DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

M.E. - POWER ELECTRONICS AND DRIVES

CURRICULUM & SYLLABI

Regulations 2020

(Applicable to candidates admitted in the Academic Year 2020-2021 onwards)

K.S.R. College of Engineering (Autonomous)

(Approved by AICTE, Accredited by NAAC with A grade & Affiliated to Anna University)

K.S.R. Kalvi Nagar, Tiruchengode – 637 215

Namakkal (Dt), Tamilnadu, India

Email : info@ksrce.ac.in Website : www.ksrce.ac.in

	K.S.R. COLLEGE OF ENGINEERING (Autonomous) (Approved by AICTE, New Delhi and Affiliated to Anna University) K.S.R. Kalvi Nagar, Tiruchengode – 637 215	CURRICULUM PG R 2020
Department	Electrical and Electronics Engineering	
Programme	M.E. – Power Electronics and Drives	

SEMESTER – I

Sl. No.	Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
			L	T	P	C	CA	ES	Total
THEORY									
1.	MA20141	Applied Mathematics for Electrical Engineers	3	0	0	3	30	70	100
2.	PE20111	Analysis of Power Converters	3	0	0	3	30	70	100
3.	PE20112	Analysis of Inverters	3	0	0	3	30	70	100
4.	PE20113	Modeling of Electrical Machines	3	0	0	3	30	70	100
5.	-	Elective–I	3	0	0	3	30	70	100
6.	-	Elective–II	3	0	0	3	30	70	100
PRACTICAL									
7.	PE20121	Power Electronics Simulation Laboratory	0	0	3	2	50	50	100
8.	PE20122	Technical Presentation – I	0	2	0	1	50	50	100
Total			**18**	**2**	**3**	**21**	**800**		

SEMESTER – II

Sl. No.	Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
			L	T	P	C	CA	ES	Total
THEORY									
1.	PE20201	Soft Computing Techniques (Common to CS & PE)	3	0	0	3	30	70	100
2.	PE20212	Solid State DC Drives	3	0	0	3	30	70	100
3.	PE20213	Solid State AC Drives	3	0	0	3	30	70	100
4.	PE20214	FACTS Controllers	3	0	0	3	30	70	100
5.	-	Elective–III	3	0	0	3	30	70	100
6.	-	Elective – IV	3	0	0	3	30	70	100
PRACTICAL									
7.	PE20221	Solid State Drives Laboratory	0	0	3	2	50	50	100
8.	PE20222	Technical Presentation - II	0	2	0	1	50	50	100
Total			**18**	**2**	**3**	**21**	**800**		

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SEMESTER – III

Sl. No.	Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
			L	T	P	C	CA	ES	Total
THEORY									
1.	-	Elective – V	3	0	0	3	30	70	100
2.	-	Elective – VI	3	0	0	3	30	70	100
3.	-	Audit Course	2	0	0	0	50	50	100
PRACTICAL									
4.	PE20321	Project Phase – I	0	0	12	6	50	50	100
Total			**8**	**0**	**12**	**12**	**400**		

SEMESTER – IV

Sl. No.	Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
			L	T	P	C	CA	ES	Total
PRACTICAL									
1.	PE20421	Project Phase – II	0	0	24	12	50	50	100
Total			**0**	**0**	**24**	**12**	**100**		

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ELECTIVE – I & II (SEMESTER – I)

Sl. No.	Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
			L	T	P	C	CA	ES	Total
THEORY									
1.	PE20161	Advanced Power Semiconductor Devices	3	0	0	3	30	70	100
2.	PE20162	Non-Conventional Energy Sources	3	0	0	3	30	70	100
3.	PE20163	High Voltage DC Transmission System	3	0	0	3	30	70	100
4.	PE20164	Protection for Electrical Drives	3	0	0	3	30	70	100
5.	PE20165	Embedded System Design	3	0	0	3	30	70	100
6.	PE20166	Virtual Instrumentation System	3	0	0	3	30	70	100
7.	PE20167	Microcontroller based System Design	3	0	0	3	30	70	100

ELECTIVE – III and IV (SEMESTER – II)

Sl. No.	Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
			L	T	P	C	CA	ES	Total
THEORY									
1.	PE20261	PWM Techniques for Power Converters	3	0	0	3	30	70	100
2.	PE20262	Special Electrical Machines	3	0	0	3	30	70	100
3.	PE20263	Power Quality Management	3	0	0	3	30	70	100
4.	PE20264	System Theory	3	0	0	3	30	70	100
5.	PE20265	Industrial Robotics	3	0	0	3	30	70	100
6.	PE20266	Advanced Digital Signal Processing	3	0	0	3	30	70	100
7.	PE20267	Electric Vehicles	3	0	0	3	30	70	100

ELECTIVE – V & VI (SEMESTER – III)									
Sl. No.	**Course Code**	**Course Name**	**Hours/ Week**			**Credit**	**Maximum Marks**		
			L	**T**	**P**	**C**	**CA**	**ES**	**Total**
THEORY									
1.	PE20361	Power Electronics in Wind & Solar Power Conversion	3	0	0	3	30	70	100
2.	PE20362	Smart Grid	3	0	0	3	30	70	100
3.	PE20363	Machine Learning	3	0	0	3	30	70	100
4.	PE20364	Electrical Energy Conservation and Management	3	0	0	3	30	70	100
5.	PE20365	Application of MEMS Technology	3	0	0	3	30	70	100
6.	PE20366	Digital Signal Processors and Applications	3	0	0	3	30	70	100
7.	PE20367	Industrial Drives and Application	3	0	0	3	30	70	100

AUDIT COURSE (SEMESTER – III)									
Sl. No.	**Course Code**	**Course Name**	**Hours/ Week**			**Credit**	**Maximum Marks**		
			L	**T**	**P**	**C**	**CA**	**ES**	**Total**
THEORY									
1.	PE203A1	English for Research Paper Writing	2	0	0	0	50	50	100
2.	PE203A2	Disaster Management	2	0	0	0	50	50	100
3.	PE203A3	Constitution of India	2	0	0	0	50	50	100

K.S.R. COLLEGE OF ENGINEERING (Autonomous) **R 2020**

SEMESTER – I

		L	T	P	C
MA20141	**APPLIED MATHEMATICS FOR ELECTRICAL ENGINEERS (M.E. - POWER ELECTRONICS AND DRIVES)**	3	0	0	3

Course Outcomes: Upon Completion of the course, the students should be able to :		***Cognitive Level***
CO1:	*Develop the skills in finding the Eigen values by QR transformation.*	*Understand*
CO2:	*Apply simplex method to solve the linear programming problems, Transportation and Assignment problems*	*Apply*
CO3:	*Describe the concept of one dimensional random variables and probability distributions and its applications*	*Remember*
CO4:	*Identifying the waiting times by using single and multi-server queuing models.*	*Evaluate*
CO5:	*Solve the boundary value problems by various numerical analysis techniques.*	*Apply*

UNIT – I ADVANCED MATRIX THEORY [09]

Eigen-Values using QR Transformations – Generalized Eigen Vectors – Canonical Forms – Singular Value Decomposition and Applications – Pseudo Inverse.

UNIT – II LINEAR PROGRAMMING [09]

Formulation – Graphical Solution – Simplex Method – Big M Method – Transportation and Assignment Problems.

UNIT - III ONE DIMENSIONAL RANDOM VARIABLES [09]

Random Variables – Probability Function – Moments – Moment Generating Functions and their Properties – Binomial, Poisson, Uniform, Exponential and Normal Distributions – Function of a Random Variable.

UNIT - IV QUEUEING MODELS [09]

Poisson Process – Markovian queues – Applications of Queuing Models – Characteristics of Queuing Models – Kendall's notation – Mode I – (M/M/1) : (∞/FIFO) Single Server with Infinite Capacity – Little's Formula – Model II – (M/M/C): (∞/FIFO) Multi Server with Infinite Capacity – Model III – (M/M/1) : $(N/FIFO)$ Single Server with Finite Capacity – Model IV – (M/M/C) : $(N/FIFO)$ Multi Server with Finite Capacity – Machine Interference Model – Steady State Analysis.

UNIT – V COMPUTATIONAL METHODS IN ENGINEERING [09]

Boundary Value Problems for ODE – Finite Difference Methods – Numerical Solution of PDE – Solution of Laplace and Poisson Equations – Liebmann's Iteration Process – Solution of Heat Conduction Equation by Schmidt Explicit Formula and Crank Nicolson Implicit Scheme – Solution of Wave Equation.

Total = 45 Periods

Reference Books :

1 Bronson, R., Matrix Operation, Schaum's outline series, McGraw Hill, New York, Second Edition, 2011.

2 Taha, H. A., Operations Research, Pearson Education, New Delhi, Ninth Edition, 2012.

3 Donald Gross and Carl M. Harris, Fundamentals of Queuing theory, John Wiley and Sons, New York, Tenth Edition, 2013.

4 Grewal, B.S., Numerical methods in Engineering and Science, Khanna Publishers, Chennai, Ninth Edition, 2013.

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SEMESTER - I

		L	T	P	C
PE20111	**ANALYSIS OF POWER CONVERTERS**	3	0	0	3

Course Outcomes : On successful completion of the course, the student will be able to		***Cognitive Level***
CO1:	*Explain the operation of DC-DC converters.*	*Understand*
CO2:	*Recall the principle, operation and analysis of DC-DC converter.*	*Remember*
CO3:	*Describe the different type's resonant switching converters.*	*Remember*
CO4:	*Evaluate the design parameters of switched mode converters.*	*Evaluate*
CO5:	*Explain the principles and analysis of AC-AC converter.*	*Understand*

UNIT - I AC-DC CONVERTER [09]

Half, semi and fully controlled single and three phase converters with RL, RLE loads and freewheeling diodes – continuous and discontinuous modes of operation - Inverter operation – Dual converter – Sequence control of converters – Performance parameters: harmonics, ripple, distortion, power factor – effect of source impedance and overlap-reactive power and power balance in converter circuits.

UNIT - II DC-DC CONVERTER [09]

Principles of step-down and step-up converters – Analysis of buck, boost, buck-boost and cuk converters – time ratio and current limit control – Full bridge converter – Basic concepts of Switched Mode power converters, constituent elements, operating principles, Steady state analysis, control methods, duty ratio, current programmed and frequency programmed, Dynamic analysis and frequency domain models.

UNIT - III RESONANT CONVERTERS [09]

Classification of resonant converters, Basic resonant circuit concepts, Load resonant converters, Resonant switch converters, Zero voltage switching.

UNIT - IV DESIGN OF SWITCHED MODE CONVERTERS [09]

Reactive Elements in Power Electronic Systems, Design of inductor, Design of transformer, Capacitors for power electronic applications, Design of feedback compensators, unity power factor rectifiers, resistor emulation principle and applications to rectifiers.

UNIT - V AC-AC CONVERTERS [09]

Principle of phase control, single phase and three phase AC voltage controllers – Various configurations – analysis with R and RL loads, Single-phase and three-phase cycloconverter with R, RL and RLE loads – Voltage control, Harmonic analysis, Matrix converter.

Total = 45 Periods

Reference Books :

1 Rashid, M.H., Power Electronics Circuits, Devices and Applications, Prentice Hall India, New Delhi, Fourth Edition, 1995.
2 Ned Mohan, Undeland and Robbin, Power Electronics: converters, Application and design, John Wiley and sons. Inc, Newyork, Third Edition, 1995.
3 Switched Mode Power Conversion, Course Notes, CCE, IISc, 2004.
4 Issa Batarseh, Power Electronic Circuits, John Wiley, Second Edition, 2004.
5 Philip. T Krein, Elements of Power Electronics, Oxford Press, Second Edition, 1990.

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SEMESTER – I

PE20112	ANALYSIS OF INVERTERS	L	T	P	C
		3	0	0	3

Course Outcomes : On successful completion of the course, the student will be able to		***Cognitive Level***
CO1:	*Describe the various types of inverter control strategies.*	*Understand*
CO2:	*Explain the operating principle of various types of single phase inverters.*	*Understand*
CO3:	*Describe the various mode operations in three phase inverter.*	*Understand*
CO4:	*Analyze and design multilevel inverters for industrial application.*	*Analyze*
CO5:	*Develop an efficient system using resonant and soft switching inverters.*	*Apply*

UNIT - I INVERTER CONTROL STRATEGIES [09]

Review of Inverter Operating Principle – Inverter Switching: Unipolar – Bipolar – Inverter Dead Time – Inverter Modulation: Different Types – Sine Tri angle: Analysis of Sine Triangle Modulation – Trapezoidal modulation – Third harmonic modulation: Analysis of third harmonic modulation – Comparison of Sine Triangle and third harmonic modulation – Output filter requirement for different PWM Techniques.

UNIT - II SINGLE PHASE INVERTERS [09]

Principle of operation of half and full bridge inverters – Performance parameters – Voltage control of single phase inverters using various PWM techniques – Various harmonic elimination techniques.

UNIT - III THREE PHASE INVERTERS [09]

180 degree and 120 degree conduction mode inverters with star and delta connected loads – Voltage control of three phase inverters: Operation of six-step thyristor inverter – Inverter operation modes – Load – Commutated inverters.

UNIT - IV MULTILEVEL INVERTERS [09]

Multilevel concept – Diode clamped – Flying capacitor – Cascade type multilevel inverters – Comparison of multilevel inverters – Application of multilevel inverters.

UNIT - V RESONANT INVERTERS [09]

Series and parallel resonant inverters - Voltage control of resonant inverters – Class E resonant inverter – Resonant DC – link inverters.

