JALPAIGURI GOVERNMENT ENGINEERING COLLEGE
JALPAIGURI- 735 102
(An Autonomous Government College)

COURSE STRUCTURE AND SYLLABUS
FOR
M.TECH. IN ELECTRICAL ENGINEERING
(POWER ELECTRONICS AND DRIVES)

(Implemented from the Academic Year 2018-19 for the new batch only)

Phone: 03561 – 255131 (Principal), Fax: 03561 – 256143

255465 (EPABX)- 105(EE)

www.jgec.ac.in

First Semester

A. THEORY							
Sl. No.	**Subject Code**	**Subject Name**	**Contact Hours/Week**				**Credits**
			L	**T**	**P**	**Total**	
01	**PED-101**	**Power Electronic Converters**	**3**	**0**	**0**	**3**	**03**
02	**PED-102**	**Electric Drives System**	**3**	**0**	**0**	**3**	**03**
03	Two from the pool of elective subjects	**Elective-I**	**3**	**0**	**0**	**3**	**03**
04		**Elective- II**	**3**	**0**	**0**	**3**	**03**
05	**RMI-101**	**Research Methodology and IPR**	**2**	**0**	**0**	**2**	**02**
06	**AUD-101**	**One from the pool of Audit subjects**	**2**	**0**	**0**	**2**	**00**
Total of Theory			**16**	**00**	**00**	**16**	**14**
B. PRACTICAL							
01	**PED-191**	**Electrical Engineering -I Laboratory**	**0**	**0**	**8**	**8**	**04**
Total of Practical			**00**	**00**	**08**	**08**	**04**
C. SESSIONAL							
Total of Sessional			**00**	**00**	**00**	**00**	**00**
Total of Semester			**16**	**00**	**08**	**24**	**18**

Second Semester

A. THEORY							
Sl. No.	**Subject Code**	**Subject Name**	**Contact Hours/Week**				**Credits**
			L	**T**	**P**	**Total**	
01	**PED-201**	**Advanced Power Electronic Circuits**	**3**	**0**	**0**	**3**	**03**
02	**PED-202**	**Modeling and Analysis of Electrical Machines**	**3**	**0**	**0**	**3**	**03**
03	Two from the pool of elective subjects	**Elective-III**	**3**	**0**	**0**	**3**	**03**
04		**Elective-IV**	**3**	**0**	**0**	**3**	**03**
05	**AUD-201**	**Second One from the pool of Audit subjects**	**2**	**0**	**0**	**2**	**00**
Total of Theory			**14**	**00**	**00**	**14**	**12**
B. PRACTICAL							
01	**PED-291**	**Electrical Engineering -II Laboratory**	**0**	**0**	**8**	**8**	**04**
Total of Practical			**00**	**00**	**08**	**08**	**04**
C. SESSIONAL							
01	**PED-281**	**Mini Project with Seminar**	**0**	**0**	**4**	**4**	**02**
Total of Sessional			**00**	**00**	**04**	**04**	**02**
Total of Semester			**14**	**00**	**08**	**26**	**18**

Third Semester

A. THEORY							
Sl. No.	Subject Code	Subject Name	Contact Hours/Week				Credits
			L	T	P	Total	
01	PED-301	Elective-V	3	0	0	3	03
02	OEL-301	One from the pool of Open Elective subjects	3	0	0	3	03
Total of Theory			06	00	00	06	06
B. PRACTICAL							
Total of Practical			00	00	00	00	00
C. SESSIONAL							
01	PED-381	Major Project Phase-I Dissertation	0	0	20	20	10
Total of Sessional			00	00	20	20	10
Total of Semester			06	00	20	26	16

Fourth Semester

A. THEORY							
Sl. No.	Subject Code	Subject Name	Contact Hours/Week				Credits
			L	T	P	Total	
Total of Theory			00	00	00	00	00
B. PRACTICAL							
Total of Practical			00	00	00	00	00
C. SESSIONAL							
01	PED-481	Major Project Phase-II : Dissertation	0	0	32	32	16
Total of Sessional			00	00	32	32	16
Total of Semester			00	00	32	32	16

