the quantitative aptitude problems and improve their problem-solving skills
- solve the quantitative aptitude in advance level tests to get placed in tier 1 companies
- improve their reasoning skills to get placed in reputed companies

UNIT I BASICS - SELF ANALYSIS **6**

Introduction - Self Explorations-Who Am I; Know yourself; SWOT Analysis – Corporate resume building – Group Discussion: Level – 0 – Role Play: Team.

UNIT II PERSONALITY DEVELOPMENT **6**

Just A Minute (JAM): Level 0-Extempore – Johari Window Model – Goal Setting – Achievement worksheet – Group Discussion: Leve-1 - Mock Interview Practice: Level 0

UNIT III QUANTITATIVE APTITUDE I **6**

Number System - LCM & HCF - Square root & Cube root – Percentage - Time - Speed & Distance

UNIT IV QUANTITATIVE APTITUDE II **6**

Trains - Boats & Streams – Average – Ages - Area

UNIT V LOGICAL AND VERBAL REASONING **6**

Series Completion: Number Series, Letter Series, Symbol Series - Blood Relation - Coding and Decoding - Logical Sequence – Analogy - Character Puzzles – Classification - Data Sufficiency

TOTAL PERIODS: 30

COURSE OUTCOMES

At the end of this course, students will be able to

- demonstrate the interpersonal skills in group discussions
- enhance their verbal and written ability
- practice soft skills to excel in their jobs
- compute problems based on quantitative aptitude
- reveal their logical and verbal reasoning by scoring the expected percentage to get placed in reputed companies

TEXT BOOKS

1. Agarwal, R.S." a modern approach to Verbal & Non Verbal Reasoning", S.Chand& Co Ltd, new delhi
2. Agarwal, R.S. " Objective General English", S.Chand&Co

REFERENCES

1. Abhijit Guha, "Quantitative Aptitude ", Tata-Mcgraw Hill.
2. Word Power Made Easy By Norman Lewis ,Wr.Goyal Publications

3. Johnson, D.W. Reaching out – Interpersonal Effectiveness and self actualization. Boston: Allyn And Bacon
4. Infosys Campus Connect Program – students' guide for soft skills

CO-PO MAPPING

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's
(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

CO's	Programme Outcomes PO's												PSO's	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	2	3	3	1	-	-	-	-	-	-	3	2
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CO3	3	2	2	2	-	-	1	-	-	-	-	-	2	3
CO4	3	2	2	-	-	1	-	-	-	-	2	-	2	3
CO5	2	3	3	2	1	3	3	1	-	1	2	-	2	3

PAVAI ENGINEERING COLLEGE, NAMAKKAL
Approved
BOARD OF STUDIES
Mathematics
14/8/24
AUTONOMOUS

SEMESTER VI

EE19601 PROTECTION AND SWITCHGEAR 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- know the characteristics and functions of relays and protection schemes.
- impart knowledge on general protection schemes of the electrical apparatus.
- learn the causes of abnormal operating conditions of the apparatus.
- study the functioning of circuit breakers.
- establish the concept of static and numerical relays.

UNIT I PROTECTIVE RELAYS 9

Principles and need for protective schemes; Methods of neutral grounding- Zones of protection and essential qualities of protection; Construction and characteristics of relays - Over current relays, directional, distance and differential relays ,under frequency relays ,negative sequence relays.

UNIT II APPARATUS PROTECTION 9

Apparatus protection - Generator and transformer protection, protection of bus bars, transmission lines, CT's, PT's and their application in protective schemes.

UNIT III THEORY OF CIRCUIT INTERRUPTION 9

Physics of arc phenomena and arc interruption - Restriking voltage and recovery voltage, rate of rise of recovery voltage; Current chopping - interruption of capacitive current, resistance switching; DC circuit breaking.

UNIT IV CIRCUIT BREAKERS 9

Types of circuit breakers - Air blast, oil, SF6 and vacuum circuit breakers; Comparative merits of different circuit breakers; Testing of circuit breakers; Circuit breaker ratings.

UNIT V STATIC RELAYS AND NUMERICAL PROTECTION 9

Static relays - phase, amplitude comparators; Synthesis of various relays using static comparators; Block diagram of numerical relays - Over current protection, transformer differential protection and distant protection of transmission lines.

TOTAL PERIODS: 45

COURSE OUTCOMES

At the end of this course, students will be able to

- recapitulate the construction and operation of protective relays.
- describe the general protection schemes of the electrical apparatus.
- evaluate the theory of circuit interruption.
- identify the circuit breakers based on the operation and characteristics.
- perform synthesis of numerical protection of transmission line using static comparator.

TEXT BOOKS

1. V.K.Mehta, Rohit Mehta "Principles of Power systems" S.Chand Publications, 2017.
2. Y.G.Paithankar and S.R.Bhide, "Fundamentals of power system protection", Second Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2016.

REFERENCES

1. Badri Ram ,B.H. Vishwakarma, "Power System Protection and Switchgear", New Age International Pvt Ltd Publishers, Second Edition, 2016.
2. C.L. Wadhwa, "Electrical Power Systems", New Age International (P) Ltd., 2014.
3. RavindraP.Singh, "Switchgear and Power System Protection", PHI Learning Private Ltd., NewDelhi, 2015
4. M.L.Soni, P.V.Gupta, U.S.Bhatnagar, A.Chakrabarti, "A Text Book on Power System Engineering", Dhanpat Raiand Co.,2014.

CO-PO MAPPING

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CO4	3	2	1	1	-	1	-	-	-	1	1	2	3	3
CO5	3	3	1	2	-	1	-	1	-	-	1	2	3	3

EE19602 **SOLID STATE DRIVES** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- understand the stable steady-state operation and transient dynamics of a motor-load system.
- study the operation of the converter/chopper fed dc drive and to solve simple problems.
- learn the operation of both classical and modern induction motor drives.
- comprehend the differences between synchronous motor drive and induction motor drive and to learn the basics of permanent magnet synchronous motor drives.
- know about current and speed controllers for a closed loop solid-state DC motor drive.

UNIT I CHARACTERISTICSOF ELECTRIC DRIVES **9**

Electric Drives - Equations governing motor load dynamics, dynamics of electrical drives, multi quadrant dynamics in the speed torque plane; Regenerative braking - Electrical drives modes of acceleration; Rating of motors and heating cooling of drives; Selection of drives – classes of duty and selection of motor.

UNIT II SOLID STATE CONTROL OF DC DRIVES **9**

Converter fed DC drives; Steady state analysis of single phase and three phase DC drives; Chopper fed DC drive – Four quadrant chopper; Closed loop drive system - Closed loop current limit control scheme, closed loop torque control, closed loop speed control.

UNIT III SOLID STATE CONTROL OF INDUCTION MOTOR DRIVES **9**

Speed control of induction motor drives – Stator voltage control; Adjustable frequency induction motor drives – Voltage / frequency control, closed loop induction motor drive with constant volts/Hz control strategy, rotor controlled induction motor drives, closed loop control of static rotor resistance control; Slip power recovery system; Static kramer system; Current source inverter fed induction motor drives.