Total = 45 Periods

Reference Books :

1 Rashid, M.H., Power Electronics Circuits, Devices and Applications, Prentice Hall India, New Delhi, Second Edition, 2004.
2 Jai P. Agrawal, Power Electronics Systems, Pearson Education, Second Edition, 2002.
3 Bimal K.Bose, Modern Power Electronics and AC Drives, Pearson Education, Second Edition, 2003.
4 Ned Mohan, Undelandand Robbin, Power Electronics: Converters, Application and Design, John Wileyand sons. Inc, Newyork, Third Edition, 1995.
5 Joseph Vithayathil, Power Electronics – Principles and Applications, McGraw Hill Inc., New York, Second Edition, 1995.
6 Vedam Subrahmanyam, Power Electronics, New Age International (P) Limited, New Delhi, Revised Second Edition, 1996.

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SEMESTER – I

PE20113	MODELING OF ELECTRICAL MACHINES	L	T	P	C
		3	0	0	3

Course Outcomes : On successful completion of the course, the student will be able to		***Cognitive Level***
CO1:	*Analyze the various electrical parameters in mathematical form.*	*Analyze*
CO2:	*Determine the electrical machine equivalent circuit parameters and modeling of electrical machines.*	*Evaluate*
CO3:	*Design and develop the mathematical model of various DC machines using different types of reference frame theories and transformation relationships.*	*Apply*
CO4:	*Design and develop the mathematical model of various Induction machines using different types of reference frame theories and transformation relationships*	*Apply*
CO5:	*Design and develop the mathematical model of various Synchronous machines using different types of reference frame theories and transformation relationships.*	*Apply*

UNIT - I PRINCIPLES OF ELECTRO MAGNETIC ENERGY CONVERSION [09]

General expression of stored magnetic energy, co-energy and force / torque – Example using single and doubly excited system – Calculation of air gap MMF and per phase machine inductance using physical machine data.

UNIT - II REFERENCE FRAME THEORY [09]

Static and rotating reference frames – Transformation of variables – Reference frames– Transformation between reference frames–transformation of a balanced set – balanced steady state phasor and voltage equations – variables observed from several frames of reference.

UNIT - III DC MACHINES [09]

Voltage and toque equations – Dynamic characteristics of permanent magnet and shunt DC motors – State equations - solution of dynamic characteristic by laplace transformation.

UNIT - IV INDUCTION MACHINES [09]

Voltage and toque equations – transformation for rotor circuits – voltage and toque equations in reference frame variables – analysis of steady state operation – free acceleration characteristics – dynamic performance for load and torque variations – dynamic performance for three phase fault – computer simulation in arbitrary reference frame.

UNIT - V SYNCHRONOUS MACHINES [09]

Voltage and Torque Equation – voltage Equation in arbitrary reference frame and rotor reference frame – Park equations - rotor angle and angle between rotor – steady state analysis – dynamic performances for torque variations- dynamic performance for three phase fault – transient stability limit – critical clearing time – computer simulation.

Total = 45 Periods

Reference Books :

1 Paul C. Krause, Oleg Wasyn czuk and Scott D. Sudhoff, Analysis of Electric Machinery and Drive Systems, IEEE Press, Second Edition, 2002.
2 Krishnan, R., Electric Motor Drives, Modeling, Analysis and Control, Prentice Hall of India, First Edition, 2002.
3 Samuel Seely, Electomechanical Energy Conversion, Tata McGraw Hill Publishing Company, Second Edition, 2000.
4 Fitzgerald, A.E., Jr. Charles Kingsley, and Umanx D. Stephan, Electric Machinery, Tata McGraw Hill, Fifth Edition, 1992.

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SEMESTER – I

		L	T	P	C
PE20121	**POWER ELECTRONICS SIMULATION LABORATORY**	0	0	3	2

Course Outcomes : On successful completion of the course, the student will be able to	***Cognitive Level***
CO1: Simulate the single phase semi and fully controlled converter with various loads.	*Apply*
CO2: Analyze the three phase semi and fully controlled converter with various loads.	*Analyze*
CO3: Evaluate the performance of single phase dual converter by the simulation.	*Evaluate*
CO4: Observe the performance of single and three phase inverters with PWM controller.	*Evaluate*
CO5: Discriminate the performance of AC voltage regulator in single phase and three phase.	*Analyze*

List of Experiments:

1. Simulation of Single-Phase Semi converter.
    a) R Load
    b) RL Load
    c) RLE (Motor) Load
2. Simulation of Single-Phase Fully controlled converter.
    a) R Load
    b) RL Load
    c) RLE (Motor) Load
3. Simulation of Three-Phase semi converter.
4. Simulation of Three-Phase fully controlled converter.
5. Simulation of Single-Phase dual converter.
6. Simulation of Single-Phase full bridge Inverter.
7. Simulation of Three-Phase full bridge inverter.
    a) 180 degree mode operation
    b) 120 degree mode operation
8. Simulation of Single-Phase AC Voltage Controller.
    a) Lamp Load
    b) Motor Load
9. Simulation of Three-Phase AC Voltage Controller.
    a) Lamp Load
    b) Motor Load
10. Simulation of PWM inverters.
    a) Sinusoidal PWM
    b) Square PWM

Total = 45 Periods

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SEMESTER – I

		L	T	P	C
PE20122	**TECHNICAL PRESENTATION - I**	0	2	0	1

Course Outcomes : On successful completion of the course, the student will be able to		***Cognitive Level***
CO1:	*Familiarize the problems in general area of interest by the student.*	*Understand*
CO2:	*Identify the area / problem by referring journals, conference proceedings, etc.*	*Analyze*
CO3:	*Enhance the collective skills between theoretical knowledge and real time problems.*	*Create*
CO4:	*Gain knowledge on the problem by presentation and review.*	*Understand*
CO5:	*Acquire idea on report writing and presentation.*	*Understand*

The students should adhere the following Guidelines:

- The students have to refer the journals and conference proceedings and collect the published literature.
- By mutual discussions with the faculty in-charge the student can decide a topic in general.
- The student is expected to collect at least 20 such research papers published in the last 5 years.
- Using OHP / Power Point, the student has to make presentation for 20 minutes followed by 10 minutes discussion.
- The student has to make five presentations in the semester.
- The student has to write a technical report for about 30 - 50 pages (Title page, One page Abstract, Review of Research paper under various sub - headings, concluding remarks and list of references). The technical report has to be submitted to the course coordinator one week before the final presentation.

Total : 30 Periods

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SEMESTER – II

		L	T	P	C
PE20201	**SOFT COMPUTING TECHNIQUES** (Common to CS & PE)	3	0	0	3

Course Outcomes : On successful completion of the course, the student will be able to		***Cognitive Level***
CO1:	*Infer the concepts of artificial neural network.*	*Understand*
CO2:	*Apply the knowledge of neural network to develop architecture and algorithms of BPN, hopfield.*	*Apply*
CO3:	*Analyze the concept competitive neural networks.*	*Understand*
CO4:	*Discuss the concepts of fuzzy logic system with classical system; apply the knowledge of fuzzy logic controller for classical applications.*	*Apply*
CO5:	*Illustrate the fundamentals of genetic algorithm and its various functionalities.*	*Remember*

UNIT - I ARTIFICIAL NEURAL NETWORK [09]

Motivation for the development of neural networks – Biological neural networks – Artificial neural networks – Fundamental Concepts – Weights – Biases and thresholds – Common activation functions. McCulloch-pitts neuron: Architecture – Algorithm – Applications – Hebb Net – Architecture – Algorithm – Application – Perceptron – Architecture – Algorithm – Applications – Linear separability – Perceptron learning rule convergence theorem – Delta rule.

UNIT - II NEURAL NETWORK ARCHITECTURE AND ALGORITHMS [09]

Back propogation Neural Net: Standard and counter back propogation – Architecture – Algorithm – Number of hidden layers – Applications – Hopfield neural net – Discrete and Continuous – Architecture – Algorithm – Applications – Associative Memory Neural Networks – Boltzman Machine.

UNIT - III COMPETITIVE NEURAL NETWORKS [09]

Fixed-weight competitive nets – Maxnet- Mexican Hat Net – Kohonen self-organizing Maps – Applications – Adaptive Resonance Theory – Basic architecture and operation – Neuro controllers – Functional diagram – Inverse dynamics – coping control action – Case studies.

UNIT - IV FUZZY LOGIC [09]

Fuzzy sets – Properties of Classical and Fuzzy sets – Operations on Fuzzy sets – Fuzzy relations – Linguistic variables – Linguistic Hedges – Fuzzy statements – Assignment statements – Conditional statements – Unconditional statements – Fuzzy rule base – Canonical rule formation – Decomposition of compound rules.- Fuzzy logic controller: Functional diagram – Fuzzification – Membership value assignments using intuition – Membership functions – Defuzzification: Max – Membership principle – Centroid method – Weighted average method – Inference Engine – Knowledge Base – Rule base – Case studies.

UNIT - V EVOLUTIONARY PROGRAMMING [09]

Optimization – Traditional optimization methods – Concept of Evolutionary Algorithm – Simulated Annealing – Genetic Algorithm – Encoding and decoding of variables – GA operators – Reproductions – Cross over – Mutation – Fitness function – Fitness scaling – Real coded GA – Advanced operators – Particle swarm optimization.

Total = 45 Periods

Reference Books :

1 Jacek.M.Zurada, Introduction to Artificial Neural Systems, Jaico Publishing House, Third Edition, 2006.
2 Lawrence Faussett, Fundamental of neural networks, Prentice Hall, First Edition, 2004.
3 Ross, T.J., Fuzzy Logic with Engineering Applications, McGraw-Hill, Newyork, First Edition, 2005.
4 Zimmerman, H.J., Fuzzy set theory-and its Applications-Kluwer Academic Publishers, Fourth Edition, 1994.
5 Driankov, Hellendroon, Introduction to Fuzzy Control, Narosa Publishers, Second Revised Edition, 1996.
6 David. E. Gold berg, Genetic algorithms in search optimization and machine learning, Addison Wesley, Pearson Education, Asia, Fourth Edition, 2001.

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SEMESTER – II

PE20212	SOLID STATE DC DRIVES	L	T	P	C
		3	0	0	3

Course Outcomes : On successful completion of the course, the student will be able to		***Cognitive Level***
CO1:	*Describe the various types of DC motor characteristics and basic of mechanical system.*	*Remember*
CO2:	*Analysis the control converter fed DC motor drive system.*	*Analyze*
CO3:	*Analysis the control of chopper fed DC motor drive system.*	*Analyze*
CO4:	*Design the closed loop control of DC motor based drives.*	*Apply*
CO5:	*Explain the various braking schemes of converter and chopper fed DC motor drives.*	*Remember*

UNIT - I DC MOTORS FUNDAMENTALS AND MECHANICAL SYSTEMS [09]

DC motor-Types, induced EMF, speed - torque relations; Speed control – Armature and field speed control; Ward Leonard control – Constant torque and constant horse power operation-Introduction to high speed drives and modern drives. Characteristics of mechanical system – dynamic equations, components of torque, types of load; Requirements of drives characteristics – multi-quadrant operation; Drive elements, types of motor duty and selection of motor rating.

UNIT - II CONVERTER CONTROL OF DC MOTORS [09]

Principle of phase control – Fundamental relations; Analysis of series and separately excited DC motor with single – phase and three-phase converters – waveforms, performance parameters, performance characteristics. Continuous and discontinuous armature current operations; Current ripple and it selection performance; Simulation of 1 - phase fully controlled converter fed separately excited DC motor.

UNIT - III CHOPPER CONTROL [09]

Introduction to time ratio control and frequency modulation; Class A,B,C,D and E chopper controlled DC motor – Step-up chopper for photo voltaic systems – Multi – phase chopper; Simulation of chopper fed separately excited DC motor; Related problems.

UNIT - IV CLOSED LOOP CONTROL [09]

Modeling of drive elements – Equivalent circuit, transfer function of self, separately excited DC motors; Linear Transfer function model of power converters; Sensing and feeds back elements – Closed loop speed control – current and speed loops, P, PI and PID controllers – response comparison. Design of closed – loop operation of DC drive systems – Firing schemes for chopper and converter fed DC drives.

UNIT - V BRAKING OF DC DRIVES [09]

Inching and Jogging operation – Methods of braking of phase controlled and chopper controlled DC separately excited and series motors - DC drives in transit systems.

Total = 45 Periods

Reference Books :

1 Sen, P.C., Thyristor DC Drives, John wiley and Sons, Newyork, First Edition, 1981.
2 Gopal K. Dubey, Power Semi-conductor controlled Drives, Prentice Hall Inc., New Jersey, First Edition, 1989.
3 Krishnan, R. Electric Motor Drives – Modeling, Analysis and Control, Prentice – Hall of India Pvt. Ltd., New Delhi, First Edition, 2003.
4 Gobal K. Dubey, Fundamentals of Electrical Drives, Narosal Publishing House, New Delhi, Second Edition, 2001.
5 Bimal K.Bose, Modern Power Electronics and AC Drives, Pearson Education (Singapore) Pvt. Ltd., New Delhi, First Edition, 2015.
6 Vedam Subramanyam, Electric Drives – Concepts and Applications, Tata McGraw-Hill, New Delhi, Second Edition, 2017.