List of Elective Subjects

Elective-I/II: (Any two subjects to be chosen from the following pool of Electives.) : PED-103: Energy Management & Audit PED-104: Power Quality ManagementPED-105: Generation of Non ConventionalEnergy PED-106: Advanced Control SystemsPED-107: Micro-Controller based System Design PED-108: Optimization TechniquePED-109: Soft Computing PED-110: DSP based System PED-111: Advanced MathematicsPED-112: Artificial Neural Network PED-113: Embedded System PED-114: NONLINEAR DYNAMICS AND CHAOSPED- 115: Electrical Machines Analysis

Elective-III/IV: (Any two subjects to be chosen from the following pool of Electives.) : PED-203:Optimal and Adaptive ControlPED-204: Digital Control of Power Electronic and Drive Systems PED-205:INDUSTRIAL LOAD MODELING AND CONTROLPED-206:Smart Grids PED-207:Advanced Digital Signal Processing PED-208:Advanced Microcontroller based SystemsPED-209:DistributedGenerationPED-210:Energy Efficient MotorPED-211:FACTS AND CUSTOM POWER DEVICESPED-212:FPGA BASED DESIGNPED-213: Power Electronics Control

Elective-V: PED-301 (a) SCADA Systems and Applications (b) ADVANCED FPGA BASED DESIGN (c) HVDC (d) Intelligent Control of Drives (e) Modeling and Control of Wind Energy Generation (f) Modeling and Simulation of Systems Using MATLAB and Simulink (g) Condition Monitoring of Electrical Equipments.

AUD-101& AUD-201: Audit course 1 & 2(one to be chosen as AUD-101& second one as AUD-201)
(a) English for Research Paper Writing (b) Disaster Management (c) Sanskrit for Technical Knowledge (d) Value Education (e) Constitution of India (f) Pedagogy Studies (g) Stress Management by Yoga (h) Personality Development through Life Enlightenment Skills.

OEL-301: (a) Business Analytics (b) Industrial Safety (c) Cost Management of Engineering Projects (d) Composite Materials (e) Waste to Energy(f) Operations Research

Subject Code	Subject Name	Contact Hrs./Week			Subject Code	Subject Name	Contact Hrs./Week	
		L –T-P-T	Cr.				L –T-P-T	Cr.
PED-101	Power Electronic Converters	**3-0-0-0**	**3**		**PED-201**	Advanced Power Electronic Circuits	**3-0-0-0**	**3**
PED-102	Electric Drives System	**3-0-0-0**	**3**		**PED-202**	Modeling and Analysis of Electrical Machines	**3-0-0-0**	**3**
Elective-III	**Any two subjects to be chosen from the following pool of Electives**	**3-0-0-0**	**3**		**Elective-III**	**Any two subjects to be chosen from the following pool of Electives**	**3-0-0-0**	**3**
lective-IV		**3-0-0-0**	**3**		**Elective-**		**3-0-0-0**	**3**
RMI-101	Research Methodology and IPR	**2-0-0-2**	**2**					
PED-191	**Electrical Engineering Laboratory -I**	**0-0-8-8**	**4**		**PED-291**	**Electrical Engineering Laboratory -II**	**0-0-8-8**	**4**
AUD-101	One from the pool of Audit subjects	**2-0-0-2**	**0**		**PED-281**	Mini Project with Seminar	**0-0-4-4**	**2**
					AUD-201	One from the pool of Audit subjects	**2-0-0-2**	**0**
		16-0-8-24	**18**				**14-0-8-26**	**18**
PED-301	Elective-V	**3-0-0-0**	**3**		**PED-481**	Major Project Phase-II : Dissertation	**0-0-32-32**	**16**
OEL-301	One from the pool of Open Elective subjects	**3-0-0-0**	**3**					
PED-381	Major Project Phase-I Dissertation	**0-0-20-20**	**10**					
		6-0-20-20	**16**				**0-0-24-24**	**22**