UNIT IV SOLID STATE CONTROL OF SYNCHRONOUS MOTOR DRIVES **9**

Types of synchronous motors – Self controlled synchronous motor drives; Voltage source inverter fed synchronous; Current source inverter fed Synchronous motor; Synchronous motor fed cycloconverter; Brushless DC motor drives; Brushless excitation wound field synchronous motor drives; Synchronous motor power factor control; Closed loop control of synchronous motor drives.

UNIT V DESIGN OF CONTROLLERS FOR SOLID STATE DRIVES **9**

Transfer functions of the DC drive subsystems; DC motor and load, converter, current and speed controllers, Feedback- Current ,speed, closed loop control with current and speed feedback; Design of controllers- Current controller and speed controller; Converter selection and characteristics.

TOTAL PERIODS: 45

COURSE OUTCOMES

At the end of this course, students will be able to

- obtain the stable steady-state and transient dynamics of a motor-load system.
- analyze the operation of the converter / chopper fed dc drive.
- perform analysis of classical and modern induction motor drives.
- differentiate between synchronous motor drive and induction motor drive.
- analyze and design the current, speed controllers for a closed loop solid-state DC motor drive.

TEXT BOOKS

1. Dubey.G.K., "Fundamental of Electrical Drives", Narosa publishing House, New Delhi 2018.
2. R.Krishnan, "Electric Motor & Drives: Modeling, Analysis and Control", Prentice Hall of India, 2019.

REFERENCES

1. Murphy, J.M.D and Turnbull.F.G. , "Thyristor control of AC Motors", Pergamon Press, New Delhi 2018
2. Vedam Subramanyan, "Thyristor control of Electrical Drives", Tata McGraw Hill Publishing Company, New Delhi 2017.
3. Shaahin Felizadeh, "Electric Machines and Drives", CRC Press (Taylor and Francis Group), 2018.
4. Bimal K. Bose. "Modern Power Electronics and AC Drives", Pearson Education, 2016.

CO-PO MAPPING

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's
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CO4	3	1	2	-	2	1	-	2	-	1	-	1	3	3
CO5	3	1	3	-	3	1	-	-	-	-	1	1	3	3

EE19603 MICROPROCESSORS AND MICROCONTROLLERS 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- acquire knowledge on the architecture of 8085 microprocessor.
- familiarize the instructions for 8085 programming.
- gain information about the architecture of 8051 microcontrollers.
- understand the importance of peripheral interfacing.
- know about the programming of microcontroller for application.

UNIT I 8085 PROCESSOR 9

Hardware architecture - pinouts, functional building blocks of processor; Memory organization – I/O ports and data transfer concept; Timing diagram; Interrupts.

UNIT II PROGRAMMING OF 8085 PROCESSOR 9

Instruction format and addressing modes; Assembly language format - Data transfer, data manipulation and control instructions; Programming- Loop structure with counting and indexing; Look up table - Subroutine instructions - stack.

UNIT III 8051 MICRO CONTROLLER 9

Hardware architecture - pinouts, functional building blocks of processor; Memory organization – I/O ports and data transfer concepts- Data transfer, manipulation, control algorithms, and I/O instructions Timing diagram; Interrupts;.

UNIT IV PERIPHERAL INTERFACING 9

Study on architecture- configuration; Interfacing with ICs- 8255, 8259, 8254, 8279; A/D and D/A converters and Interfacing with 8085.

UNIT V MICRO CONTROLLER PROGRAMMING AND APPLICATIONS 9

Simple programming exercises- key board and display interface; Control of servo motor; Stepper motor control; Washing Machine Control; Application to automation systems.

TOTAL PERIODS: 45

COURSE OUTCOMES

At the end of this course, students will be able to

- explain the architecture of 8085 microprocessor
- write program using 8085 assembly language.
- describe the architecture of 8051 microcontrollers.
- interface various ICs with 8085.
- develop the microprocessor and microcontroller-based applications

TEXT BOOKS

1. R.S. Gaonkar, "Microprocessor Architecture Programming and Application with 8085", Wiley Eastern Ltd., New Delhi, 2013.
2. Sunil Mathur &Jeebananda Panda, "Microprocessor and Microcontrollers", PHI Learning Pvt. Ltd, 2016.

REFERENCES

1. Muhammad Ali Mazidi & Janice Gilli Mazidi, R.D.Kinely "The 8051 Micro Controller and Embedded Systems", PHI Pearson Education, 5th Indian reprint, 2018.
2. Krishna Kant, "Microprocessor and Microcontrollers", Eastern Company Edition, Prentice Hall of India, New Delhi, Reprint 2017.
3. Soumitra Kumar Mandal, "Microprocessor & Microcontroller Architecture, Programming & Interfacing using 8085,8086,8051" ,McGraw Hill Edu,2013.
4. Ajay V.Deshmukh, "Microcontroller Theory &Applications", McGraw Hill Edu,2016

CO-PO MAPPING

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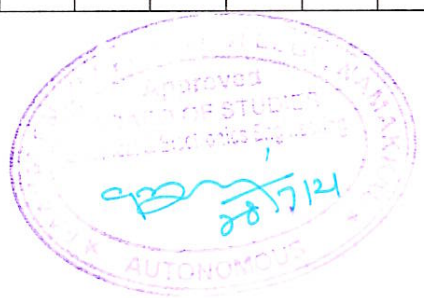
CO4	3	-	2	1	3	1	-	-	-	1	2	1	3	3
CO5	3	-	2	2	3	1	-	-	1	-	2	1	3	3



EE19604 WIND AND SOLAR ENERGY SYSTEMS 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- impart knowledge on wind energy conversion and performance of wind power generators.
- gain idea on grid coupling and control strategies for wind energy system.
- understand the process of solar energy conversion using photovoltaic (PV) system and applications.
- impart detailed knowledge on performance of grid connected operation of solar and wind energy system.
- get basic information of hybrid wind-PV and energy storage.

UNIT I WIND ENERGY CONVERSION SYSTEMS 9

Basic principle of wind energy conversion; Nature of wind; Wind survey in India; Power in the wind; Performance of induction generators for WECS; Analysis of different wind power generators – Induction generator, Permanent magnet synchronous generator, doubly fed induction generator, self-exited induction generator.

UNIT II GRID CONNECTED WIND ENERGY SYSTEMS 9

Grid Connected WECS- Grid connectors concepts, wind farm and its accessories; Systems for feeding into the grid - Induction generators for direct grid coupling; Asynchronous generators in static cascades; Synchronous generators grid related problems; Generator control; Performance improvements; Different schemes ; AC voltage controllers; Harmonics and power factor improvement.

UNIT III SOLAR ENERGY CONVERSION SYSTEMS 9

Photovoltaic(PV) energy conversion- Solar radiation and measurement, solar cells and their characteristics; PV arrays; Switching devices for solar energy conversion; Grid connection issues; Principle of operation- Line commutated converters (inversion-mode),boost and buck-boost converters, selection of inverter, battery sizing, array sizing; PV Applications- Standalone inverters, charge controllers, water pumping, audio visual equipment's, street lighting; Analysis of PV systems.