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SEMESTER – II

		L	T	P	C
PE20213	**SOLID STATE AC DRIVES**	3	0	0	3

Course Outcomes : On successful completion of the course, the student will be able to		***Cognitive Level***
CO1:	*Describe the operation on induction motor for various methods.*	*Remember*
CO2:	*Apply the concept CSI and VSI fed induction motor control.*	*Apply*
CO3:	*Explain the concept rotor controlled induction motor drive.*	*Remember*
CO4:	*Formulate the procedure for filed oriented control.*	*Apply*
CO5:	*Explain the synchronous motor drives and its performance.*	*Remember*

UNIT - I INTRODUCTION TO INDUCTION MOTORS [09]

Steady state performance equations – Rotating magnetic field – torque production, Equivalent circuit – Variable voltage, constant frequency operation – Variable frequency operation and constant Volt/Hz operation. Drive operating regions, variable stat or current operation, different braking methods.

UNIT - II VSI AND CSI FED INDUCTION MOTOR CONTROL [09]

AC voltage controller circuit – six step inverter voltage controls – closed loop variable frequency PWM inverter with dynamic braking – CSI fed IM variable frequency drives comparison – Application: SFIG, DFIG.

UNIT - III ROTOR CONTROLLED INDUCTION MOTOR DRIVES [09]

Static rotor resistance control-injection of voltage in the rotor circuit – Statics Scherbius drives – power factor considerations – modified Kramer drives.

UNIT - IV FIELD ORIENTED CONTROL [09]

Field oriented control of induction machines – Theory – DC drive analogy – Direct and Indirect methods – Flux vector estimation - Direct torque control of Induction Machines – Torque expression with stator and rotor fluxes, DTC control strategy.

UNIT - V SYNCHRONOUS MOTOR DRIVES [09]

Wound field cylindrical rotor motor – Equivalent circuits – performance equations of operation from a voltage source – Power factor control and V curves – starting and braking, self-control – Load commutated Synchronous motor drives – Brush and Brushless excitation – Application: PMSG switch controlled constant speed with AC load.

Total = 45 Periods

Reference Books :

1. Bimal K. Bose, Modern Power Electronics and AC Drives, Pearson Education, Asia, First Edition, 2015.
2. Vedam Subramanyam, Electric Drives–Concepts and Applications, Tata McGraw Hill, Second Edition, 2017.
3. Gopal K.Dubey, Power Semiconductor controlled Drives, Prentice Hall Inc., New Jersey, First Edition, 1989.
4. Krishnan, R., Electric Motor Drives–Modeling, Analysis and Control, Prentice-Hall of India Pvt. Ltd., New Delhi, First Edition, 2003.
5. Leonhard, W., Control of Electrical Drives, Narosa Publishing House, Second Edition, 1992.
6. Murphy J.M.D., and Turnbull, Thyristor Control of AC Motors, Pergamon Press, Oxford, 1988.

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SEMESTER – II

		L	T	P	C
PE20214	**FACTS CONTROLLERS**	3	0	0	3

Course Outcomes : On successful completion of the course, the student will be able to		***Cognitive Level***
CO1:	*Explain the various FACTS controllers operation on FACTS systems.*	*Remember*
CO2:	*Categorize the different VAR compensation techniques.*	*Understand*
CO3:	*Illustrate the concepts thyrister controlled series capacitor and its application.*	*Remember*
CO4:	*Apply the concept voltage source converter based FACTS controller.*	*Apply*
CO5:	*Explain the coordination of FACTS controller in different controller.*	*Remember*

UNIT - I INTRODUCTION [09]

Reactive Power Control in AC Transmission lines – Uncompensated transmission line – Need for Controllers – Basic types of Controllers - shunt compensated controller – series compensated controller – Thyristor controlled voltage regulator – comparison of HVDC and FACTS technologies. General modeling of DC links, solutions of AC-DC power flow- flexible AC transmission systems(FACTS) – Concept of FACTS - Flow of power in an AC system- Dynamic stability consideration - Basic types of FACTS controllers - Static shunt compensators, Series compensators – Basic concepts of static VAR Compensator (SVC) – Thyristor Switched Series Capacitor (TCSC) – Unified Power Flow Controller (UPFC).

UNIT - II VAR COMPENSATORS [09]

Methods of controllable VAR generation – switching converter type VAR generators – Basic operating Principle and control approaches – Voltage control by SVC – Dynamic characteristics – Sign of SVC voltage regulator – Modelling of SVC for power flow and transient stability Applications: Enhancement of transient stability – Steady state power transfer – Prevention of Voltage instability.

UNIT - III THYRISTOR CONTROLLED SERIES CAPACITOR (TCSC) AND APPLICATION [09]

Different operating modes of the TCSC – Modelling of TCSC – Modelling for power Flow and stability studies. Applications: Improvement of the system stability limits – Enhancement of system damping – SSR Mitigation.

UNIT - IV VOLTAGE SOURCE CONVERTER BASED FACTS CONTROLLERS [09]

Principle of operation Static Synchronous Compensator (STATCOM) – V-I Characteristics. Applications: Enhancement of transient stability – Prevention of voltage instability. SSSC operation of SSSC and the control of power flow – Modeling of SSSC in load flow and transient stability studies. Applications: SSR Mitigation - UPFC and IPFC – comparison of different facts controllers.

UNIT - V CO-ORDINATION OF FACTS CONTROLLERS [09]

Controller interactions – Control coordination using genetic algorithms - SVC – SVC interaction – Co-ordination of multiple controllers using linear control techniques- Advancements in facts controllers and their co-ordination.

Total = 45 Periods

Reference Books :

1 Mohan Mathur, R., Rajiv K. Varma, Thyristor – Based Facts Controllers for Electrical Transmission Systems, IEEE press and John Wiley and Sons, Student Edition, 2011.
2 Narain, G. Hingorani, Understanding FACTS – Concepts and Technology of Flexible AC Transmission Systems, Standard Publishers Distributors, Delhi - 110006, First Edition, 2000.
3 Padiyar, K.R., FACTS Controllers in Power Transmission and Distribution, New Age International Pvt. Limited, Publishers, New Delhi, Second Edition, 2016.
4 John, A.T., Flexible A.C. Transmission Systems, Institution of Electrical and Electronic Engineers, 1999.
5 Sood, V.K., HVDC and FACTS controllers – Applications of Static Converters in Power System, Kluwer Academic Publishers, First Edition, 2012.

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SEMESTER – II

		L	T	P	C
PE20221	**SOLID STATE DRIVES LABORATORY**	0	0	3	2

Course Outcomes : On successful completion of the course, the student will be able to		***Cognitive Level***
CO1:	*Analyze the drive performance of AC motor and DC motor using MATLAB environment.*	*Analyze*
CO2:	*Evaluate the performance of DC and AC motors using DSP controller.*	*Apply*
CO3:	*Observe the performance of Switched Reluctance Motors and BLDC motor using DSP controller.*	*Understand*
CO4:	*Discriminate the performance of DC Motor using three phase rectifier drive.*	*Analyze*
CO5:	*Analyze the performance of induction motor using FPGA controller.*	*Analyze*

List of Experiments

1. Microcontroller based speed control of converter fed DC motor.
2. Microcontroller based speed control of chopper fed DC motor.
3. Microcontroller based speed control of VSI fed three–phase induction motor.
4. Microcontroller based speed control of Steppe motor.
5. DSP based speed control of BLDC motor.
6. DSP based speed control of SRM motor.
7. FPGA based speed control of VSI fed Induction Motor.
8. IGBT based three-phase SVPWM Inverter.
9. Simulation of four quadrant operation of three-phase induction motor.
10. Simulation of Automatic Voltage Regulation of three-phase synchronous generator.

Total = 45 Periods

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SEMESTER – II

		L	T	P	C
PE20222	**TECHNICAL PRESENTATION - II**	0	2	0	1

Course Outcomes : On successful completion of the course, the student will be able to		***Cognitive Level***
CO1:	*Identify the problems in general area of interest by the student.*	*Understand*
CO2:	*Explore the area / problem by referring journals, conference proceedings etc.*	*Analyze*
CO3:	*Enhance the collective skills between theoretical knowledge and real time problems.*	*Create*
CO4:	*Gain knowledge on the area by presentation and review.*	*Understand*
CO5:	*Acquire idea on report writing and presentation related to the area.*	*Understand*

The students should adhere the following Guidelines:

- The students have to refer the journals and conference proceedings and collect the published literature.
- By mutual discussions with the faculty in-charge the student can decide a topic related to area / subject.
- The student is expected to collect at least 20 such research papers published in the last 5 years.
- Using OHP / Power Point, the student has to make presentation for 20 minutes followed by 10 minutes discussion.
- The student has to make five presentations in the semester.
- The student has to write a technical report for about 30 - 50 pages (Title page, One page Abstract, Review of Research paper under various sub - headings, concluding remarks and list of references). The technical report has to be submitted to the course coordinator one week before the final presentation, after the approval of the faculty in-charge.

Total : 30 Periods

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SEMESTER - III

		L	T	P	C
PE20321	**PROJECT PHASE - I**	0	0	12	6

Course Outcomes : On successful completion of the course, the student will be able to		***Cognitive Level***
CO1:	*Identify real time problems.*	*Apply*
CO2:	*Acquire knowledge on the industrial oriented projects.*	*Understand*
CO3:	*Collect the data from the literature surveys and able to find out the solutions.*	*Analyze*
CO4:	*Select the topic based on the critical problems and hazards identified.*	*Apply*
CO5:	*Apply the solutions for the problems identified.*	*Apply*

The students should adhere the following Guidelines:

1. Every student shall have a supervisor who is the member of the faculty of the institution. Identification of student and his faculty supervisor has to be completed within the first two weeks from the day of beginning of third semester.
2. In consultation with the supervisor, the problem has to be selected.
3. The projects undertaken span a diverse range of topics; including theoretical, simulation and experimental studies preferably it can be a collaborative project with industry.
4. Student has to perform a literature survey to review current knowledge and developments in the chosen technical area.
5. Student has to prepare a detailed action plan for conducting the investigation analytically, computationally and experimentally.
6. A detailed study of the problem and its financial implications and hazards has to be studied.
7. The methodology to tackle this problem can be studied and analyzed.
8. A project report has to be submitted at the end of the semester as per guidelines given by the college.
9. Final project presentation and viva voce by the assessment board will be done at the end of that semester.
10. The extension of same project should be continued in the Phase-II.

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SEMESTER - IV

		L	T	P	C
PE20421	**PROJECT PHASE - II**	0	0	24	12

Prerequisite: *All the core and Elective Courses of the Programme*

Course Outcomes: On successful completion of the course, the student will be able to		***Cognitive Level***
CO1:	*Identify the electrical engineering related problems and to find the research-oriented solutions.*	*Understand*
CO2:	*Enhance the collective skills between theoretical knowledge and real time practical implementations.*	*Understand*
CO3:	*Get employability and entrepreneurship capacity due to knowledge up gradation with skilled up through learning & practicing in Design / development through simulation/ experimental analysis by individual.*	*Create*
CO4:	*Test and validate through conformance of the developed prototype and analyse the cost effectiveness.*	*Analyze*
CO5:	*Prepare a good project report and be able to present the ideas with clarity.*	*Understand*

The students should adhere the following guidelines:

1. The supervisor allotted for project Phase I will continue to supervise project phase II.
2. As per methodology suggested in Phase I, the project can be implemented.
3. Outcome of implementation can be studied and each student shall finally produce a comprehensive report covering background information, literature survey, problem statement, results, discussions with conclusion and industry certificate (If applicable).
4. This final report shall be in type written form as specified in the guidelines.
5. The project report should be evaluated jointly by external and internal examiners.

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SEMESTER – I (Elective)

		L	T	P	C
PE20161	**ADVANCED POWER SEMICONDUCTOR DEVICES**	3	0	0	3

Course Outcomes: On successful completion of the course, the student will be able to		***Cognitive Level***
CO1:	Summarize the power semiconductor device types and characteristics.	*Understand*
CO2:	Explain the construction, operating principles, characteristics of various current control devices.	*Remember*
CO3:	Explain the construction, operating principles, characteristics of various voltage control devices.	*Remember*
CO4:	Design of firing circuits and protection circuits for power devices.	*Apply*
CO5:	Explain the various methods of thermal protection and cooling methods.	*Remember*

UNIT - I INTRODUCTION [09]

Power switching devices overview – Attribute so fanideal switch, application requirements, circuit symbols – Power handling capability – (SOA); Device selection strategy – On-state and switching losses – EMI due to switching – Power diodes – Types, forward and reverse characteristics, switching characteristics – rating.

UNIT - II CURRENT CONTROLLED DEVICES [09]

BJTs–Construction, static characteristics, switching characteristics – Negative temperature co efficient and secondary breakdown – Power Darlington – Thyristor – Physical and electrical principle underlying operating mode – Two transistor analogy – concept of latching – Gate and switching characteristics – Converter grade and inverter grade and other types; series and parallel operation – Comparison of BJT and Thyristor – Steady state and dynamic models of BJT and Thyristor.

UNIT - III VOLTAGE CONTROLLED DEVICES [09]

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

UNIT - IV FIRING AND PROTECTING CIRCUITS [09]

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

UNIT - V THERMAL PROTECTION [09]

Heat transfer – conduction, convection and radiation – Cooling–liquid cooling, vapour – phase cooling; Guidance for heat sink selection – Thermal resistance and impedance – Electrical analogy of thermal components, heat sink types and design – Mounting types.