List of Elective Subjects

Elective-I/II:(Any two subjects to be chosen from the following pool of Electives.) : PED-103: Energy Management & Audit **PED-104:** Power Quality Management **PED-105:** Generation of Non Conventional Energy **PED-106:** Advanced Control Systems**PED-107:** Micro-Controller based System Design **PED-108:** Optimization Technique **PED-109:** Soft Computing **PED-110:** DSP based System **PED-111:** Advanced Mathematics **PED-112:** Artificial Neural Network **PED-113:** Embedded System **PED-114: NONLINEAR DYNAMICS AND CHAOSPED-115: Electrical Machines Analysis**

Elective-III/IV: (Any two subjects to be chosen from the following pool of Electives.) : PED-203: Optimal and Adaptive Control**PED-204**: Digital Control of Power Electronic and Drive Systems **PED-205:**INDUSTRIAL LOAD MODELING AND CONTROL**PED-206:**Smart Grids **PED-207:**Advanced Digital Signal Processing **PED-208:**Advanced Microcontroller based Systems**PED-209:**DistributedGeneration**PED-210:**Energy Efficient Motor**PED-211:** FACTS AND CUSTOM POWER DEVICES **PED-212:**FPGA BASED DESIGN**PED- 213: Power Electronics Control**

Elective-V: PED-301 (a) SCADA Systems and Applications (b) ADVANCED FPGA BASED DESIGN (c) HVDC (d) Intelligent Control of Drives (e) Modeling and Control of Wind Energy Generation (f) Modeling and Simulation of Systems Using MATLAB and Simulink (g) Condition Monitoring of Electrical Equipments.

AUD-101& AUD-201: Audit course 1 & 2(one to be chosen as AUD-101& second one as AUD-201)
(a) English for Research Paper Writing (b) Disaster Management (c) Sanskrit for Technical Knowledge (d) Value Education (e) Constitution of India (f) Pedagogy Studies (g) Stress Management by Yoga (h) Personality Development through Life Enlightenment Skills.

OEL-301: (a) Business Analytics (b) Industrial Safety (c) Cost Management of Engineering Projects (d) Composite Materials (e) Waste to Energy (f) Operations Research

Detailed Syllabus for M Tech On Power Electronics and Drives in Electrical Engineering

1st Semester:

PED-101: Power Electronic Converters:

1. Analysis of power semiconductor switched circuits with R, L, RL, RC loads, D.C. motor load. Battery charging circuit.**2.**Single-Phase and Three-Phase AC to DC converters. Half controlled configurations-operating domains of three phase full converters and semi-converters. Reactive power considerations.

3. Analysis and design of DC to DC converters. Control of DC-DC converters: Buck converters, Boost converters, Buck-Boost converters, Cuk converters.

4. Single phase and three phase inverters. Voltage source and Current source inverters. Voltage control and harmonic minimization in inverters.

5. AC to AC power conversion using voltage regulators. Choppers and cyclo-converters.Consideration of harmonics, introduction to Matrix converters.

6. Design aspects of converters, Few practical applications.

Suggested reading:

1. Ned Mohan, Undeland&Robbin, "Power Electronics: converters, Application and design", John's Wiley & sons. NY.
2. M.H.Rashid, "Power Electronics", Prentice Hall of India 1994.

PED-102: Electric DrivesSystem:

1. Dynamics of Electric Drives: Fundamentals of torque equation. Speed torque convention and multi-quadrant operation, components of load torques.

2. Classification of load torques steady state stability. Load equation, Speed control and drive classification. Close loop control of drives.

3. DC motor Drives-Modeling of DC machines. Steady state characteristics with armature and speed control. Phase controlled DC motor drives, chopper controlled DC motor drives.