UNIT IV OPERATION OF POWER SYSTEM WITH WIND AND SOLAR ENERGY SYSTEMS 9

Interface requirement - Synchronizing with grid, operating limit, load scheduling, utility resource planning, electrical performance, voltage, current and power efficiency; Component design for maximum efficiency - Static bus impedance and voltage regulation, quality of power, renewable capacity limit , plant economy.

UNIT V HYBRID SYSTEM 9

Need for hybrid systems - Range and types of hybrid systems, layout of wind-PV hybrid system; Role of energy storage systems, energy storage; Construction and working of lithium-ion battery, fuel cells, supercapacitors.

TOTAL PERIODS: 45

COURSE OUTCOMES

At the end of this course, students will be able to

- analyze the performance of power generators in wind energy conversion.
- describe about grid coupling and control strategies for wind energy system.
- explain the process of solar energy conversion using photovoltaic (PV) system and applications.
- enumerate the performance of grid connected operation of solar and wind energy system.
- analyze the layout of hybrid wind-PV system and importance of energy storage.

TEXT BOOKS

1. Rai ,G.D., "Non- conventional resources of energy" , Khanna publishers ,Fourth edition , 2018.
2. B.H.Khan, "Non Conventional Energy Resources", Tata McGrawHill, 2nd Edition reprint 2016.

REFERENCES

1. Rashid. M. H, "Power Electronics Handbook", Academic press, 2001.
2. Joshua Earnest, Tore Wizeliu, 'Wind Power Plants and Project Development', PHI Learning Pvt.Ltd, New Delhi, 2011.
3. J.K.Manwell, J.G.McGowan, A.L.Rogers, "Wind energy explained – Theory Design and applications", John Wiley& Sons, 2nd Edition reprint 2015.
4. Solanki C. S. "Solar Photovoltaics: Fundamentals, Technologies and Applications", Prentice Hall India 2017.

CO-PO MAPPING

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CO4	3	2	2	3	2	1	-	1	-	2	2	3	3	3
CO5	3	3	2	3	3	1	-	-	-	-	2	3	3	3

EE19605 **ELECTRICAL DRIVES LABORATORY** **0 0 2 1**

COURSE OBJECTIVES

To enable the students to

- familiar with the speed control concepts of motor drives.
- gain knowledge on DSP induction motor drive.
- acquire knowledge on FPGA for induction motor speed control.
- enhance concepts using chopper fed motor drives.

LIST OF EXPERIMENTS

1. Speed control of DC motor using three phase rectifiers.
2. Speed control of three phase induction motor using PWM inverter.
3. DSP based induction motor drive.
4. Induction motor speed control using FPGA.
5. Speed control of brushless DC motor.
6. DSP based chopper fed DC motor drive.
7. Speed control of DC motor using dual converter.

TOTAL PERIODS: 30

COURSE OUTCOMES

At the end of this course, students will be able to

- apply the speed control concepts of motor drives.
- implement concepts of DSP based electrical drives.
- work with FPGA for induction motor speed control.
- implement chopper fed motor drives.

CO-PO MAPPING

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CO2	2	2	1	2	-	2	1	-	-	-	2	2	3	3
CO3	2	2	1	2	-	2	-	-	1	-	2	2	3	3
CO4	2	2	1	2	1	1	-	-	-	-	2	2	3	3

EE19606 **MICROPROCESSORS AND MICROCONTROLLERS LABORATORY** **0 0 2 1**

COURSE OBJECTIVES

To enable the students to

- understand 8085, 8051 programming and instruction sets.
- acquire knowledge on programming concepts.
- know the ideas for code conversion programming.
- Understand 8085 I/O interfacing with peripheral devices such as ADC, DAC, and stepper motor.

LIST OF EXPERIMENTS

I. PROGRAMS USING 8085

1. 8 bit addition and subtraction.
2. 8 bit multiplication and division.
3. Sorting the given set of numbers in ascending and descending order.
4. Code conversion.
5. Interfacing with ADC and DAC.

6 Interfacing with stepper motor.

II.PROGRAMS USING 8051

1. 16 bit addition and subtraction.
2. 16 bit multiplication and division.

TOTAL PERIODS: 30

COURSE OUTCOMES

At the end of this course, students will be able to

- develop programming skills in 8085 microprocessors and 8051 microcontrollers based on its instruction sets.
- write basic programming using 8085 and 8051.
- apply programming concept for code conversion process.
- interface the peripheral devices with 8085.

CO-PO MAPPING

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CO4	2	2	1	2	-	1	-	-	-	-	2	2	3	3

EN19601 **CAREER DEVELOPMENT LABORATORY II** **0 0 2 1**

COURSE OBJECTIVES

To enable the students to

- enhance their own potential strength and reduce weakness to survive in corporate world
- evaluate their own personality skills to face the interviews in a successful way
- solve the quantitative aptitude problems and improve their problem-solving skills
- solve the quantitative aptitude in advance level tests to get placed in tier 1 companies
- improve their reasoning skills to get placed in reputed companies

UNIT I CORPORATE READINESS **6**

Writing Skills: Email Writing - Paragraph writing -Time Management – Stress Management – JAM: Level 1 - Self Introduction – JAM: Level 2 – Buddy Presentation - Role Play: Individual

UNIT II INTERVIEW SKILLS **6**

Group Discussion: Level II – Group Discussion: Level III – General – Interview Techniques - Selection process - Grooming - Dress code - Body Language – Mock Interview Practice: Level 1

UNIT III QUANTITATIVE APTITUDE I **6**

Simplification - Time and work - Pipes and cisterns - Ratio and Proportion - Partnership

UNIT IV QUANTITATIVE APTITUDE II **6**

Simple interest and Compound interest - Profit and loss - Permutation and combination Probability - Calendar

UNIT V LOGICAL AND VERBAL REASONING **6**

Seating arrangement – Direction - Arithmetic reasoning – Syllogisms - Making Judgments - Statements and conclusions - Matching definition - Cause and effect

TOTAL PERIODS: 30

COURSE OUTCOMES

At the end of this course, students will be able to

- demonstrate the interpersonal skills in Group Discussions
- enhance their verbal and written ability
- practice soft skills to excel in their jobs
- compute problems based on quantitative aptitude
- reveal their logical and verbal reasoning by scoring the expected percentage to get placed in reputed companies

TEXT BOOKS

1. Agarwal, R.S." a modern approach to Verbal & Non Verbal Reasoning", S.Chand& Co Ltd, new delhi
2. Agarwal, R.S. " Objective General English", S.Chand&Co

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1. Abhijit Guha, "Quantitative Aptitude ", Tata-McGraw Hill.
2. Word Power Made Easy By Norman Lewis ,Wr.Goyal Publications

3. Johnson, D.W. Reaching out – Interpersonal Effectiveness and self actualization. Boston: Allyn and Bacon.
4. Infosys Campus Connect Program – students' guide for soft skills

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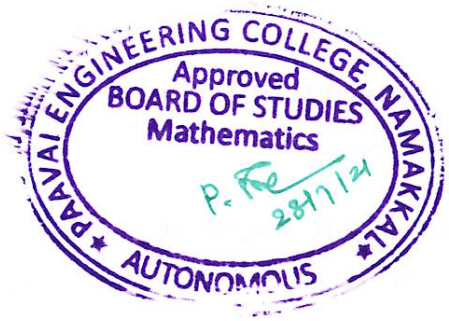
CO5	2	3	3	2	1	3	3	1	-	1	2	-	2	3



PROFESSIONAL ELECTIVE I

EE19151 BIO MEDICAL ENGINEERING 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the knowledge about the organs of human body and measure the parameters
- learn the bio potential electrodes, transducers, and their types
- gain the knowledge about the various measurements of blood pressure.
- study about the modern imaging systems.
- know the latest technologies in biomedical engineering.