Total = 45 Periods

Reference Books:

1 Mohan, Undeland and Robins, Power Electronics–Concepts, applications and design, John Wileyand sons, Singapore, Third Edition, 2002.
2 Rashid, M.H, Power Electronics circuits, Devices and Applications, Prentice Hall India, New Delhi, Third Edition, 2009.
3 Singh M.D., Khanchandani, K.B., Power Electronics, Tata McGraw Hill, Second Edition, 2001.
4 Williams, B.W. Power Electronics–Devices, Drivers, Applications and passive components, Macmillan, Second Edition, 1992.

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SEMESTER – I (Elective)

PE20162	NON-CONVENTIONAL ENERGY SOURCES	L	T	P	C
		3	0	0	3

Course Outcomes : On successful completion of the course, the student will be able to		***Cognitive Level***
CO1:	*Explain the solar thermal and solar PV systems.*	*Remember*
CO2:	*Describe the various types of wind energy conversion systems.*	*Remember*
CO3:	*Summarize the Fuel cell and Hydrogen energy sources.*	*Remember*
CO4:	*Identify the energy tapping methods from ocean source and tidal energy.*	*Remember*
CO5:	*Illustrate the concept of geo thermal and biomass energy.*	*Remember*

UNIT - I SOLAR ENERGY [09]

Introduction to solar energy: solar radiation, availability, measurement and estimation – Solar thermal conversion devices and storage – solar cells and photo voltaic conversion – PV systems – MPPT. Applications of PV Systems – solar energy collector sand storages.

UNIT - II WIND ENERGY [09]

Introduction – Basic principles of wind energy conversion – wind data and energy estimation – site selection consideration – basic components of wind energy conversion system – Types of wind machines – basic components of wind electric conversion systems. Schemes for electric generations – generator control, load control, energy storage – applications of wind energy – Inter connected systems.

UNIT - III CHEMICAL ENERGY SOURCES [09]

Introduction – fuel cells – design and principles of operation of a fuel cell – classification of fuel cells. Types of fuel cells – conversion efficiency of fuel cells. Types of electrodes, work output and EMF of fuel cell, Applications of fuel cells. Hydrogen energy: Introduction – hydrogen production – electrolysis, thermo chemical methods, Westing House Electro - chemical thermal sulphur cycle. Fossil fuel methods. Hydrogen storage, Utilization of hydrogen gas.

UNIT - IV ENERGY FROM OCEANS [09]

Introduction, ocean thermal electric conversion (OTEC), methods of ocean thermal electric power generation, open cycle OTEC system, closed OTEC cycle. Energy from tides: Basic principles of tidal power, component of tidal power plants, operation methods of utilization of tidal energy, site requirements, storage, advantages and limitations of tidal power generation. Ocean waves, energy and power from the waves, wave energy conversion devices.

UNIT - V GEO THERMAL ENERGY [09]

Introduction, estimation of geothermal power, nature of geothermal fields, geothermal sources, inter connection of geothermal fossil systems, prime movers for geo thermal energy conversion - Application of geothermal energy - Energy from biomass: Introduction, Biomass conversion technologies, photosynthesis, classification of biogas plants - Biomass Energy conversion, Energy from waste.

Total = 45 Periods

Reference Books :

1 Sukatme, S.P., Solar Energy – Principles of thermal collection and storage, Tata McGraw Hill, Second Edition, 1991.
2 Rai, G.D., Non-Conventional Energy Sources, khanna Publishers, New Delhi, 2000.
3 Duffie, J.A., and W.A. Beckman, Solar Engineering of Thermal Processes, John Wiley, New York, Second Edition, 1991.
4 Goswami, D.Y., Kreith, F., and Kreider, J.F. Principles of Solar Engineering, Taylor and Francis, Philadelphia, Second Edition, 2000.
5 Hall, D.D., Grover, R.P., Bio -Mass Regenerable Energy, John Wiley, Newyork, 1987.
6 Twidell, J., Weir, T., Renewable Energy Resources, E and FN Spon Ltd., London, Third Edition, 1986.

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SEMESTER – I (Elective)

		L	T	P	C
PE20163	**HIGH VOLTAGE DC TRANSMISSION SYSTEM**	3	0	0	3

Course Outcomes : On successful completion of the course, the student will be able to		***Cognitive Level***
CO1:	*Explain the concept of electrical power transmission systems and the performance of HVDC systems.*	*Remember*
CO2:	*Analyze the configuration and characteristics of HVDC converters.*	*Understand*
CO3:	*Apply the concept multi-terminal DC systems types, control and protection.*	*Apply*
CO4:	*Analyze the power flow in AC to DC system.*	*Understand*
CO5:	*Discriminate the method of simulation in HVDC system.*	*Understand*

UNIT - I DC POWER TRANSMISSION TECHNOLOGY [09]

Introduction – Comparison of AC and DC transmission – Application of DC transmission – Description of DC transmission system – Planning for HVDC transmission – Modern trends in DC transmission – DC breakers – Cables, VSC based HVDC.

UNIT - II ANALYSIS OF HVDC CONVERTERS AND HVDC SYSTEM CONTROL [09]

Pulse number, choice of converter configuration – Simplified analysis of Graetz circuit Converter bridge characteristics – characteristics of a twelve pulse converter- detailed analysis of converters. General principles of DC link control – Converter control characteristics – System Control hierarchy – Firing angle control – Current and extinction angle control – Generation of harmonics and filtering - power control – Higher level controllers.

UNIT - III MULTI TERMINAL DC SYSTEMS [09]

Introduction – Potential applications of MTDC systems – Types of MTDC systems – Control and protection of MTDC systems – Study of MTDC systems.

UNIT - IV POWER FLOW ANALYSIS IN AC/DC SYSTEMS [09]

Per unit system for DC Quantities – Modelling of DC links – Solution of DC load flow – Solution of AC-DC power flow – Case studies.

UNIT - V SIMULATION OF HVDC SYSTEMS [09]

Introduction – System simulation: Philosophy and tools – HVDC system simulation – Modeling of HVDC systems for digital dynamic simulation – Dynamic in traction between DC and AC systems.

Total = 45 Periods

Reference Books :

1 K.R. Padiyar, HVDC Power Transmission Systems, New Age International Pvt. Ltd., New Delhi, 2002.
2 J.Arrillaga, High Voltage Direct Current Transmission, Peter Pregrinus, London, 1983.
3 P. Kundur, Power System Stability and Control, McGraw-Hill, 1993.
4 Erich Uhlmann, Power Transmission by Direct Current, BS Publications, 2004.
5 V.K. Sood, HVDC and FACTS controllers – Applications of Static Converters in Power System, Kluwer Academic Publishers, 2004.

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SEMESTER – I (Elective)

		L	T	P	C
PE20164	**PROTECTION FOR ELECTRICAL DRIVES**	3	0	0	3

Course Outcomes: On successful completion of the course, the student will be able to		***Cognitive Level***
CO1:	*Describe the programmable logic controllers used for protection of electrical drives.*	*Remember*
CO2:	*Explain the concept of distributed control system.*	*Remember*
CO3:	*Design the modeling of electrical drive system.*	*Understand*
CO4:	*Illustrate the DC drive protection scheme.*	*Remember*
CO5:	*Describe the AC drive protection scheme.*	*Remember*

UNIT - I PROGRAMMABLE LOGIC CONTROLLERS (PLC) [09]

Evolution of modern PLC – Relay based PLC – Microprocessor based PLC – Input and output modules – Other functional elements – Personal computer as PLC – Programming the PLC – Communication in PLC – Typical applications of PLC – PID control capability in programmable controllers.

UNIT - II DISTRIBUTED CONTROLSYSTEM [09]

Evolution of DCS – Typical architecture – Local Control Unit (LCU) and architecture – LCU languages – LCU process interfacing issues – Communication system requirements – Architectural issues – Protocol issues – Communication media – Message security – Communication system standards – Field Bus – HART Operation interface: Requirements – Display alarms and alarm management – Engineering interface: Requirements – Supervisory control.

UNIT - III MODELLING OF DRIVE SYSTEM [09]

Mathematical modeling of a drive system – First order , second order process – Analysis of closed loop control system – Stability analysis – Controllability and observability of time invariant systems. Design of control algorithm using Z transform – PID algorithms – Design for load changes.

UNIT - IV DC DRIVE PROTECTION [09]

Overvoltage protection of power controllers feeding DC drives: Origin of voltage transients – Suppression of voltage transients – Delayed commutation – Commutation overlap – Protection against failure of commutation in AC-DC converter and DC-DC chopper feeding a DC drive – Protection against failure of field – Short circuit protection – Soft start control – Protection against over speed – Protection against fluctuating loads – Drive instability – Development of schemes for above types of drive protection – Use of PLC in these schemes.

UNIT - V AC DRIVE PROTECTION [09]

Protection against over / under voltage and under frequency in AC drives – Protection against over current due to acceleration and deceleration – Protection against failure of commutation in inverters, cycloconverters and AC voltage controller feeding AC drives – Protection against over speed – Drive instability – Protection against stalling – Protection against single phasing – Development of schemes for above types of drive protection – Use of PLC in these schemes.

Total = 45 Periods

Reference Books :

1 Michal P Lucas, Distributed Control Systems, Van Noster and Reinhold co, First Edition, 1986.
2 Kuo, B.C., Digital Control Systems, Holt Reinhart, Second Edition, 2012.
3 Vedam Subramaniam, Electrical Drive and Control, New age international (P) Ltd., New Delhi, Second Edition, 2012.
4 Muphy J.M.D.,Turnbull, F.G., Thyristor control of AC motor, Pergamon press oxford, First Edition, 1988.
5 Dewan, S.B Slemon, and Stravghen, G.R., A Power semiconductor drives, John Wiley and Sons, New York, 1984.

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SEMESTER - I (Elective)

PE20165	EMBEDDED SYSTEM DESIGN	L	T	P	C
		3	0	0	3

Course Outcomes: On successful completion of the course, the student will be able to ***Cognitive Level***

CO1:	*Describe the basic concepts of embedded system.*	*Remember*
CO2:	*Familiarize various concepts used in PIC micro controller.*	*Remember*
CO3:	*Analyze the ARM processor with various configurations.*	*Understand*
CO4:	*Apply operation system services in real time applications.*	*Remember*
CO5:	*Gain the knowledge about various design examples in system design.*	*Understand*

UNIT - I INTRODUCTION OF EMBEDDED SYSTEM [09]

Introduction - Embedded systems description, definition, design considerations& requirements – Overview of Embedded system Architecture – Classification of Embedded Systems – Purpose of Embedded system – Embedded Design Life Cycle –Major Application area of Embedded System.

UNIT - II PIC MICROCONTROLLER 16F87X [09]

Architecture – Features – Resets – Memory Organizations: Program Memory, Data Memory – Instruction Set .Interrupts – I/O Ports – Timers – CCP Modules – Master Synchronous serial Port (MSSP) – USART– ADC - I^2C.

UNIT - III ARM PROCESSORS [09]

ARM processor – processor and memory organization, Data operations, Flow of Control, CPU Bus configuration, ARM Bus, ARM Architecture – ARM Programmers model – ARM Development tools – ARM Assembly Language Programming, ARM Instruction Set – Thumb Instruction set – Embedded ARM Applications. Design Example: Alarm Clock.

UNIT - IV A REAL-TIME OPERATING SYSTEMS [09]

Operating system services – I/O subsystems – Network operating systems – Interrupt Routines in RTOS Environment –RTOST ask scheduling models, Interrupt – Performance Metricin Scheduling Models – IEEE standard POSIX functions for standardization of RTOS and inter-task communication functions – List of Basic functions in a Preemptive scheduler – F if teen point strategy for synchronization between processors, ISRs, OS Function sand Tasks–OS security issues – Mobile OS.

UNIT - V SYSTEM DESIGN TECHNIQUES [09]

Design Methodologies, Requirement Analysis, Specification, System Analysis and Architecture Design, Quality Assurance, Design Example: Telephone PBX System Architecture, Inkjet printer - Hardware Design and Software Design, Personal Digital Assistants, Set-top Boxes.

Total = 45 Periods

Reference Books :

1 Shibu, S.K.V., Introduction to Embedded system, Tata McGraw Hill, Second Edition, 2014.
2 Arnold S. Berger, Embedded System Design, CMP books, USA, First Edition, 2005.
3 John B Peatman, Design with PIC Microcontrollers, Prentice Hall of India, First Edition, 2007.
4 Ajay V Deshmukh, Microcontroller Theory and Applications, Tata McGraw Hill, First Edition, 2007.
5 Wayne Wolf, Computers as Components: Principles of Embedded Computing System Design, Morgan Kaufman Publishers, First Edition, 2001.
6 Steve Furber, ARM System-on-Chip Architecture, Addison-Wesley Professional, Second Edition, 2000.
7 Raj Kamal, Embedded Systems Architecture, Programming and Design, Tata McGraw- Hill, New Delhi, Third Edition, 2003.

SEMESTER – I (Elective)

PE20166	VIRTUAL INSTRUMENTATION SYSTEM	L	T	P	C
		3	0	0	3

Course Outcomes: On successful completion of the course, the student will be able to ***Cognitive Level***

CO1:	*Explain the virtual instrumentation system and LabVIEW.*	*Remember*
CO2:	*Discuss the concepts of LabVIEW and its features in various fields.*	*Remember*
CO3:	*Explain the programming techniques of LabVIEW.*	*Remember*
CO4:	*Discuss the concepts of Data acquisition and instrument control.*	*Remember*
CO5:	*Demonstrate the applications of LabVIEW in power electronics.*	*Understand*

UNIT - I INTRODUCTION [09]

Virtual Instrumentation and LabVIEW – Evolution of LabVIEW – Difference between LabVIEW and Conventional languages – data flow programming – Graphical programming – Diagram of virtual instrument – Architecture, advantages over conventional instruments.