4. Poly-phase induction machines- Dynamic modeling of induction machines. Small signal equations, control characteristics of induction machines. Phase-controlled induction machines.Stator voltage control. Slip energy recovery scheme, frequency control and vector control of induction motor drives.

5. Traction motor: Starting. Speed-Time characteristics. Braking. Traction motors used in practice.

6. Industrial Drives-Digital Control of Electric Drives. Stepper motor. Servo motor and their Applications.

Suggested reading

1. G.K, Dubey, "Power semiconductor controlled Drives", Prentice Hall international, New Jersey, 1989.
2. R.Krishanam, "Electric motor drives modeling, analysis and control", PHI-India-2009.
3. G. K. Dubey,"Fundamentals of electric Drives, Narosa Publishing House", 2nd edition, 2011.
4. W. Leonhard, "Control of Electrical drives", Springer, 3rd edition, 2001.
5. P.C. Krause –, "Analysis of Electric Machine", Wiley-IEEE press 3rdedition.
6. K. Bose,"Modern Power Electronics and AC Drives", Prentice Hall publication, 1st edition, 2001.

PED- 103:Energy Management& Audit :

Energy Management & Audit: Definition, need, types, approach-understanding energy costs, Bench marking, Energy performance, Matching energy, efficiencies, optimizing the input, Fuel & energy substitution, instruments.

Energy Action Planning: Key elements, Force field analysis, Energy policy, perspective, Contents, Formulation, Ratification, Organizing –location, top management support, Managerial function, Roles and responsibilities of energy manager, Accountability. Motivation of employees for information, designing barriers, Strategies, marketing and communicating-training and planning.

Financial Management: Investment, appraisal and criteria, Financial analysis techniques-Simple pay back period, Return on investment, Net present value, Internal rate of return, Cash flows, Risk and sensitivity analysis; Financing options, Energy performance contracts and role of ESCOs.

Project Management: Energy monitor of Electrical system: Power supply, Electricity billing, Electrical load management and MD control, PF improvement and its benefit, Selection and location of capacitors, Performance assessment of PF capacitors, distribution and transformer losses. Electric motors: Types, characteristics, losses, efficiency, selection, energy efficient motors, Factors affecting motor performance, Rewinding and motor replacement issues. Energy saving opportunities with Pumps, cooling towers, fans and blower. Lighting System: Light source, Choice of lighting, Luminance requirements, and Energy conservation avenues. Energy Efficient Technologies in Electrical Systems: Maximum demand controllers, Automatic power factor controllers, Energy efficient motors, Soft starters with energy saver, Variable speed drives, Energy efficient transformers, Electronic ballast, Occupancy sensors, Energy efficient lighting controls.

Energy Monitoring and Targeting: Defining monitoring & targeting, Elements of monitoring & targeting, Data and information-analysis, Techniques -energy consumption, Production, Cumulative sum of differences (CUSUM).

Electrical Systems: Electricity billing, Electrical load management and maximum demand control, Power factor improvement and its benefit, Selection and location of capacitors, Performance assessment of PF capacitors, Distribution and transformer losses.

Electric motors: Types, Losses in induction motors, Motor efficiency, Factors affecting motor performance, Rewinding and motor replacement issues, Energy saving opportunities..

Fans and blowers: Types, Performance evaluation, Efficient system operation, Flow control strategies and energy conservation opportunities

Pumps and Pumping System: Types, Performance evaluation, Efficient system operation, Flow control strategies and energy conservation opportunities

Lighting System: Light source, Choice of lighting, Luminance requirements, and Energy conservation avenues

Diesel Generating system: Factors affecting selection, Energy performance assessment of diesel conservation avenues

Cogeneration: Need, principle, technical options, classification, influencing factor, technical parameters, prime mover, performance, merit case study.