UNIT I ELECTRO PHYSIOLOGY 9

Cell and its structure- Electrical, mechanical and chemical activities; Action and resting potential- Organization of nervous system, CNS, PNS, neurons, axons, synapse; Propagation of electrical impulses along the nerve; Sodium pump; Cardio pulmonary system; Physiology of heart, lung, kidney.

UNIT II BIO POTENTIAL ELECTRODES AND TRANSDUCERS 9

Design of medical instruments - Components of biomedical instrument system; Electrodes- Micro electrodes, needle electrodes, surface electrodes; Transducers -Piezo electric, ultrasonic, passive transducers, resistive, capacitive, inductive; Biomedical measurements like PH, PCO2, PO2 of blood; Isolation amplifier, preamplifier, current amplifier, chopper amplifier.

UNIT III INSTRUMENTS USED FOR DIAGNOSIS 9

ECG- Einthoven triangle, leads, electrodes, vector cardiograph, measurement of cardiac output; EEG; EMG; Plethysmography; Blood flow measurements; Holter monitor; Respiratory rate measurement; Oximeter; Patient monitoring system; ICCU.

UNIT IV MODERN IMAGING SYSTEM 9

Ultrasonic diagnosis; Ultrasonic scanning; Isotopes in medical diagnosis; Pace makers, Defibrillators; Doppler Monitor(colour); Medical imaging-X-ray generation; Radiographic and fluoroscopic Techniques; Image intensifiers; Computer aided tomography; PET; SPECT; Laser applications; Echocardiography; CT scan; MRI/NMR; Endoscopy; Retinal Imaging.

UNIT V RECENT TRENDS AND INSTRUMENTS FOR THERAPY 9

Dialysers; Surgical diathermy; Electro anaesthetic and surgical techniques; Sources of electric hazards and safety techniques; Telemetry - Single channel, multi-channel, implantable, wireless; Telemedicine- Telemedicine applications; Robotic surgery.

TOTAL PERIODS: 45

COURSE OUTCOMES

At the end of this course, students will be able to

- acquaint the physiology of the heart, lung, blood circulations, respirations, patient monitoring and electrical safety in clinical environment.
- apply the proper electrodes and transducers based on the application.
- obtain the knowledge in various electrical origins of recording methods of ECG, EEG,EMG, ERG
- know how to use the latest medical equipment's available for measurement of non-electrical parameters in the physiological systems of the human body and the modern methods of imaging techniques used for diagnostic purpose in the health care centre.
- identify the latest procedure adopted for providing medical assistance through telemedicine and the Therapeutic equipments used for diagnostic and surgery purposes.

TEXT BOOKS

1. Khandpur, "Handbook of Biomedical Instrumentation" 2nd Edition, Reprint, Tata McGraw Hill, 2018.
2. M.Arumugam, "Biomedical Instrumentation", Anuradha Publications, Reprint 2017.

REFERENCES

1. Leslie Cromwell, Fred J. Werbell and Eruch A. Pfeigger, "Biomedical Instrumentation and Measurements", 2nd Edition Reprint 2017
2. WQ. J.Tompskins and J.G. Webster, "Design of Microcomputer Based Medical Instrumentation", Prentice-Hall, 2016.
3. Geddes and Baker, "Principle of Applied Biomedical Instrumentation", John Wiley and Sons, New York, 2016.
4. John G. Webster, "Medical Instrumentation Application and Design", John Wiley and sons, India, 3rd Edition, Reprint 2018.

CO-PO MAPPING

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's
(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

CO's	Programme Outcomes PO's												PSO's	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	-	-	2	2	2	-	-	-	-	1	3	3
CO2	3	2	3	-	2	2	-	1	1	-	-	1	3	3
CO3	3	1	-	-	3	2	-	-	-	1	-	1	3	3
CO4	3	2	-	-	2	2	1	-	1	-	-	1	3	3
CO5	3	2	-	-	3	2	-	2	-	-	-	1	3	3

EE19152 **NANO SCIENCE** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- impart knowledge on the basics about the semiconductor and optoelectronic materials.
- know about the nano structure properties.
- understand the analysis of quantum techniques.
- know about the different techniques in characterization.
- understand the application of nano science.

UNIT I BASICS OF NANOSCIENCE **9**

Basic properties of Conductors, Insulators and Semiconductors; Band diagram concept of typical semiconductors; Basic chemistry concepts; Physical aspects, bonding, wave-particle duality, Heisenberg uncertainty principle, schrodinger wave equation, quantum confinement in 1-D, 2-D and 3-D; Effects of the nanometer length scale- Change in properties.

UNIT II PROPERTIES AND ANALYSIS OF NANOSTRUCTURES **9**

Basic types of nanostructures- Quantum wells, quantum wires, carbon nanotubes, nanowires; Quantum dots, nanoclusters; Nanoparticles- Colloidal nanoparticle crystals, functionalized nanoparticles; Fabrication methods- Top-down processes, bottom-up processes, nanolithography techniques, arc discharge method, laser ablaton method, ion implantation, chemical vapour deposition.

UNIT III ANALYSIS OF QUANTUM TECHNIQUES **9**

Charging of quantum dots, coulomb blockade, quantum mechanical treatment of quantum wells, wires, and dots, widening of band gap in quantum dots, strong and weak confinement; Properties of coupled quantum dots; Optical scattering from nan defects.

UNIT IV CHARACTERIZATION TECHNIQUES **9**

Classification of characterization methods; Different microscopy techniques-Light microscopy-Principle, resolution, electron microscopy; Scanning electron microscopy (SEM)-Principle , resolution; Scanning probe microscopy; Scanning tunneling microscopy (STM); Atomic force microscopy (AFM), principle, resolution.

UNIT V APPLICATIONS **9**

Information storage- nano electronics, molecular switch, super chip, nano crystal; Nano biotechlogy-Nano probes in medical diagnostics and biotechnology, nano medicines, targetted drug delivery; Bio imaging - Micro electro mechanical systems (MEMS), Nano electro mechanical systems (NEMS); Solar cell, battery.

TOTAL PERIODS: 45

COURSE OUTCOMES

At the end of this course, students will be able to

- explain the concept of nano physics and quantum dots.
- determine the behavior of materials in nano scale.
- examine the energy level of different materials.
- analyze different techniques used in characterization.
- Implement nano science technology in various applications.

TEXT BOOKS

1. K.Bamam and D.Vvedensky , "Low Dimensional Semiconductor Structures", 2017.
2. B. H. Bransden, Charles Jean Joachain "Quantum Mechanics" Prentice Hall, 2017.