UNIT - II LabVIEW ENVIRONMENT [09]

Front panel – Block diagram – Icon and Connector – Control Palette – Function Palette – Tools Palette – Function and Libraries – Creating, editing, wiring, debugging and saving VIS – sub VIS – creating sub VIS – Simple examples – Looping: For loop, while loop – Shift registers – Case and sequence; structures, formula nodes – Simple programs using loops, structures and formula nodes.

UNIT - III PROGRAMMING TECHNIQUES [09]

Arrays – clusters, charts and graphs, local and global variables – Property node, string and file I/O – Simple programs using arrays, clusters, variables and string variables.

UNIT - IV DATA ACQUISITION AND INSTRUMENT CONTROL [09]

DAQ – Components – Buffers: Buffered and non-buffered I/O – Triggering – Analog I/O – Digital I/O – Counters and timers – Instrument control: VISA, GPIB, VXI and PXI.

UNIT - V APPLICATIONS OF LabVIEW [09]

Connectivity in LabVIEW: an introduction IVI – Lab windows/CVI – Applications of LabVIEW: Diode, SCR Conduction, Three phase rectifiers, Single phase AC Chopper, Cyclo converters, PWM and Single phase inverter control methods, and DC motor control.

Total = 45 Periods

Reference Books :

1 Sanjeev Gupta, Virtual Instrumentation using LabVIEW, Tata McGraw Hill, Second Edition, 2010.
2 Gary Johnson and Richard Jennings, LabVIEW graphical programming, Tata McGraw Hill, Fourth Edition, 2011.
3 Jeffrey Travis, LabVIEW for Everyone, Prentice Hall, Third Edition, 2007.
4 Jovitha Jerome, Virtual Instrumentation using LabVIEW, PHI Learning Private Limited, First Edition, 2010.
5 Lab VIEW Basics I and II Manual, National Instruments, 2003.
6 Nesimi Ertugrul, LabVIEW for Electric Circuits, Machines, Drives, and Laboratories, National Instruments, Pearson Education Limited, First Edition, 2010.

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SEMESTER – I (Elective)

PE20167	MICROCONTROLLER BASED SYSTEM DESIGN	L	T	P	C
		3	0	0	3

Course Outcomes: On successful completion of the course, the student will be able to ***Cognitive Level***

CO1:	*Explain the 8051 architecture.*	*Remember*
CO2:	*Infer the peripherals and interfacing of 8051.*	*Remember*
CO3:	*Illustrate the 8096 architecture.*	*Remember*
CO4:	*Outline the peripheral and interfacing of 8096.*	*Remember*
CO5:	*Discuss the case study of 8051 and 8096.*	*Remember*

UNIT – I 8051 ARCHITECTURE [09]

Basic organization – 8051 CPU structure – Register file – Interrupts – Timers – Port circuits – Instruction set – Timing diagram – Addressing modes – Simple program and applications.

UNIT – II PERIPHERALS AND INTERFACING [09]

Typical Bus structure – Bus – Memory organization – Timing characteristics – Extended Model and Memory Interfacing – Polling – Interfacing Basic I/O devices – Analog and Digital interfacing – PWM mode operation – Serial port application.

UNIT – III 8096 ARCHITECTURE [09]

CPU operation – Interrupt structure – Timers – High Speed Input / Output Ports – I/O control and Status registers – Instruction set – Addressing modes – Simple programming – Queues – Tables and Strings – Stack memories – Key Switch – Parsing.

UNIT – IV PERIPHERALS AND INTERFACING [09]

Analog Interface – Serial Ports – Watch dog timers – Real Time Clock – Multitasking– Bus Control – Memory Timing – External ROM and RAM expansion – PWM control – A/D interfacing.

UNIT – V CASE STUDY FOR 8051 AND 8096 [09]

Real Time clock – DC Motor Speed Control – Generation of gating signals for Converters and Inverters – Frequency Measurement – Temperature Control.

Total : 45 Periods

References:

1 Muhammad Ali Mazidi and Janice Gillispiemazidi, The 8051 Microcontroller and Embedded Systems, Pearson Education, Second Edition, 2007.

2 Kenneth Ayala, The 8051 Microcontroller, Cengage Learning, Third Edition 2005.

3 John B.Peatman, Design with Micro controllers, McGraw Hill international Limited, Singapore, First Edition, 1989.

4 Intel Manual on 16 bit embedded controllers, Santa Clara, 1991.

5 Myke Predko, Programming and customizing the 8051 microcontroller, Tata McGraw Hill, First Edition, 2001.

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SEMESTER – II (Elective)

		L	T	P	C
PE20261	**PWM TECHNIQUES FOR POWER CONVERTERS**	3	0	0	3

Course Outcomes: On successful completion of the course, the student will be able to		***Cognitive Level***
CO1:	*Describe the control strategies of inverters.*	*Remember*
CO2:	*Implement the space vector modulation in two level inverters.*	*Understand*
CO3:	*Analyze the space vector modulation in three level inverters.*	*Understand*
CO4:	*Explain the programmed modulation of Inverter.*	*Remember*
CO5:	*Implement the modulation controllers.*	*Understand*

UNIT - I INVERTER CONTROL STRATEGIES [09]

Review of Inverter Operating Principle – Inverter Switching – Unipolar – Bipolar – Inverter Dead Time – Inverter Modulation – Different Types – Sine Triangle – Analysis of Sine Triangle Modulation – Trapezoidal modulation – Third harmonic modulation – Analysis of Third harmonic modulation – Comparison of Sine Triangle and Third harmonic modulation – Output filter requirement for different PWM Techniques.

UNIT - II SPACE VECTOR MODULATION (TWO LEVELINVERTER) [09]

Concept of a Space vector – dq0 components of Three-phase sine wave source/level – dq0 components for voltage source Inverter operated in square wave Mode – Synchronously Rotating Reference frame – Space vector Modulation (SVM) – Principle of Space Vector Modulation – SVM Compared to regular sampled PWM – phase Leg Reference – Naturally Sampled SVM – Analytical solution – Harmonic losses – placement of the Zero space vector – Discontinuous PWM – Phase leg Reference – Analytical solution – Harmonic losses – Single edge SVM – Switched pulse sequence – Comparison of Harmonic performance.

UNIT - III SPACE VECTOR MODULATION (THREE LEVEL INVERTER) [09]

Topology of a Three Phase Inverter – Three Phase Modulation with Sinusoidal reference – Third harmonic Reference injection – Analytic calculation of Harmonic Losses – Discontinuous Modulation – Triple carrier Ratio and Sub harmonic Space Vector PWM – Multilevel Converter – Optimized Space Vector Sequence – Modulation for selecting switch closing state – Decomposition Methods – Hexagonal Co-ordinary System – Optimal Space Vector position within a switching period – Discontinuous Modulation in Multilevel Inverter.

UNIT - IV OVER MODULATION AND PROGRAMMED MODULATION OF INVERTER [09]

The over modulation Region – Naturally Sampled over modulation of one phase leg of an Inverter – Regular Sampled over modulation of one phase leg of an Inverter – Naturally Sampled over modulation of single and three phase Inverter – PWM controller gain during over modulation – Space Vector approach to over modulation – Optimized space vector Modulation – Harmonic elimination PWM – Performance index for optimality – optimum PWM – Minimum loss PWM.

UNIT - V IMPLEMENTATION OF MODULATION CONTROLLER [09]

Elements of a PWM converter system – VSI Power Conversion stage – Gate Drive Interface – Controller Power supply – I/O conditioning circuitry – PWM controller. Hardware Implementation of the PWM process – Analog versus digital Implementation – Digital Timer Logic Structure. PWM software Implementation – Background software – Calculation of the PWM Timing Intervals.

Total = 45 Periods

Reference Books :

1 Grahame Holmes, D., and Thomas A. Lipo, Pulse Width Modulation for Power Converters-Principles and Practice, IEEE Press, 2003.

2 Blaabjerg. F., Pedersen, J.K., Thoegersen, P., Improved Modulation Techniques for PWM-VSI Drive, IEEE Trans. on Industrial Electronics, vol.44, no.1, pp.87- 95, Feb.1997.

3 Nonert, R. and Wu, R.S., Improved three phase pulse width modulation for over modulation, IEEE Trans. on Industry Applications, Vol.1A, 20, no.5, pp.1224-1228, Sep./Oct. 1985.

4 Boys, J.T., Handley, P.G., Harmonic analysis of space vector modulated PWM waveforms, IEEE Proceedings (London), vol. 137, no.4, pp. 197-204, July 1990.

5 Celanovic, N., Boroyevich, D., Comprehensive study of neutral-point voltage balancing problem in three-phase converters, IEEE Trans. on Industry Application, vol.37, no.2, pp.637-641, 2001.

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SEMESTER – II (Elective)

PE20262	SPECIAL ELECTRICAL MACHINES	L	T	P	C
		3	0	0	3

Course Outcomes: On successful completion of the course, the student will be able to ***Cognitive Level***

CO1:	*Demonstrate the construction and operation of synchronous reluctance motor.*	*Remember*
CO2:	*Explain the construction, operating principles of various stepper motors.*	*Remember*
CO3:	*Summarize the constructional features of switched reluctance motor and controllers.*	*Remember*
CO4:	*Demonstrate the principle of operation of permanent magnet synchronous motors and control schemes.*	*Remember*
CO5:	*Explain the operation, performance characteristics of permanent magnet brushless DC motors.*	*Remember*

UNIT - I SYNCHRONOUS RELUCTANCE MOTORS [09]

Constructional features: axial and radial air gap Motors. Operating principle, reluctance torque – phasor diagram, motor characteristics–Linear induction machines.

UNIT - II STEPPING MOTORS [09]

Constructional features, principle of operation, modes of excitation torque production in Variable Reluctance (VR) stepping motor, Dynamic characteristics, Drive systems and circuit for open loop control, Closed loop control of stepping motor.

UNIT – III SWITCHED RELUTANCE MOTORS [09]

Constructional features – principle of operation – Torque equation – Power Controllers – Characteristics and control Microprocessor based controller.

UNIT - IV PERMANENT MAGNET SYNCHRONOUS MOTORS [09]

Principle of operation, EMF, power input and torque expressions, Phasor diagram, Power controllers, Torque speed characteristics, Self-control, Vector control, Current control schemes.

UNIT - V PERMANENT MAGNET BRUSHLESS DC MOTORS [09]

Commutation in DC motors, Difference between mechanical and electronic commutators, Hall sensors, Optical sensors, Multiphase Brushless motor, Square wave permanent magnet brushless motor drives, Torque and EMF equation, Torque-speed characteristics, Controllers – Microprocessor based controller.

Total = 45 Periods

Reference Books :

1 Miller, T.J.E., Brushless permanent magnet and reluctance motor drives, Clarendon Press, Oxford, First Edition, 1993.
2 Kenjo, T., Stepping motors and their microprocessor control, Clarendon Press, Oxford, Second Edition, 1995.
3 Kenjoand, T., Naganori, S., Permanent Magnet and brushless DC Motors, Clarendon Press, Oxford, First Edition, 1989.
4 Bose, B.K., Modern Power Electronics and AC drives, Prentice-hall of India Pvt. Ltd, First Edition, 2008.
5 Krishnan, R., Electric Motor Drives – Modeling, Analysis and Control, Prentice–Hall of India Pvt. Ltd., New Delhi, First Edition, 2003.
6 Venkatrathnam, Special Electrical Machines, CRC Press; First Edition, 2009.

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SEMESTER – II (Elective)

PE20263	POWER QUALITY MANAGEMENT	L	T	P	C
		3	0	0	3

Course Outcomes: On successful completion of the course, the student will be able to ***Cognitive Level***

CO1:	*Summarize the various Power quality issues.*	Remember
CO2:	*Identify the various Non-Linear loads and issues.*	Apply
CO3:	*Explain the monitoring and diagnostic techniques for power quality issues.*	Remember
CO4:	*Analyze the Mitigation methods in power quality issues.*	Understand
CO5:	*Describe the various power quality improvement methods.*	Remember

UNIT - I INTRODUCTION [09]

Introduction – Characterization of Electric Power Quality: Transients, short duration and long duration voltage variations, Voltage imbalance, waveform distortion, Voltage fluctuations, Power frequency variation, Power acceptability curves – power quality problems: poor load power factor, Non-linear and unbalanced loads, DC offset in loads, Notching in load voltage, Disturbance in supply voltage – Power quality standards.

UNIT - II NON- LINEAR LOADS [09]

Single phase static and rotating AC/DC converters, Three phase static AC/DC converters, Battery chargers, Arc furnaces, Fluorescent lighting, pulse modulated devices, Adjustable speed drives.

UNIT - III POWER QUALITY MONITORING [09]

Monitoring and diagnostic techniques for various power quality problems – modeling of power quality (harmonics and voltage sag) problems by mathematical simulation tools – power line disturbance analyzer – quality measurement equipment – harmonic/spectrum analyzer – flicker meters – disturbance analyzer. Applications of expert systems for power quality monitoring.