Books:

1. Albert : Plant Engineers & Managers Guide to Energy Conservation Page of 18 11
2. WayheC.Tuner : Energy Management Handbook
3. Anthony J. Pansini. : Engineering Economic Analysis Guide Boo
4. D. Paul-Mehta : Handbook of Energy Engineering.
5. Paul O'Callaghan : Energy Management.
6. Books of Energy Management & Auditors, Bureau ofEnergy Efficiency, (A Statutory body under Ministry of Power, Government of India), www.bee-india.nic.in9volume I,II& III

PED- 104:Power Quality Management:

INTRODUCTION: Power Quality phenomena – Basic terminologies – various events in Power Quality – Causes for reduction in Power Quality — Power Quality Standards

VOLTAGE SAG: Causes of voltage sags – magnitude and duration of voltage sags – effect on adjustable AC Drives, DC drives, computers and consumer electronics – monitoring and mitigation of voltage sags.

INTERRUPTION: Origin of Long and Short interruptions – influence on various equipment – reliability of power supply– basic reliability evaluation techniques – monitoring and mitigation of interruptions

HARMONICS: Origin of harmonics – effect of harmonics on adjustable speed ac drives – harmonic reduction using PWM and harmonic injection.

POWER QUALITY MEASUREMENTS: Interpretation and analysis of Power Quality Measurements, Active Filters as Power Quality Conditioners – Basic concept of Unified Power Quality Conditioners.

Energy Efficient Technologies in Electrical Systems: Maximum demand controllers, Automatic power factor controllers, Energy efficient motors, Soft starters with energy saver, Variable speed drives, Energy efficient transformers, Electronic ballast, Occupancy sensors, Energy efficient lighting controls, Energy saving potential of each technology.

Books:

1. Math. H. J. Bollen, “Understanding Power QualityProblems – Voltage Sags and Interruptions”, IEEE Press, 2000
2. David D. Shipp and William S. Vilcheck, “Power Quality and Line Considerations for Variable Speed AC Drives”, IEEE Transactions on Industry Applications, Vol. 32, March / April – 1996

3. Po – Tai Cheng, Subhashish Bhattacharya and Deepak. D. Divan, "Line Harmonics Reduction in High – PowerSystems Using Square – Wave Inverters – Based Dominant Harmonic Active Filter", IEEE Transactions on Power Electronics, Vol. 14, No. 2, March 1999
4. Hideaki Fujita and HifofumiAkagi, "The UnifiedPower Quality Conditioner: The Integration of Seriesand Shunt Active Filters", IEEE Transactions onPower Electronics, Vol. 13, No. 2, March 1998.
5. Christopher J. Melhorn and Mark. F. McGranaghan, "Interpretation and Analysis of Power Quality Measurements", Electrotek Concepts, Inc.1998
6. Harmonic Distortion in the electric supply system", – Technical Note No. 3 from Integral Energy Power Quality Centre, University of Wollongong, March2000

PED- 105:Generation of Non- Conventional Energy :

INTRODUCTION TO SOLAR AND WIND ENERGY:Recent trends in energy consumption – World energyscenario – Energy sources and their availability – Conventional and renewable sources – Need to develop new energy technologies – Solar radiation and measurement – Solar cells and their characteristics – Influence of insulation and temperature – PV arrays – Electrical storage with batteries – Solar availability in Indi8a – Switching devices for solar energy conversion – Standalone inverters – Charge controllers – Water pumping – Audio visual equipment, Street lighting, Analysis ofPV systems

POWER CONDITIONING CONVERTERS:DC Power conditioning converters – Maximum Power point tracking algorithms – AC power conditioners – Line commutated inverters– synchronized operation with grid supply – Harmonic problem

WIND ENERGY CONVERSION SYSTEM:Basic principle of wind energy conversion – natureof wind – Wind survey in India – Power in the wind – components of a wind energy conversion system – Performance of Induction Generators for WECS – Classification of WECS