REFERENCES

1. A.S. Edelstein and R.C. Cammearata, eds., "Nanomaterials: Synthesis, Properties and Applications", Institute of Physics Publishing, Bristol and Philadelphia, 2017.
2. N John Dinardo, "Nanoscale Charecterisation of surfaces & Interfaces", 2nd edition, Weinheim Cambridge, Wiley-VCH, 2016.
3. Akhlesh Lakhtakia,"The Hand Book of Nano Technology, Nanometer Structure, Theory, Modeling and Simulations". Prentice-Hall of India (P) Ltd, New Delhi, 2017.
4. Krause P. C. and Wasynczuk O., "Electromechanical Motion Devices", McGraw-Hill, New York,2017.

CO-PO MAPPING

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(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

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CO1	3	1	1	2	1	1	-	-	-	-	2	2	3	3
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CO3	3	2	2	3	3	1	-	-	-	-	2	3	3	3
CO4	3	2	2	3	2	1	1	-	1	-	2	3	3	3
CO5	3	3	2	3	3	1	-	1	-	-	2	3	3	3

EE19153 **VLSI DESIGN AND CIRCUITS** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- understand the concept of MOS transistors operations and their characteristics.
- analyze about the fabrication process of CMOS technology and its layout design rules.
- devise the process of CMOS and their circuit families.
- know about sheet resistance, area capacitance of layers gate logic, some clocked sequential circuits.
- identify the concepts of algorithmic design flow and programmable logic devices.

UNIT I MOS TECHNOLOGY AND CIRCUITS **9**

Introduction to integrated circuit technology - Basic MOS transistor, depletion mode, enhancement mode; NMOS fabrication; CMOS fabrication - n well, p well, twin tub, SOI, basic electrical properties of MOS device, threshold voltage, body effect, comparison of CMOS and bipolar .

UNIT II MOS CIRCUIT DESIGN PROCESS **9**

MOS layers, stick diagrams, NMOS design style, CMOS design style, design rules and layout, lambda based design rules, contact cut, propagation delays, combinational logic, pass transistor and trans conductance.

UNIT III COMBINATIONAL LOGIC CIRCUITS **9**

Design - Half adder, full adder, multiplexer, demultiplexer, transmission gates; Elmores delay model - static CMOS design; Power dissipation; Low power design principles; Comparison of circuit families.

UNIT IV DESIGN OF ARITHMETIC BUILDING BLOCKS AND SUBSYSTEM **9**

Arithmetic Building Blocks- Data paths, adders, multipliers, shifters, ALUs, power and speed tradeoffs; Designing memory and array structures- Memory architectures and building blocks, memory core, memory peripheral circuitry

UNIT V IMPLEMENTATION STRATEGIES **9**

Full custom and semi-custom ASIC design; Classification of gate arrays; Programmable logic devices PLD; Programming of PAL; FPGA building block architectures; ASIC design flow.

TOTAL PERIODS: 45

COURSE OUTCOMES

At the end of this course, students will be able to

- design the CMOS circuits, including logic components.
- apply CMOS technology-specific layout rules in the placement and routing of transistors and interconnect.
- verify the functionality, timing, power, and operations of different logic circuits.
- design the logic gates with its characteristics.
- identify to analyze circuits using programmable logic device and design flow.

TEXT BOOKS

1. Neil H.E. Waste and Kamran Eshraghian, "Principles of CMOS VLSI Design", Pearson Education ASIA, 2nd Edition, 2017.
2. D.A.Pucknell, K.Eshraghian, "Basic VLSI Design", 3rd Edition, Prentice Hall of India, NewDelhi, 2016.

REFERENCES

1. Kaushik Roy, Sharat Prasad, "Low Power CMOS VLSI Circuit Design ", 2016.
2. N.H.Weste, "Principles of CMOS VLSI Design", Pearson Education, India, 2015.
3. Wayne Wolf, "Modern VLSI Design" , 2nd Edition, Prentice Hall, 2016.
4. S.H.Gerez, "Algorithms for VLSI Design Automation" , 2015.

CO-PO MAPPING

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
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CO2	3	-	3	-	-	-	-	-	1	-	-	1	3	3
CO3	3	2	3	2	-	-	-	-	2	-	1	2	3	3
CO4	3	2	3	1	1	-	-	-	2	-	2	2	3	3
CO5	3	-	2	-	2	-	1	-	-	-	-	2	3	3

EE19154 COMMUNICATION ENGINEERING 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the fundamentals of analog communication and different type of modulation.
- know about the pulse modulation and on off keying (OOK) Systems.
- gain knowledge on the different coding techniques.
- familiar with the spread spectrum and multiple access techniques in communication systems.
- basics of telecommunication, satellite and optical communication services.

UNIT I ANALOG COMMUNICATION 9

Amplitude modulation – AM, DSBSC, SSBSC, VSB, PSD, modulators and demodulators; Angle modulation; PM and FM ; PSD; Modulators and demodulators; Super heterodyne receivers

UNIT II DIGITAL COMMUNICATION 9

Pulse Modulations- Concepts of sampling and sampling theorems; PAM, PWM, PPM, PTM; Quantization Technique- Delta modulation, slope overload error; ADM; Pulse code modulation, DPCM.OOK systems- ASK, FSK, PSK, applications of data communication; Time division multiplexing; Frequency division multiplexing.

UNIT III CODING TECHNIQUES 9

Primary communication- Entropy, properties, BSC, BEC; Source coding- Shannon fanon and Huffman coding theorem; Efficiency of transmissions; Error control codes and applications- Convolutional and block codes.

UNIT IV SPREAD SPECTRUM AND MA TECHNIQUES 9

Introduction to SS techniques- Direct sequence spread spectrum (DSSS); Frequency hopping spread spectrum (FHSS); Time hopping spread spectrum (THSS); MA Techniques - FDMA , TDMA, CDMA, SDMA, OFDM.

UNIT V COMMUNICATION SERVICES 9

Tele communication- GSM architecture, frequency reuse; GPRS; EDGE; Satellite communication- Read, orbit, satellite altitude, transmission path, satellite system; Fiber optical communication- Need, principles of light transmission, optical fiber communication system, light sources, types and configuration of optical fiber.

TOTAL PERIODS: 45

COURSE OUTCOMES

At the end of this course, students will be able to

- characterize and determine different methods of analog communication schemes.
- describe the pulse modulation of digital communication techniques.
- characterize the different type of coding techniques.
- analyze different spread spectrum and multiple access techniques.
- describe the operation of telecommunication, satellite and optical communication systems.

TEXT BOOKS

1. Taub & Schiling "Principles of communication systems" Tata McGraw hill 2017.
2. J.Das "Principles of digital communication" New Age International, 2015.

REFERENCES

1. Thedore.S.Rappaport, "Wireless Communication", Pearson Education, 2016.
2. Kennedy, "Electronics of Communication Systems" McGraw Hill 5th reprint 2014.
3. Simon Haykin, "Digital Communications", John Wiley, 2016.
4. Lathi B.P. "Modern digital and analog communication systems", Oxford University Press, 2016.