UNIT - IV ANALYSIS AND CONVENTIONAL MITIGATION METHODS [09]

Analysis of power outages, Analysis of unbalance: Symmetrical components of phasor quantities, Instantaneous symmetrical components, Instantaneous real and reactive powers, Analysis of distortion: On–line extraction of fundamental sequence components from measured samples – Harmonic indices – Analysis of voltage sag: Detorit Edison sag score, Voltage sag energy, Voltage Sag Lost Energy Index (VSLEI) – Analysis of voltage flicker, Reduced duration and customer impact of outages, Classical load balancing problem: Open loop balancing, Closed loop balancing, current balancing, Harmonic reduction, Voltage sag reduction.

UNIT - V POWER QUALITY IMPROVEMENT [09]

Utility-Customer interface – Harmonic filters: passive, Active and hybrid filters – Custom power devices: Network reconfiguring Devices, Load compensation using DSTATCOM, Voltage regulation using DSTATCOM, protecting sensitive loads using DVR, UPQC – control strategies: P-Q theory, Synchronous detection method – Custom power park – Status of application of custom power devices.

Total = 45 Periods

Reference Books :

1 Roger. C. Dugan, Mark. F. McGranagham, Surya Santosoamd H.Wayne Beaty, Electrical Power Systems Quality, McGraw Hill, Second Edition, 2003.
2 Arindam Ghosh, Power Quality Enhancement Using Custom Power Devices, Kluwer Academic Publishers, First Edition, 2011.
3 Heydt, G.T., Electric Power Quality, Stars in Circle Publications, Second Edition, 1994.
4 Duggan, R.C., Power Quality, IEEE Press Series on Power, Third Edition, 2010.
5 Arrillaga, J., Watson, N.R., Power system harmonics, Wiley Publication, Second Edition, 2012.
6 Derek A. Paice, Power electronic converter harmonics, IEEE Press, Second Edition, 2012.

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SEMESTER – II (Elective)

PE20264	SYSTEM THEORY	L	T	P	C
		3	0	0	3

Course Outcomes: On successful completion of the course, the student will be able to		***Cognitive Level***
CO1:	*Explain state variable representation model and physical systems.*	*Remember*
CO2:	*Determine the solution of state equations*	*Understand*
CO3:	*Describe the reduction techniques realization of transfer functions*	*Remember*
CO4:	*Determine the stability of various systems.*	*Understand*
CO5:	*Describe state feedback and pole placement techniques.*	*Remember*

UNIT - I STATE VARIABLE REPRESENTATION [09]

Introduction – Concept of State – State equation for Dynamic Systems– Time invariance and linearity – Non uniqueness of state model– State Diagrams – Physical System and State Assignment.

UNIT - II SOLUTION OF STATE EQUATION [09]

Existence and uniqueness of solutions to Continuous– time state equations – Solution of Non Linear and Linear time varying state equations – Evaluation of matrix exponential – System modes – Role of Eigen values and Eigen vectors.

UNIT - III CONTROLLABILITY AND OBSERVABILITY [09]

Controllability and Observability – Stabilizability and Detectability – Test for Continuous time Systems – Time varying and Time invariant case – Output Controllability – Reducibility – System Realizations.

UNIT - IV STABILTY [09]

Introduction – Equilibrium Points – Stability in the sense of Lyapunov – BIBO Stability – Stability of LTI Systems – Equilibrium Stability of Nonlinear Continuous Time Autonomous Systems – The Direct Method of Lyapunov and the Linear Continuous – Time Autonomous Systems – Finding Lyapunov Functions for Nonlinear Continuous Time Autonomous Systems – Krasovskii and Variable – Gradient Method.

UNIT - V MODAL CONTROL [09]

Introduction – Controllable and Observable Companion Forms– SISO and MIMO Systems – The Effect of State Feedback on Controllability and Observability – Pole Placement by State Feedback for both SISO and MIMO Systems – Full Order and Reduced Order Observers.

Total = 45 Periods

Reference Books :

1 Gopal, M., Modern Control System Theory, New Age International, Fourth Edition, 2005.
2 Ogatta, K., Modern Control Engineering, PHI, Fifth Edition, 2009.
3 John S.Bay, Fundamentals of Linear State Space Systems, McGraw-Hill, First Edition, 1999.
4 Roy Choudhury, D. Modern Control Systems, New Age International, First Edition, 2005.
5 Bubnicki, Z., Modern Control Theory, Springer, First Edition, 2005.

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SEMESTER – II (Elective)

		L	T	P	C
PE20265	**INDUSTRIAL ROBOTICS**	3	0	0	3

Course Outcomes: On successful completion of the course, the student will be able to ***Cognitive Level***

CO1:	*Explain the robot technology as their fundamental principles, laws and robot configurations.*	*Remember*
CO2:	*Illustrate the various drive systems, power sources and the concepts of sensors to control the robots.*	*Remember*
CO3:	*Outline the design configurations of manipulators, grippers and end effector mechanism in robots.*	*Remember*
CO4:	*Outline the robot kinematics, programming language and the concepts of path planning for robotics.*	*Remember*
CO5:	*Describe the wide range of robotic application of manufacturing and non-manufacturing sector.*	*Remember*

UNIT - I INTRODUCTION [09]

Robotics and Automation - Definition and Origin of Robotics - Historical Development – Basic structure of Robots - Complete Classification of Robots-Fundamentals about Robot Technology - Asimov's laws of Robotics - Dynamic Stabilization of Robotics - Basic Robot Configurations and their Relative Merits and Demerits.

UNIT - II POWER SOURCES AND SENSORS [09]

Types of Drive Systems - Hydraulic, Pneumatic and Electric Drives Block Diagram Approach – Determination of HP of Motor and Gearing Ratio-Variable Speed Arrangements – Path Determination - Micro Machines in Robotics - Machine Vision - Ranging, Laser, Acoustic, Magnetic, Fiber Optic, Tactile and Intelligent Sensors Definition and Use.

UNIT - III MANIPULATORS AND GRIPPERS [09]

General Description of Robot Manipulator-Construction of Manipulators – Manipulator Motions - Manipulator Dynamics and Force Control - Electronics and Pneumatic Manipulator Control Circuits - End Effectors - Mechanism of Gripping - U Various Types of Grippers – Design Considerations.

UNIT - IV KINEMATICS AND PATH PLANNING [09]

Robot kinematics - Kinematic Equations, Forward and Inverse Kinematics - Solution of Inverse Kinematics Problem - Multiple Solution Jacobian Work Envelope - Hill Climbing Techniques - Robot Programming Languages.

UNIT - V APPLICATIONS [09]

Selection of Robot - Robot Applications in Industry - Design a Modern Robot for Manufacturing and Non-Manufacturing Industry – Robot Cell Design - Future Applications and Challenges.

Total = 45 Periods

Reference Books :

1 Mikell P.Groover, Weiss G.M., Nagel R.N., Odraj N.G., Industrial Robotics, McGraw Hill Singapore, First Edition, 1996.
2 Ghosh, Control in Robotics and Automation: Sensor Based Integration, Allied Publishers, Chennai, First Edition, 1998
3 Deb S.R., Robotics Technology and Flexible Automation, John Wiley, USA, Second Edition, 2010.
4 Asfahl C.R., Robotics and Manufacturing Automation, John Wiley, USA, Second Edition, 1992.
5 McKerrow P.J., Introduction to Robotics, Addison Wesley, USA, First Edition, 1991.
6 Klafter R.D., Chimielewski T.A., Negin M., Robotic Engineering - An Integrated Approach, Prentice Hall of India, New Delhi, First Edition, 1994.

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SEMESTER - II (Elective)

PE20266	ADVANCED DIGITAL SIGNAL PROCESSING	L	T	P	C
		3	0	0	3

Prerequisite: *-*

Course Outcomes: On successful completion of the course, the student will be able to		***Cognitive Level***
CO1:	*Analyze the properties of discrete time random signals.*	*Apply*
CO2:	Examine the various spectrum estimation techniques.	*Analyze*
CO3:	*Discuss various linear prediction algorithms and the concept of wiener filters.*	*Analyze*
CO4:	Design FIR adaptive filters using LMS and RLS algorithm.	*Apply*
CO5:	*Discuss the concepts of* multirate digital signal processing.	*Remember*

UNIT - I DISCRETE RANDOM SIGNAL PROCESSING [9]

Discrete random process – stationary process, ensemble averages, auto correlation, auto covariance matrices, mean ergodic process and correlation – ergodic process. Parseval's theorem – Wiener Khintchine relation – power density spectrum – low pass and high pass filters.

UNIT - II SPECTRUM ESTIMATION AND ANALYSIS [9]

Principles – Traditional methods; pitfalls, windowing, periodogram, modified periodogram, Blackman – Tukey metho, fast correlation method. AR model – Yule- Walker method, Burg method – MA model – ARMA model.

UNIT - III LINEAR PREDICTION [9]

Forward and backward predictions, Solution of the normal equations – Levinson- Durbin algorithms. Least mean squared error criterion – FIR Wiener filter and Wiener IIR filters – Wiener filter for filtering and prediction.

UNIT - IV ADAPTIVE FILTER [9]

Concepts of adaptive filter – FIR adaptive filters – Newton's steepest descent method – Adaptive filter based on steepest descent method – Widrow Hoff LMS adaptive algorithm – Adaptive channel equalization – Adaptive echo chancellor – Adaptive noise cancellation – RLS Adaptive filters – Exponentially weighted RLS – Sliding window RLS – Simplified HR LMS adaptive filter.

UNIT - V MULTIRATE DIGITAL SIGNAL PROCESSING [9]

Mathematical description of sampling rate – Interpolation and Decimation by integer factor – Sampling rate conversion by rational factor- Filter design for sampling rate conversion; direct form FIR structures, Polyphase structures, time-variant structures. Multistage implementation of multirate system. Applications – High quality analogue to digital conversion for digital audio, efficient implementation of narrowband digital filters.

Total = 45 Periods

Reference Books:

1 Monson H. Hayes, Statistical Digital Signal Processing and Modeling, John Wiley and Sons Inc., New York, First Edition, 1996.

2 John G. Proakis, Dimitris G.Manolakis, Digital Signal Processing: Principles Algorithms and Applications, PHI, India, Twelth Indian reprint, 2001.

3 Emmanuel C. Ifeachor, Barrie N. Jervis, Digital Signal Processing – A Practical approach, Addison – Wesley publishing company, Second Edition, 2002.

4 Mitra, S.K.., Digital Signal Processing – A computer-based approach, Tata McGraw Hill, New Delhi, Fourth Edition, 2001.

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SEMESTER – II (Elective)

		L	T	P	C
PE20267	**ELECTRIC VEHICLES**	3	0	0	3

Prerequisite: *-*

Course Outcomes: On successful completion of the course, the student will be able to		***Cognitive Level***
CO1:	*Explain the hybrid electric vehicles and their characteristics.*	*Remember*
CO2:	*Describe the different hybrid power train topology and fuel efficiency analysis.*	*Remember*
CO3:	*Enlighten the electric propulsion system and the drive motor control system.*	*Remember*
CO4:	*Elucidate the selection of energy storage technology and the sizing of drives.*	*Understand*
CO5:	*Describe the energy management strategies and energy storage systems.*	*Remember*

UNIT – I HYBRID ELECTRIC VEHICLES [09]

Impact of different transportation technologies on environment and energy supply – Air pollution and global warming – History of hybrid electric, electric and fuel cell vehicles – vehicle motion and the dynamic equations for the vehicle – vehicle power plant and transmission characteristics – Fuel economy characteristics of internal combustion engine.

UNIT – II HYBRID POWER TRAIN TOPOLOGY AND DYNAMICS [09]

Basic architecture – Analysis of drive trains and power flows – Drive cycle implications and fuel efficiency estimations – Sizing of components for different hybrid drive train topologies – Topologies for electric drive-train – Fuel efficiency estimations and wheel to wheel fuel efficiency analysis – Sizing of components for different electric drive train topologies.

UNIT – III ELECTRIC PROPULSION UNIT [09]

Electric drives used in HEV/EVs, classifications and characteristics – Induction motor, permanent magnet motors, switch reluctance motors, their configurations and optimization for EV/HEVs. Induction motor drives, Permanent Magnetic Motor drives, switch reluctance motor drives – their control and applications in EV/HEVs – Losses in traction motors, inverters and efficiency maps.

UNIT – IV SIZING OF DRIVES [09]

Sizing the power electronics based on Switch Technology – Switching Frequency and Ripple capacitor design – Selection of energy storage technology – Matching the electric drive and ICE, Transmission selection and gear step selection – Sizing the propulsion motor, its torque, constant power speed ratio and machine dimensions.

UNIT – V VEHICLE POWER MANAGEMENT AND ENERGY STORAGE SYSTEMS [09]

Energy storage, battery based energy storage and simplified models of battery – Fuel cells, Super capacitor, Flywheels and their modeling for energy storage in EHV/BEV – Energy management strategies and its general architecture – Rule and optimization based Energy Management Strategies (EMS).

Total = 45 Periods

Reference Books :

1. Mehrdad Ehsani, Yimin Gao, Sebatien Gay and Ali Emadi, Modern Electric, Hybrid Electric and Fuel cell vehicles: Fundamentals, Theory and Design, CRC press, First Edition, 2009.
2. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, Second Edition, 2010.
3. James Larminie and John Lowry, Electric Vehicle Technology Explained, John Wiley & Sons Ltd, Second Edition, 2012.
4. Sandeep Dhameja, Electric Vehicle Battery Systems, Butterworth – Heinemann, First Edition, 2001.
5. Ronald K Jurgen, Electric and Hybrid – Electric Vehicles, SAE, First Edition, 2002.
6. Ron Hodkinson and John Fenton, Light Weight Electric/Hybrid Vehicle Design, Butterworth–Heinemann, First Edition, 2001.