INDUCTION GENERATOR: Self excited Induction Generator for isolated Power Generators – Theory of self excitation – Capacitance requirements – Power conditioning schemes – Controllable DC Power from SEIGs

OPTIMISATION TECHNIQUE:Wind / Solar PV integrated systems – selection of power conversion ratio – Optimization of system components – Storage

Books :

1. Rai G.D., "Non – Conventional Energy Sources", Khanna Publishers, 1993.
2. Rai G.D., "Solar Energy Utilisation", Khanna Publishers, 1993.
3. Daniel, Hunt V, "Wind Power – A Handbook of WECS", Van Nostrend Co., New York, 1981.
4. Gary L. Johnson, "Wind Energy Systems", Prentice Hall Inc., 1985.
5. Freris L. L., "Wind Energy Conversion", Prentice Hall (UK) Ltd., 1990

PED-106: Advanced Control Systems :

Review of Modeling and Analysis of LTI Systems: Modeling of physical Systems. Design specificationsand performance indices, Motion control systems, Transportation lags. Approximation of time-delay functions., Sensitivity of control systems to parameter variations. Effects of disturbance of signals.Disturbance rejection.

Analysis in state-space: A perspective on state-space design. State variables. State models for physical systems. SISO and MIMOsystems.Solution of state equations. Transfer function. Eigenvalues andeigenvectors. Jacobianlinearization technique.State transformations and diagonalization.Transformation to phase-variable canonical form.Controllability and observability.Duality property.Stability.

Introduction to Discrete-time Systems: Basic elements of discrete-time control system. Z-transform and properties.Inverse Z-transform.Difference equation and its solution by Z-transform method.Z-transfer function.State diagram of digital systems.Time delay.Direct, cascade and parallel decomposition of Z-transfer functions.

Feedback control design: Continuous control design. Proportional, derivativeand integral control action.PID controller tuningrules.Ziegler-Nichols method. Two degree of freedom control systems. Compensator design using Bode diagram in frequency response approach.Lag, Lead, Lag-lead compensator.Control law design for full state feedback by pole placement. Full order observer system. Observer based state feedback. Separation principal.

Non linear system: Classification and types of non-linearity. Phenomena peculiar to non-linear systems.Methods of analysis. Linearization based on Taylor's series expansion. Jacobian Linearization. Phase trajectory and its construction. Phase-plane analysis of linear and non-linear systems. Existence of limit cycles.Describing function of typical non-linearities.Stability analysis by DF method.Introduction to DIDF.Popov's circle criterion. Stability analysis by Lyapunov's indirect and direct methods, Lypunov's theorem.

Reference Books:

1. Ogata, K – Modern Control Engineering, PHI Learning
2. Kuo, B.C. – Automation Control Systems, PrenticeHall
3. Roy Choudhury, D – Modern Control Engineering, Prentice Hall
4. Nagrath, J. J. Gopal, M – Control System Engineering, New Age Pub.
5. Schulz, D.G. and Melsa, .L. – State Functions and Linear Control Systems, McGraw-Hill.
6. Stepheni, Shahian, Savant, Hostetler – Design offeedback control systems, Oxford University Press.
7. Vidyasagar- Nonlinear system analysis, Prentice-Hall.
8. Gibson, J.E.-Non linearsystem , Mc. Grawhill.
9. Gopal. M, Digital Control and State Variable Methods, TMH.

PED-107: Microcontroller Based System Design :

Introduction – embedded systems and their characteristics, review of micro – processors, MPU design options, Instruction sets – CISC and RISC – instruction pipelining, the microcontroller – its applications and environment.