CO-PO MAPPING

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CO3	3	-	1	2	3	1	1	-	-	-	-	2	3	3
CO4	3	-	-	2	3	1	-	-	1	-	2	2	3	3
CO5	3	-	-	2	3	1	-	-	-	2	-	2	3	3

EE19251 RESTRUCTURED POWER SYSTEMS 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- know the basic restructuring of power industry and market models based on Contractual arrangements.
- infer knowledge on fundamental concepts of congestion management.
- gain the concepts of locational marginal pricing and financial transmission rights.
- understand marginal transmission pricing , ancillary services.
- realize the need for tariff, framework of Indian power sector.

UNIT I INTRODUCTION TO RESTRUCTURING OF POWER INDUSTRY 9

Introduction- Deregulation of power industry, restructuring process, issues involved in deregulation; Deregulation of various power systems; Fundamentals of economics- Consumer behavior, supplier behavior, market equilibrium, short and long run costs, various costs of production; Market models- Market models based on contractual arrangements, comparison of various market models.

UNIT II TRANSMISSION CONGESTION MANAGEMENT 9

Introduction- Definition of congestion, reasons for transfer capability limitation, importance of congestion management, features of congestion management; Classification of congestion management methods; Calculation of ATC – Non-market methods, market methods, nodal pricing, inter zonal and intra zonal congestion management; Price area congestion management; Capacity alleviation method.

UNIT III LOCATIONAL MARGINAL PRICES AND FINANCIAL TRANSMISSION RIGHTS 9

Mathematical preliminaries- Locational marginal pricing, lossless DCOPF model for LMP calculation, loss compensated DCOPF model for LMP calculation, ACOPF model for LMP calculation, financial transmission rights; Risk hedging functionality; Simultaneous feasibility test and revenue adequency; FTR issuance process: FTR auction, FTR allocation; Treatment of revenue shortfall – Secondary trading of FTRs , flow gate rights; FTR and market power, FTR and merchant transmission investment.

UNIT IV ANCILLARY SERVICE MANAGEMENT AND PRICING OF TRANSMISSION NETWORK 9

Introduction of ancillary services – Types of ancillary services, Classification of ancillary services, load generation balancing related services; Voltage control and reactive power support devices; Black start capability service - ancillary service, co-optimization of energy and reserve services; International comparison ; Transmission pricing – Principles, classification, role in transmission pricing methods, marginal transmission pricing paradigm, composite pricing paradigm, merits and demerits of different paradigm.

UNIT V REFORMS IN INDIAN POWER SECTOR 9

Introduction – Framework of Indian power sector, reform initiatives, availability based tariff; Electricity act 2003, open access issues; Power exchange - Power sector reforms and issues; Case study in India.

TOTAL PERIODS: 45

COURSE OUTCOMES

At the end of this course, students will be able to

- explain the market models for restructuring of power industry on contractual arrangements.
- implement the concept of congestion management.
- analyze about marginal pricing and financial transmission rights.
- evaluate marginal transmission pricing, ancillary services.
- investigate Indian power sectors reformation through case study.

TEXT BOOKS

1. Mohammad Shahidehpour, Muwaffaq Alomoush, Marcel Dekker, "Restructured electrical power systems: operation, trading and volatility" 2016.
2. Kankar Bhattacharya, Jaap E. Daadler, Math H.J. Boolen, "Operation of restructured power systems", Kluwer Academic, 2016.

REFERENCES

1. Sally Hunt, "Making competition work in electricity", John Willey and Sons Inc. 2012.
2. Steven Stoft, "Power system economics: designing markets for electricity", John Wiley & Sons, 2015.
3. S.K Gupta , " Restructuring of power systems", 2018.
4. Ilic, Marija, Galiana, Francisco, Fink, Lester "Power Systems Restructuring Engineering and Economics", 2015.

CO-PO MAPPING

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(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

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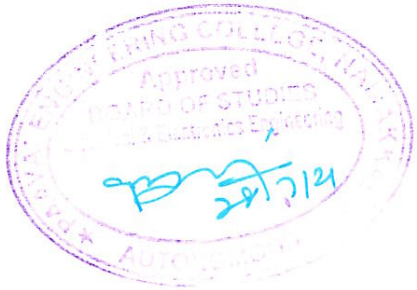
CO3	3	3	3	3	2	2	3	-	-	-	1	-	3	3
CO4	3	2	2	3	2	2	1	-	1	1	-	-	3	3
CO5	3	-	1	2	-	3	1	-	-	-	-	-	3	3



EE19252 **POWER SYSTEM DYNAMICS** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- know the basics of mathematical description of a synchronous machine.
- acquire the knowledge of small signal stability analysis.
- understand the concept of excitation system and its modelling.
- know the stability analysis of various power system networks.
- gain basic concept related to voltage stability in transmission system.

UNIT I SYNCHRONOUS MACHINE MODELING **9**

Synchronous machine - Physical and mathematical description of a synchronous machine; Basic equations of a synchronous machine - dq0 transformation, per unit representation, equivalent circuits for direct and quadrature axes.

UNIT II SMALL-SIGNAL STABILITY ANALYSIS **9**

Classification of stability - Basic concepts and definitions - Rotor angle stability, fundamental concepts of stability of dynamic systems; State-space representation - Stability of dynamic system, linearization, eigen properties of the state matrix; Single-machine infinite bus (SMIB) configuration - Classical machine model stability analysis with numerical example, small signal stability of multi-machine system.

UNIT III EXCITATION SYSTEMS AND IT'S MODELLING **9**

Excitation system modeling - excitation system requirements , types of excitation; Dynamic performance measures - Large signal and small signal performance measures, control and protective functions; Modelling of excitation system - Per unit system, modelling of excitation system components, modeling of complete excitation system, field testing for model development and verification.

UNIT IV STABILITY ANALYSIS **9**

Introduction - Factors influencing transient stability, simulation of power system dynamic response; Structure of power system model - Synchronous machine representation, excitation system representation, transmission network and load representation, overall system equations, solution for overall system equation; Analysis of unbalanced faults - Introduction to symmetrical components, sequence impedance of synchronous machine, transmission lines and transformers; Simulation of different types of faults.

UNIT V VOLTAGE STABILITY **9**

Basic concepts related to voltage stability - Transmission system characteristics, generator and load characteristics, characteristics of reactive compensating devices, Voltage collapse - Modelling requirement, dynamic and static analysis, determination of shortest distance to instability; Continuous power flow analysis; Prevention of voltage collapse - System design measures, system operating measures.

TOTAL PERIODS: 45

COURSE OUTCOMES

At the end of this course, students will be able to

- deliver the basic design consideration of synchronous machine.
- describe the fundamental dynamic behaviour of stability analysis in power systems.
- explain excitation system and its modelling.
- interpret analysis of system stability.
- analyze voltage collapse and modelling requirement.

TEXT BOOKS

1. Padiyar K.R., "Power System Dynamics, Stability and Control", Interline Publications, 2017.
2. Prabha, Kundur, "Power System Stability and Control", TMH, 9th Reprint,2016.