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SEMESTER – III (Elective)

		L	T	P	C
PE20361	**POWER ELECTRONICS IN WIND AND SOLAR POWER CONVERSION**	3	0	0	3

Prerequisite: *-*

Course Outcomes: On successful completion of the course, the student will be able to		***Cognitive Level***
CO1:	*Describe the various energy sources, energy policies and environmental aspects of energy.*	*Remember*
CO2:	*Explain the operation of wind energy conversion system with different converter.*	*Remember*
CO3:	*Analyze the wind system with different wind energy conversion systems.*	*Understand*
CO4:	*Explain the principle of solar photovoltaic system and the performance of various solar collectors and etc.*	*Remember*
CO5:	*Analysis solar energy system with different application.*	*Understand*

UNIT - I ENERGY SOURCES [09]

Trends in energy consumption – World energy scenario – Energy sources and their availability – Conventional and renewable sources – Emerging energy technologies – Solar potential in India – Solar radiation and measurement – Solar cells and their characteristics – Nature of Wind – Wind survey in India – Power in the wind – Maximum Power Point Tracking (MPPT).

UNIT - II WIND ENERGY CONVERSION [09]

Review of reference theory fundamentals – principle of operation and analysis of IG, PMSG, SCIG and DFIG, Power Converters – Three Phase AC voltage controllers – AC-DC-AC converters, Cyclo converter – PWM Inverters, Grid Interactive Inverters – Matrix Converters.

UNIT - III ANALYSIS OF WIND SYSTEMS [09]

Stand-alone operation of fixed and variable speed wind energy conversion systems – Grid connection Issues – Grid integrated PMSG and SCIG Based WECS.

UNIT - IV SOLAR ENERGY CONVERSION [09]

Solar: Block diagram of solar photo voltaic system – Solar Thermal Energy Conversion – Principle of operation: solar water heating and solar distillation – solar thermal power plant – solar passive technique – solar air conditioning and refrigeration – solar greenhouses.

UNIT - V ANALYSIS OF SOLAR ENERGY SYSTEMS [09]

Power Converters – line commutated converters (inversion-mode) – Boost and buck-boost converters – Selection of inverter, battery sizing and array sizing – Grid Integrated Solar System – Need for Hybrid Systems – Case studies of Wind/PV.

Total = 45 Periods

Reference Books :

1 Rashid, M.H., Power Electronics Hand book, Academic press, Fourth Edition, 2017.
2 Rai, G.D., Non-conventional energy sources, Khanna publishes, Second Edition, 2012.
3 Kothari, D.P., Singal, K.C., and Rakesh Ranjan, Renewable Energy Sources and Emerging Technologies, PHI Learning, Second Edition, 2009.
4 Chetan Singh Solanki, Solar Photovoltaics Fundamentals, Technologies and Applications, PHI Learning, Third Edition, 2009.
5 Khan, B.H., Non-conventional Energy Resources, Tata McGraw-Hill Publishing Company, New Delhi, First Edition, 2009.

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SEMESTER – III (Elective)

		L	T	P	C
PE20362	**SMART GRID**	3	0	0	3

Prerequisite: *-*

Course Outcomes: On successful completion of the course, the student will be able to		***Cognitive Level***
CO1:	*Illustrate the fundamentals of smart grid system*	*Remember*
CO2:	*Describe about structural units in embedded processor architecture.*	*Remember*
CO3:	*Outline the various types of smart meters and advanced metering infrastructure.*	*Remember*
CO4:	*Explain the concept of power quality management issues in Smart Grid.*	*Remember*
CO5:	*Describe the features of high-performance computing for smart grid applications.*	*Remember*

UNIT - I INTRODUCTION TO SMART GRID [09]

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

UNIT - II SMART GRID TECHNOLOGIES [09]

Technology Drivers, Smart energy resources, Smart substations, Substation Automation, Feeder Automation, Transmission systems: EMS, FACTS and HVDC, Wide area monitoring, Protection and control, Distribution systems: DMS, Volt/VAr control, Fault Detection, Isolation and service restoration, Outage management, High-Efficiency Distribution Transformers, Phase Shifting Transformers, V2G, G2V.

UNIT - III SMART METERS AND ADVANCED METERING INFRASTRUCTURE [09]

Introduction to Smart Meters, Advanced Metering infrastructure (AMI) drivers and benefits, AMI Phasor measurement Unit(PMU), Intelligent Electronic Devices (IED) & their application for monitoring & protection

UNIT - IV POWER QUALITY MANAGEMENT IN SMART GRID [09]

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

UNIT - V HIGH PERFORMANCE COMPUTING FOR SMART GRID APPLICATIONS [09]

Local Area Network (LAN), House Area Network (HAN), Wide Area Network (WAN), Broadband over Power line (BPL), IP based Protocols, Basics of Web Service and CLOUD Computing to make Smart Grids smarter, Cyber Security for Smart Grid.

Total = 45 Periods

Text Books :

1 Janaka Ekanayake, Smart grid: Technology and applications, Wiley publication, First Edition, 2012.

2 Wayne wolf, Computers as components: Principles of embedded computing system design, Morgan Kaufmann publishers, Third Edition, 2012.

3 Stuart Borlase, Smart Grid: Infrastructure, Technology and Solutions, CRC Press, First Edition, 2012.

4 James Momoh, Smart grid: Fundamentals of Design and Analysis, Wiley publication, First Edition, 2012.

5 Buchholz, Bernd M., Styczynski, Zbigniew, Smart Grids – Fundamentals and Technologies in Electricity Networks, Springer publication, First Edition, 2014

6 Uslar, Standardization in Smart Grids: Introduction to IT related Methodologies, Architectures and Standards, Wiley publication, First Edition, 2013.

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SEMESTER – III (Elective)

PE20363	**MACHINE LEARNING**	L	T	P	C
		3	0	0	3

Prerequisite: *-*

Course Outcomes: On successful completion of the course, the student will be able to		***Cognitive Level***
CO1:	*Design a neural network for an application of your choice.*	*Understand*
CO2:	*Implement probabilistic discriminative and generative algorithms for an application of your choice and analyze the results.*	*Understand*
CO3:	*Use a tool to implement typical clustering algorithms for different types of applications.*	*Understand*
CO4:	*Design and implement an HMM for a sequence model type of application.*	*Apply*
CO5:	*Identify applications suitable for different types of machine learning with suitable justification*	*Understand*

UNIT - I BASICS OF MACHINE LEARNING **[09]**

Machine Learning – Machine Learning Foundations – Overview – Design of a Learning System – Types of Machine learning – Applications Mathematical foundations of Machine Learning – Random Variables and Probabilities – Probability Theory – Probability Distributions – Decision Theory – Bayes Decision Theory – Information Theory.

UNIT - II SUPERVISED LEARNING **[09]**

Linear Models for Regression – Linear Models for Classification – Naive Bayes – Discriminant Functions – Probabilistic Generative Models – Probabilistic Discriminative Models – Bayesian Logistic Regression – Decision Trees – Classification Trees – Regression Trees – Pruning – Neural Networks – Feed Forward Network Functions – Back-Propagation – Support vector machines – Ensemble methods – Bagging – Boosting.

UNIT - III UNSUPERVISED LEARNING **[09]**

Clustering – K means – EM Algorithm – Mixtures of Gaussians – Curse of Dimensionality – Dimensionality Reduction – Factor Analysis – Principal Component Analysis – Probabilistic PCA.

UNIT - IV PROBABILISTIC GRAPHICAL MODELS **[09]**

Graphical Models – Undirected Graphical Models – Markov Random Fields – Directed Graphical Models – Bayesian Networks – Conditional Independence Properties – Inference – Generalization – Hidden Markov Models.

UNIT - V ADVANCED LEARNING **[09]**

Sampling – Basic Sampling methods – Monte Carlo. Reinforcement Learning – K-Armed Bandit – Elements – Model-Based Learning – Value Iteration – Policy Iteration –Temporal Difference Learning – Exploration Strategies.

Total = 45 Periods

Reference Books :

1 Ethem Alpaydin, Introduction to Machine Learning, MIT Press, Third Edition, 2014.

2 Kevin P. Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, First Edition, 2012.

3 Trevor Hastie, Robert Tibshirani and Jerome Friedman, The Elements of Statistical Learning, Springer, Second Edition, 2011.

4 Christopher Bishop, Pattern Recognition and Machine Learning, Springer, First Edition, 2007.

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SEMESTER – III (Elective)

		L	T	P	C
PE20364	**ELECTRICAL ENERGY CONSERVATION AND MANAGEMENT**	3	0	0	3

Prerequisite: *-*

Course Outcomes: On successful completion of the course, the student will be able to		***Cognitive Level***
CO1:	*Give the introduction about energy conservation principle and practices.*	*Remember*
CO2:	*Describe the concept of energy efficiency in the building.*	*Remember*
CO3:	*Explain the concept of energy efficiency in the industry.*	*Remember*
CO4:	*Illustrate the concept of energy efficiency in the power plant.*	*Remember*
CO5:	*Describe the importance energy management in industry.*	*Remember*

UNIT - I ENERGY CONSERVATION PRINCIPLES AND PRACTICES [09]

Energy scenario – Principles and imperatives of energy conservation – Energy consumption pattern – Resource availability – Need for energy saving – Over view of energy consumption and its effects – kVA demand estimation – Wheeling and banking concept – EB bill detailing. Basics of monitoring and targeting – Elements of monitoring and targeting, Data and information analysis techniques.

UNIT - II ENERGY EFFICIENCY IN BUILDINGS [09]

Introduction, definition and concepts – Energy and water as a resource – Criticality of resources and needs of modern living. Electrical energy conservation – Opportunities and techniques for energy conservation in buildings. Adoption to sustainable resources, process and technologies. Green buildings, Intelligent buildings, Rating of buildings, Efficient use of buildings – Solar passive architecture – Eco-housing concepts and national and international norms.

UNIT - III ENERGY EFFICIENCY IN INDUSTRIES [09]

Potential areas for electrical energy conservation in various industries – Conservation methods – Energy management opportunities in electrical heating, lighting system, cable selection – Energy efficient motors – Factors involved in determination of motor efficiency – Adjustable AC drives – Application and its use – Variable speed drives / belt drives – Energy efficiency in electrical systems – Energy efficiency in lighting – Role of instrumentation in energy conservation.

UNIT - IV ENERGY EFFICIENCY IN POWER PLANTS [09]

Captive power generation systems – Sequence Operation of Power Plants – GIS – gas insulated substation – bus ducts – Types and working principle. Transformer – power transformer – Types of switch gear (HT and LT switch gear) GCB and generator – synchronizing procedure.

UNIT - V ENERGY MANAGEMENT [09]

Importance of energy management, Energy economics – Discount rate, Payback period, Internal rate of return, Life cycle costing risk and sensitivity analysis, Cumulative sum of differences (CUSUM), Financing options, Energy performance contract and role of ETCOS.

Total = 45 Periods

Reference Books :

1 Hamies, Energy Auditing and Conservation; Methods, Measurements, Management and Case Study, Hemisphere, Washington, First Edition, 1980.
2 Trivedi, P.R., Jolka, K.R., Energy Management, Common Wealth Publication, New Delhi, First Edition, 1997.
3 Smith, C.B., Energy Management Principles, Pergamon Press, New York, First Edition, 1981.
4 Handbook on Energy Efficiency, TERI, New Delhi, 2009.
5 Write, C. Larry, Industrial Energy Management and Utilization, Hemisphere Publishers, Washington, First Edition, 1998.

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SEMESTER – III (Elective)

		L	T	P	C
PE20365	**APPLICATION OF MEMS TECHNOLOGY**	3	0	0	3

Prerequisite: *-*

Course Outcomes: On successful completion of the course, the student will be able to		***Cognitive Level***
CO1:	*Describe the basic concept of MEMS and design process of MEMS.*	*Remember*
CO2:	*Explain properties of materials, microstructure and fabrication methods.*	*Remember*
CO3:	*Design the modeling, dynamics and Electrostatic in MEMS.*	*Apply*
CO4:	*Discuss the Electromechanical effects, thermal effects and Miro fluidics in MEMS.*	*Remember*
CO5:	*Identify and understand the various pressure sensors and accelerometer.*	*Understand*

UNIT - I INTRODUCTION TO MEMS DESIGN [09]

Microsystems Vs. MEMS – Markets for Microsystems and MEMS, Scaling Principles. MEMS Design: Device categories – High level design issues – design process – Modeling levels: Analytical modeling – numerical modeling.

UNIT - II MEMS MATERIALS FABRICATION METHODS [09]

Silicon material system: Substrates and material properties-Doping – Oxidation – Concepts of Bulk Micro machining and Surface Micro machining Additive Processes: Evaporation and sputtering – Chemical Vapour Deposition (CVD) Lithography – Wet etching: Isotropic – Anisotropic – Etch stops – Dry etching: Vapour – Plasma/RIE – DRIE – Other processing techniques and materials: LIGA – Lift-off – Chemical-Mechanical Polishing (CMP) – Soft Lithography and polymers – Wafer Bonding – Process integration: Process flows – Commercial surface micromachining – Design rules and Mask making – Sample Process Flows – A Bulk Micro machined Diaphragm Pressure Sensor – A Surface-Micro machined Suspended Filament.