16 bit microcontroller – Intel 8096 CPU structure, register file – assembly language overview – addressing modes – Instruction set – simple programs , Introduction, PIC microcontrollers PIC 16 C6x/7x, architecture, register file structure and addressingmodes, Instruction set, simple programs

Peripheral functions of PIC 16C6x/7x - Interrupts -Interrupts constraints – Interrupt servicing – Critical regions – External Interrupts – Use of Timers in interrupt Handling – Compare and capture mode – PWM outputs, I/O port expansion – Synchronous serial port module– State machines and key switches LCD display – I2C bus operations and subroutine – serial EEPROM

Analog to Digital converter: Characteristics and use

UART : Initialization – Data Handling circuitry andUSE

Special Features of PIC – Reset Alternatives Low power operation – Serial programming – parallel slaveport

Application of Micro controller in Power Electronics, Drives, control system and instrumentation

REFERENCE BOOKS :

John B. Peatman, "Design with PIC Microcontrollers", Pearson Education Asia, 2000.
John B. Peatman, "Design with Microcontrollers", McGraw Hill, 1995.

PED-108: Optimization Technique :

Introduction to Optimization: Engineering Applications of Optimization, Classification of Optimization Problems, Optimization Techniques, Solution of Optimization Problems Using MATLAB

Classical Optimization Techniques: Single-Variable& Multivariable Optimization,Convex Programming Problem.

Linear Programming: Simplex Method, MATLAB Solution of LP Problems,Revised Simplex Method,Decomposition Principle, Transportation Problem,Karmarkar'sInterior Method,Quadratic Programming,MATLAB Solutions.

Nonlinear Programming: One-Dimensional Minimization Methods, UnimodalFunction,ELIMINATION METHODS, INTERPOLATION METHODS,INDIRECT SEARCH (DESCENT) METHODS,Constrained Optimization Techniques-DIRECT METHODS, INDIRECT METHODS, MATLAB Solution

Geometric Programming: Polynomial,Unconstrained Minimization Problem and solutions, Constrained Minimization and solution.

Dynamic Programming: Multistage Decision Processes, Concept of Suboptimization and Principle of Optimality, Computational Procedure in Dynamic Programming, Example Illustrating the Calculus Method of Solution, Example Illustrating the Tabular Method of Solution,Continuous Dynamic Programming, applications.

INTEGER LINEAR PROGRAMMING: Graphical Representation,Gomory'sCutting Plane Method,

Balas' Algorithm for Zero – One Programming Problems.

INTEGER NONLINEAR PROGRAMMING: Conversion of a Zero – One Polynomial Programming Problem into aZero – One LP Problem, Branch-and-Bound Method, Sequential Linear Discrete Programming ,Generalized Penalty Function Method, Solution of Binary Programming Problems Using MATLAB.

Stochastic Programming: Stochastic Linear Programming ,Stochastic Nonlinear Programming, Stochastic Geometric Programming.

Optimal Control and Optimality Criteria Methods: Optimality Criteria Methods.

Modern Methods of Optimization: Introduction,computation, algorithms and application of Genetic Algorithms, Simulated Annealing,Particle Swarm Optimization,Ant Colony Optimization,Optimization of Fuzzy Systems,

Practical Aspects of Optimization:Reduction of Size of an Optimization Problem,Fast Reanalysis Techniques,Derivatives of Static Displacements and Stresses, Derivatives of Eigenvalues and Eigenvectors, Derivatives of Transient Response,Sensitivity of Optimum Solution to Problem Parameters,Multilevel Optimization,Parallel Processing,MultiobjectiveOptimization,Solution of Multiobjective Problems Using MATLAB.Application of Optimization Technique in Power Electronics, Drives, control system and instrumentation

Books:

Engineering Optimization:Theory and Practice, Singiresu S. Rao, John Wiley & Sons, Inc.,

PED-109: Soft Computing :

Neural Networks: Supervised Learning Neural Networks – Perceptrons - Adaline – Backpropagation Multilayer Perceptrons – Radial Basis Function Networks – UnsupervisedLearning Neural Networks – Competitive Learning NetworksHebbian Learning.