REFERENCES

1. Marijallic; John Zaborszky. "Dynamics and Control of Large Electric Power Systems",IEEE Press and John Wiley and Sons, Inc, 2017.
2. Chakrabarti A, "Power System Dynamics and Simulation", PHI learning private Ltd.2016.
3. Selected topics from IEEE Transaction and Conference Proceedings.
4. Mircea, Eremia Mohammad Shahidehpour. "Handbook of Electrical Power System Dynamics:Modeling, Stability, and Control",Wiley publication,2016.

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CO1	3	-	3	3	-	-	-	-	-	-	1	2	3	3
CO2	3	2	1	3	2	-	-	-	-	-	1	2	3	3
CO3	3	-	3	3	2	-	-	-	-	-	1	2	3	3
CO4	3	2	1	3	2	-	-	-	-	-	2	2	3	3
CO5	3	-	1	2	2	-	-	-	-	-	2	2	3	3

EE19253 **FLEXIBLE AC TRANSMISSION SYSTEM** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- understand the concepts of FACTS.
- recognize the applications of static VAR compensators in power systems.
- learn about thyristor controlled series capacitor.
- study the operation of static synchronous compensator, static synchronous series compensator.
- understand the working of unfied and interline power flow controller.

UNIT I REACTIVE POWER COMPENSATOR **9**

FACTS terms and definitions - Reactive power compensation in transmission line, uncompensated transmission line; Principle of reactive power compensation- Passive shunt compensation, passive series compensation, effect on power transfer capacity, series compensation, shunt compensation, compensation devices, passive compensation, active compensation.

UNIT II STATIC VAR COMPENSATOR (SVC) AND APPLICATIONS **9**

Static VAR Compensator- FC/TCR type SVC,TCS-TCR type SVC, SVC VI characteristics; Voltage control by SVC - Advantages of slope in dynamic characteristics, applications; Increases in steady state power transfer capacity, Enhancement of transient stability; Enhancement of power oscillation damping; Prevention of voltage instability.

UNIT III THYRISTOR CONTROLLED SERIES CAPACITOR (TCSC) AND APPLICATIONS **9**

Thyristor controlled series capacitor - Operating limits, principle of operation, impedance characteristics, operating modes of TCSC, variable reactance model; Modelling of TCSC - TCSC modeling for steady state and dynamic stability studies, TCSC model for transient and oscillatory stability studies, applications; Improvement of the system stability limit- enhancement of system damping; Voltage collapse prevention.

UNIT IV STATIC SYNCHRONOUS COMPENSATOR (STATCOM) AND STATIC SYNCHRONOUS SERIES COMPENSATOR (SSSC) **9**

Static synchronous compensator (STATCOM) - principle of operation, VI characteristics, harmonic analysis of VSC/VSI; Multipulse converter configuration; Multilevel configuration; Pulse width modulation, applications; Increases in steady state power transfer capacity; Enhancement of transient stability; Prevention of voltage instability; Static synchronous series compensator (SSSC) -Principle of operation.

UNIT V UNIFIED POWER FLOW CONTROLLER (UPFC) AND INTERLINE POWER FLOW CONTROLLER **9**

Unified power flow controller (UPFC) - Principle of operation, modes of operation, UPFC modeling, UPFC load flow model, interfacing the UPFC with the power network, UPFC dynamic model, injection model, applications; Improve damping of power system oscillations - Power system stability enhancement using PSS and UPFC; Interline power flow controller - Principle of operation.

TOTAL PERIODS: 45

COURSE OUTCOMES

At the end of this course, students will be able to

- analyze the concept of FACTS.
- implement static VAR compensators in power systems.
- apply the thyristor controlled series capacitor concepts in various application.
- describe the static synchronous compensator, static synchronous series compensator.
- explain unfied and interline power flow controller.

TEXT BOOKS

1. K.R. Padiyar, "FACTS Controllers for Power Transmission and Distribution" New Age International Publishers, 2016.
2. Narain G. Hingorani, " Understanding FACTS", Reprint 2017.

REFERENCES

1. Xiao-Ping Zhang "Flexible AC Transmission Systems" Springer ,2016.
2. Narain G.Hingorani, LaszioGyugyi, "Understanding FACTS concept and Technology", Standard Publisher, Delhi, 2015.
3. A.T.John, "Flexible A.C. Transmission Systems", Institution of Electrical and Electronic Engineers(IEEE), 2016.
4. V.K.Sood,HVDC and "FACTS controllers – Applications of Static Converters in Power System" , Kluwer Academic Publishers, 2014.

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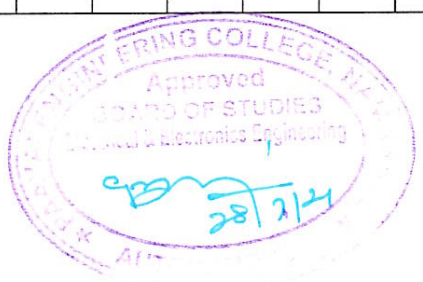
CO4	3	2	2	2	2	-	-	-	-	1	-	1	3	3
CO5	3	2	2	1	2	-	-	1	-	-	-	1	3	3



EE19254 **PROGRAMMABLE LOGIC CONTROLLERS** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- develop basic knowledge about PLC architecture.
- study the logical operation of ladder diagram and functional blocks.
- learn implementation of timers, counters and registers in PLC.
- gain knowledge of the data handling and designing systems.
- develop skill in writing simple program in PLC applications.

UNIT I PROGRAMMABLE LOGIC CONTROLLERS **9**

Controllers- Hardware, internal architecture; PLC systems- Input/output devices; Number systems- Binary system, octal and hexadecimal, binary arithmetic; PLC data- Input/output units, signal conditioning, remote connections, processing inputs, I/O addresses.

UNIT II LADDER AND FUNCTIONAL BLOCK PROGRAMMING AND INTERNAL RELAYS **9**

Ladder diagrams- Logic functions, latching, multiple outputs, entering programs; Function blocks- Internal relays, ladder programs; Battery-backed relays- One-shot operation, set and reset, master control relay.

UNIT III TIMERS, COUNTERS AND REGISTERS **9**

Types of timers - Programming timers, off-delay timers, pulse timers, forms of counter; Programming- Up and down counting, timers with counters, sequencer, shift registers, ladder programs.

UNIT IV DATA HANDLING AND DESIGNING SYSTEMS **9**

Registers and bits- Data handling, arithmetic functions, closed loop control; Program development- Safe systems, commissioning, fault finding, system documentation.

UNIT V PROGRAMMING APPLICATIONS **9**

Temperature control; Valve sequencing; Conveyor belt control; Control of a process; Problems.

TOTAL PERIODS: 45

COURSE OUTCOMES

At the end of this course, students will be able to

- explain the architecture of PLC.
- develop logical operation of ladder diagram in PLC.
- describe implementation of timers, counters and registers in PLC.
- analyze the parameters of data handling and designing systems.
- apply programming for various application in PLC.

TEXT BOOKS

1. W. Bolton "Programmable Logic Controllers" Fourth Edition Reprint 2016.
2. Michael P. Lukas, "Distributed Control System", Van Nostrand Reinhold Co.,Canada,2016.