UNIT - III MEMS MECHANICS, MODELING, DYNAMICS, STRUCTURES AND ELECTROSTATICS [09]

Mechanics of materials: Stress and strain – Plane stress – Anisotropic materials – Thermal expansion Thin film stress – Material properties – Typical values of MEMS materials – Design limits and safety factors – Lumped element modeling: Conjugate power variables, co-energy, mapping to electrical circuits – Dynamics: Linear first order systems – Linear second order systems – Structures: Bending of beams – Torsion of beams – Axial load and buckling of beams – Effect of residual stress and stress gradient Bending of Plates – Stiffness and natural frequencies – Electrostatics: Parallel plate capacitor – electrostatic actuator – Pull-in.

UNIT - IV MEMS FOR SENSING AND ACTUATION [09]

Electromechanical effects: Piezo resistance – Piezoelectricity – Shape memory alloy – Thermal effects: Temperature coefficient of resistance – Thermo-electricity – Thermocouples – Micro fluidics: Low Reynolds number fluid flow – Pressure-driven flows – Squeeze film damping – Surface tension and bubbles – Devices: pumps, valves, mixers – Integrated fluidic systems: Bio MEMS.

UNIT - V PRESSURE SENSORS AND ACCELEROMETERS [09]

Piezoresistive Pressure Sensor: Sensing Pressure, Piezoresistance – Analytic Formulation in Cubic Materials – Longitudinal and Transverse Piezoresistance – Piezoresistive Coefficients of Silicon – Structural Examples – Signal Conditioning and Calibration. Capacitive Accelerometer: Fundamentals of Quasi-Static Accelerometers, Position Measurement with Capacitance – Circuits for Capacitance Measurement – Demodulation Methods – Case Study – Specifications – Sensor Design and Modeling – Fabrication and Packaging.

Total = 45 Periods

Reference Books :

1 Stephen D. Senturia, Micro system Design, Springer International Edition, 2001.

2 Chang Liu, Foundations of MEMS, (ILLINOIS ECE Series), Pearson Education International, Second Edition, 2006.

3 Gregory TA Kovacs, Micro machined Transducers Source Book, WCB McGraw Hill, Singapore, First Edition, 1998.

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SEMESTER – III (Elective)

		L	T	P	C
PE20366	**DIGITAL SIGNAL PROCESSORS AND APPLICATIONS**	3	0	0	3

Prerequisite: *-*

Course Outcomes: On successful completion of the course, the student will be able to		***Cognitive Level***
CO1:	*Explain the basic concepts of DSP processors.*	*Remember*
CO2:	*Analyze various architecture developed using Texas processors.*	*Analyze*
CO3:	*Design different interfaces and peripheral devices in DSPr.*	*Apply*
CO4:	*Develop the instruction parameters in commercial DSPr devices.*	*Apply*
CO5:	*Demonstrate the recent application of DSPr.*	*Understand*

UNIT - I INTRODUCTION **[09]**

Need and benefits of Digital Signal Processing – Typical signal processing operations: convolution, correlation, filtering, transformation and modulation – Basic architecture of DSPr - Fundamentals of fixed point DSP architecture – Fixed point number representation and computation – Fundamentals of floating point DSP architecture – floating point number representation and computation.

UNIT - II TEXAS PROCESSORS **[09]**

Study of TMS 320 C 54XX processor - Architecture – Addressing modes – Instruction set – Pipeline structure, Operation-Programming.

UNIT - III PERIPHERALS AND INTERFACES OF DSPr **[09]**

Peripherals interface - Digital and analog Interface – Host interface – Memory interface – Parallel I/O interface – Programmed I/O, Interrupts and I/O, DMA ports – Serial ports – CODEC interface circuit.

UNIT - IV COMMERCIAL DSP DEVICES **[09]**

TMS 320F24x processor and ADSP 2181 processor- Architecture – Addressing modes – program control – Instruction and programming – simple programs – Special features – PWM generation.

UNIT - V DSPr APPLICATIONS **[09]**

AC and DC motor speed control, Biotelemetry receiver, speech and image processing systems, position control system for hard disk drive, DSP based power meter.

Total = 45 Periods

Reference Books :

1 Sanjit K Mitra, Digital Signals Processing: A Computer based Approach, Tata McGraw Hill, Fourth Edition, 2013.

2 Avatar Singh and Srinivasan, S., Digital Signal Processing: Implementation using DSP microprocessors with examples from TMS 320C54XX, Thompson Brooks/Cole, First Edition, 2004.

3 Padmanabhan, K., et. al., A Practical approach to Digital Signal Processing, New Age Publications, Second Edition, 2013.

4 Venkataramani, B., et. al., Digital Signal Processor – Architecture, Programming and Applications, TMH, New Delhi, Second Edition, 2017.

5 TMS320F24x DSP controllers, Reference Guide-Literature No: SPRU160C, June 1999.

SEMESTER – III (Elective)

PE20367	INDUSTRIAL DRIVES AND APPLICATION	L	T	P	C
		3	0	0	3

Prerequisite: *-*

Course Outcomes: On successful completion of the course, the student will be able to		***Cognitive Level***
CO1:	*Summarize the different types of motors with speed torque characteristics and basic concept and needs of electric drives.*	*Understand*
CO2:	*Illustrate the solid state DC chopper and rectifier control of DC Motor.*	*Remember*
CO3:	*Discuss the various stator and rotor side speed control techniques for Induction Motor.*	*Remember*
CO4:	*Make use of open and closed loop drives for three phase Synchronous Motor speed control.*	*Understand*
CO5:	*Classify the performance of digital control of electric drives and applications in various industries.*	*Remember*

UNIT – I INTRODUCTION [09]

Electrical drives: Advantages of electrical drives - Basic elements of an electric drive - choice of electrical drives - Dynamics of electrical drives - Fundamental torque equation and Speed-torque characteristics of various types of loads - multi quadrant operation - Thermal model of motor for heating and cooling - Classes of motor duty - determination of motor rating.

UNIT – II DC DRIVES [09]

Single phase fully controlled converter fed separately excited dc motor - Single-phase half controlled converter fed separately excited dc motor - Three phase fully controlled converter fed separately excited dc motor - three phases half controlled converter fed separately excited dc motor - multi quadrant operation of fully controlled converter fed dc drives. Chopper controlled dc drives: chopper control of separately excited dc motor - chopper control of series motor.

UNIT – III THREE PHASE INDUCTION MOTOR DRIVES [09]

Speed control of three phase induction motors – Stator control: voltage control, frequency control, v/f control – VSI, CSI and cyclo converter fed induction motor drives – Rotor control: rotor resistance control, Slip power recovery schemes: Static Kramer and Scherbius drives – Introduction to vector controlled induction motor drives – Closed loop speed control of induction motor.

UNIT – IV THREE PHASE SYNCHRONOUS MOTOR DRIVES [09]

Speed control of three phase synchronous motor – Variable frequency control: true synchronous mode, self synchronous mode – VSI, CSI and cyclo converter fed synchronous motor drives – Effect of harmonics on the performance of AC motor.

UNIT – V DIGITAL CONTROL AND DRIVE APPLICATIONS [09]

Digital control of electric drives – Advantages and limitations – Microprocessor, Microcontroller and PLC based control of drives – Drive Applications: textile mills drives, steel rolling mills drives, paper mills drives, cement mill drives.

Total = 45 Periods

Reference Books :

1 Dubey.G.K, Fundamentals of Electrical Drives, Narosa Publishing House, New Delhi, Second Edition, 2003.

2 Vedam Subramanyam, Electric Drives: Concepts and Applications, Tata McGraw hill Pvt. Ltd, New Delhi, Second Edition, 2011

3 Bose. B.K, Modern Power Electronics and AC Drives, Pearson Education, Pvt. Ltd, New Delhi, Second Edition, 2015.

4 Krishnan. R, Electric Motor Drives: Modeling, Analysis and Control, Prentice Hall of India, Pvt. Ltd, New Delhi, Second Edition, 2011.

5 Ion Boldea and Nasar. S.A, Electric Drives, Second Edition, CRC Press LLC, New York, Third Edition, 2005.

6 Nisit K. De and Prasanta K. Sen, Electric Drives, Prentice Hall of India, Pvt. Ltd, New Delhi, First Edition, 2006.

7 Moorthi, V.R., Power Electronics, Devices, Circuits and Industrial Applications, Oxford University Press, USA, First Edition, 2005.

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SEMESTER – III (AUDIT COURSE)

PE203A1	**ENGLISH FOR RESEARCH PAPER WRITING**	L	T	P	C
		2	0	0	0

Prerequisite: *-*

Course Outcomes: On successful completion of the course, the student will be able to		***Cognitive Level***
CO1:	*Be familiar with Planning and Preparation for paper writing.*	*Understand*
CO2:	*Know how to avoid the Plagiarism.*	*Understand*
CO3:	*Describe how to prepare for Literature survey.*	*Understand*
CO4:	*Get skills for writing Title, abstract and introduction.*	*Apply*
CO5:	*Get skills for writing Methods, Results and Discussion.*	*Apply*

UNIT – I PLANNING AND PREPARATION [05]

Planning and Preparation – Word Order – Breaking up long sentences – Structuring Paragraphs and Sentences – Being Concise and Removing Redundancy – Avoiding Ambiguity and Vagueness.

UNIT – II PARAPHRASING AND PLAGIARISM [05]

Clarifying Who Did What – Highlighting Your Findings – Hedging and Criticizing – Paraphrasing and Plagiarism – Sections of a Paper – Abstracts.

UNIT – III LITERATURE SURVEY [05]

Review of the Literature – Methods – Results – Discussion – Conclusions – The Final Check.

UNIT – IV ABSTRACT AND LITERATURE REVIEW [05]

Key skills are needed when writing a Title – Key skills are needed when writing an Abstract – Key skills are needed when writing an Introduction – Skills needed when writing a Review of the Literature.

UNIT – V RESULTS AND CONCLUSIONS [05]

Skills are needed when writing the Methods – Skills needed when writing the Results – Skills are needed when writing the Discussion – Skills are needed when writing the Conclusions.

Total = 25 Periods

Reference Books :

1 Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, Frist Edition, 2016.
2 Day R., How to Write and Publish a Scientific Paper, Cambridge University Press, First Edition, 2011.
3 Highman N., Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book, First Edition, 2011
4 Goldbort R., Writing for Science, Yale University Press, First Edition, 2006.

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SEMESTER – III (AUDIT COURSE)

PE203A2	**DISASTER MANAGEMENT**	L	T	P	C
		2	0	0	0

Prerequisite: *-*

Course Outcomes: On successful completion of the course, the student will be able to		***Cognitive Level***
CO1:	*Know the Types and Magnitude of disasters and Hazards.*	*Understand*
CO2:	*Get the idea of various disaster prone areas in India.*	*Understand*
CO3:	*Get the idea of preparedness and management of disaster.*	*Understand*
CO4:	*Describe the various risk assessment techniques.*	*Understand*
CO5:	*Know the concept of Strategies of Disaster Mitigation.*	*Remember*

UNIT – I BASICS OF DISASTER [05]

Disaster: Definition Factors and Significance – Difference Between Hazard and Disaster – Natural and Manmade Disasters: Difference – Nature – Types and Magnitude – 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.

UNIT – II DISASTER PRONE AREAS IN INDIA [05]

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 – III DISASTER PREPAREDNESS AND MANAGEMENT [05]

Preparedness: Monitoring of Phenomena triggering Disaster or Hazard – Evaluation of Risk: Application of Remote Sensing – Data From Meteorological and Other Agencies – Media Reports: Governmental and Community Preparedness.

UNIT – IV RISK ASSESSMENT [05]

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.

UNIT – V DISASTER MITIGATION [05]

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

Total = 25 Periods

Reference Books :

1 Nishith, R., Singh, A.K., Disaster Management in India: Perspectives, issues and strategies, New Royal book company, First Edition, 2012.
2 Sahni, Pardeep Et. Al. (Eds.), Disaster Mitigation Experiences and Reflections, Prentice Hall of India, New Delhi, First Edition, 2011.
3 Goel S. L., Disaster Administration and Management Text and Case Studies, Deep & Deep Publication Pvt. Ltd., New Delhi, First Edition, 2011.

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SEMESTER – III (AUDIT COURSE)

		L	T	P	C
PE203A3	**CONSTITUTION OF INDIA**	2	0	0	0

Prerequisite: *-*

Course Outcomes: On successful completion of the course, the student will be able to		***Cognitive Level***
CO1:	*Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.*	*Remember*
CO2:	*Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.*	*Understand*
CO3:	*Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru.*	*Understand*
CO4:	*Know the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.*	*Understand*
CO5:	*Know the passage of the Hindu Code Bill of 1956.*	*Remember*

UNIT – I HISTORY AND PHILOSOPHY [05]

History of Making of the Indian Constitution: History – Drafting Committee (Composition & Working) – Philosophy of the Indian Constitution: Preamble – Salient Features.

UNIT – II CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES [05]

Contours of Constitutional Rights and 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 – III ORGANS OF GOVERNANCE [05]

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 – IV LOCAL ADMINISTRATION [05]

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

UNIT – V ELECTION COMMISSION [05]

Election Commission: 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.

Total = 25 Periods

Reference Books :

1 Bakshi, P.M., The Constitution of India, Universal law Publishing, New Delhi, Fifteenth Edition, 2018.
2 Basu, D.D., Introduction to the constitution India, Lexisnexis Publisher, New Delhi, Twenty Fifth Edition, 2015.
3 Brij Kishore Sharma, Introduction to the constitution India, PHI Learning Pvt. Ltd, New Delhi, Seventh Edition, 2015.
4 http://nptel.ac.in/courses/109104074/8