REFERENCES

1. Hughes, T.A "Programmable Controllers" 4th Edition, ISA Press, 2015.
2. John W Webb and Ronald A Reis "Programmable Logic Controllers – Principles and Applications", Prentice Hall Inc., New Jersey, Third edition, 2013.
3. W. Bolton "Programmable Logic Controllers- Introduction" Elsevier Newnes publications reprint 2017.
4. E.A.Parr "Programmable Controllers An engineer's guide", Elsevier Newnes publications 2015.

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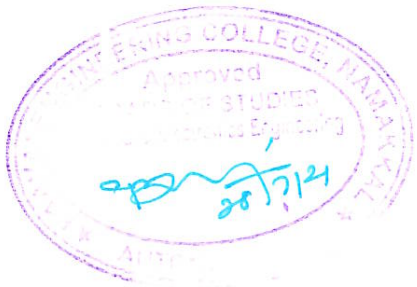
CO3	3	2	3	2	2	2	-	-	2	-	-	1	3	3
CO4	3	3	2	2	3	2	-	1	-	-	-	-	3	3
CO5	3	3	2	3	3	3	-	-	-	1	-	-	3	3



OPEN ELECTIVE I

EE19901 POWER ELECTRONIC SYSTEMS 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- impart knowledge on different types of power semi-conductor devices and their switching characteristics.
- know the controlling techniques of switching devices and protection of power semiconductor devices.
- understand the operation of Phase controlled converter and various chopper conversion techniques.
- study the mode of inverters and different modulation techniques.
- learn the types of AC voltage controllers and basics of matrix converters.

UNIT I POWER SEMI-CONDUCTOR DEVICES 9

Study of switching devices- SCR, TRIAC, GTO, BJT, MOSFET and IGBT; Static characteristics- SCR, MOSFET and IGBT; Introduction to driver and snubber circuits.

UNIT II PHASE-CONTROLLED CONVERTERS 9

Converters - 2-pulse, 3-pulse and 6-pulse; Effect of source inductance; Firing schemes for converter; Applications- Light dimmer, excitation system, solar PV systems.

UNIT III DC TO DC CONVERTERS 9

Step-down and step-up chopper-control strategy; Introduction to types of choppers-A, B, C, D and E; Switched mode regulators - Buck, boost, buck- boost regulator, Applications- Battery operated vehicles.

UNIT IV INVERTERS 9

Single phase and three phase voltage source inverters (both120^0 mode and 180^0 mode); PWM techniques- Multiple PWM, sinusoidal PWM, modified sinusoidal PWM; Current source inverter, Applications- Induction heating, UPS.

UNIT V AC TO AC CONVERTERS 9

Single phase and three phase AC voltage controllers- Multistage sequence control; Single phase and three phase cyclo converters; Introduction to matrix converters; Applications –Welding.

TOTAL PERIODS: 45

COURSE OUTCOMES

At the end of this course, students will be able to

- identify and select the switching devices for different power converter applications.
- apply the different controlling techniques and protection schemes based on the load.
- design a suitable DC power supply for given load specification from AC and DC supply.
- describe and analyze the single and three phase inverters.
- explain an AC voltage controller electromagnetic compatibility of power converters.

TEXT BOOKS

1. M.H.Rashid, "Power Electronics: Circuits, Devices Applications", Pearson, 2016.
2. M.D. Singh and Khanchandani K.B., "Power Electronics", Tata Mc.Graw Hill., 2016

REFERENCES

1. L.Umanand, "Power Electronics Essentials and Applications", Wiley India Pvt Ltd, Reprint, 2015.
2. G.K. Dubey, S.R. Doradla, A. Joshi and R.M.K. Sinha, "Thyristorised Power Controllers", New Age, International Publishers, 2017.
3. Ned Mohan,Tore M. Undeland and William P.Robins, "Power Electronics – Converters, Applications and Design", Third Edition, John Wiley and Sons, 2018.
4. R.S. Ananda Murthy and V. Nattarasu, "Power Electronics: A Simplified Approach", Pearson/Sanguine Technical Publishers,2017 .

CO-PO MAPPING

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
CO's	Programme Outcomes PO's												PSO's	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	1	1	-	2	1	-	1	-	-	1	1	3	3
CO2	3	-	1	-	2	1	-	1	1	-	2	1	3	3
CO3	3	1	1	-	2	1	1	1	-	1	2	1	3	3
CO4	3	-	1	1	2	1	-	1	1	-	2	1	3	3
CO5	3	-	1	-	2	1	-	1	-	-	2	1	3	3

EE19902 BASICS OF POWER SYSTEMS ENGINEERING 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- know about the basics of power generation and its equipment's.
- understand the concept of transmission and distribution of power systems.
- realize the importance of insulators and cables used in power sector.
- know the grounding procedure and its methods.
- get idea on basics of power distribution system.

UNIT I POWER GENERATION 9

Different types of energy sources and efficiency in their use; Main parts of power system; Electric energy generation; Major electrical equipment in power station; Non-conventional methods of electric energy generation.

UNIT II TRANSMISSION AND DISTRIBUTION 9

Structure of the power transmission system- Basic aspects of AC power transmission, concepts of power in AC transmission systems, power flow in simplest power network.

UNIT III INSULATORS AND CABLES 9

Insulator materials; Types-Pin, suspension, strain, shackle; Cables- Types, insulation in cables.

UNIT IV POWER SYSTEM GROUNDING 9

Introduction- ungrounded neutral systems, grounded neutral systems, other methods of non effective grounding; Harmonic suppressors; Choice of methods of neutral earthing; Equipment Grounding for safety; Grounding -Substation, line structure.

UNIT V POWER DISTRIBUTION SYSTEMS 9

Introduction- Radial and ring main systems, DC 3-wire system; Different types of distributors; Types of substations.

TOTAL PERIODS: 45

COURSE OUTCOMES

At the end of this course, students will be able to

- explain the concept of power generation and equipment's.
- describe transmission and distribution process in power systems.
- select insulators and cables for power sector based on different voltage levels.
- implement grounding procedure using various methods.
- explain the types of power distribution system.

TEXT BOOKS

1. A.Chakrabarti, M.L Soni, P.V. Gupta, U.S. Bhatnagar, "Power System Engineering", Dhanpat Rai & Co, Reprint 2017.
2. D Kothari and I J Nagrath, "Power System Engineering", Mc Graw Hill Education, 2018.

REFERENCES

1. S.N.Singh, "Electric Power Generation ,Transmission and Distribution", Prentice Hall of India Pvt.Ltd, New Delhi, 2018.
2. C.L.Wadhwa, "Electrical Power Systems", New Academic Science Ltd, Reprint 2016.
3. R.K.Rajput, "Power System Engineering", Laxmi Publications (P) Ltd, New Delhi, 2016.
4. V.K Mehta , "Principles of Power Systems", S.Chand publication 2017.

CO-PO MAPPING

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's
(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

CO's	Programme Outcomes PO's												PSO's	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	1	1	1	-	1	-	-	-	-	1	1	3	3
CO2	3	3	2	1	-	1	-	1	1	-	2	1	3	3
CO3	3	3	2	2	1	1	-	-	-	-	2	1	3	3
CO4	3	1	1	2	-	1	-	-	-	1	2	1	3	3
CO5	3	1	1	1	-	1	-	1	1	-	2	1	3	3