Fuzzy Set Theory: Introduction toNeuro– Fuzzy and Soft Computing – Fuzzy Sets –Basic Definition and Terminology – Set-theoretic Operations – Member Function

Formulation and Parameterization – Fuzzy Rules,Introduction to Fuzzy Reasoning –Extension Principle and Fuzzy Relations

Genetic Algorithm: Difference between Traditional Algorithms and GA, The basicoperators, Schema theorem, convergence analysis, stochastic models, applications insearch and optimization. Encoding, Fitness Function, Reproduction, Cross Over,Mutation,Application of Genetic Algorithm.

Neuro Fuzzy Modeling: Adaptive Neuro-Fuzzy Inference Systems – Architecture – Hybrid

Learning Algorithm – Learning Methods that Cross-fertilize ANFIS and RBFN – Coactive

Neuro Fuzzy Modeling – Framework Neuron Functions for Adaptive Networks – Neuro-Fuzzy Spectrum.

Application of Soft Computing in Power Electronics, Drives, control system and instrumentation

Text Books:

1.M. Mitchell, An Introduction to Genetic Algorithms, Prentice-Hall, 1998.

2.D. E. Goldberg, Genetic Algorithms in Search, Optimization, and MachineLearning, Addison-Wesley, 1989.

3.S. V. Kartalopoulos, Understanding Neural Networks and Fuzzy Logic: BasicConcepts and Applications, IEEE Press - PHI, 2004.

4.S. Rajasekaran& G. A. VijayalakshmiPai, Neural Networks, Fuzzy Logic andGenetic Algorithms: Synthesis & Applications, PHI, 2003.

5.S. N. Sivanandam& S. N. Deepa,Principles of SoftComputing, Wiley - India,2007

PED-110:DSP Based System:

Introduction to Signal Processing: Review of Laplace transform, Z transform, Fourier transform. Discrete Fourier transform, Fast Fourier transform,Algorithms and complexity, Introduction to linear optimal filtering Digital Filter: Definition and anatomy of a digital filter, Frequency domain description of signals and systems, Typical application of digital filters, Replacing analog filters with digital filters, Filtercategories: recursive and non-recursive

Digital Filter Structures: The direct form I and II structures, Cascade combination of second order sections, Parallel combination of second order sections, Linear- phase FIR filter structures, Frequency sampling structure for the FIR filter

Effect of Word Length: Round off error, Truncation error, Quantization error, Limit cycle Introduction to DSP Hardware: Application of DSP in Power Electronics, Drives, control system and instrumentation

Suggested Readings:

1. S. K. Mitra, Digital Signal Processing,
2. J. C. Proakis, and D. G. Maniolakis, Digital Signal Processing: Principles, Algorithms and Applications, Prentice Hall.
3. Oppenheim, and R. W. Shaffer, Discrete Time Signal Processing, Prentice Hall, 1992.
4. J. Johnson, Digital Signal Processing, Prentice Hall.
5. B. VenkataRamani, and M. Bhaskar, Digital Signal Processors, New Delhi: Tata McGraw Hill.

PED-111: Advanced Mathematics :

Advanced Matrix Theory : Computation of the greatest and the least eigen values of a matrix by power method, Modal matrix, Spectral matrix, Real Quadratic form. Sylvester's theorem.

Linear Programming : Graphical method, Simplex method, Charnes' Big M Technique, Two phase Technique, Revised Simplex method. Duality theory, Dual simplex method, Transportation Problems and Assignment problems.

Nonlinear Programming : Nonlinear Programming with special reference to quadratic programming, Kuhn-Tucker conditions, Wolfe's modified simplex method.

Network Analysis : Shortest Path Problem (Dijkstra Algorithm, Floyd Algorithm), Maximal- Flow Problem(Ford Fulkerson Algorithm), Project Scheduling by PERT-CPM.

Integral Equations : Integral Equations, Fredholm Integral Equations, Volterra Integral Equations , Deduction of Differential Equations to Integral Equations and vice-versa. Solution of FredholmIntegral Equations of 2nd kind with Separable Kernel. Iterative Methods for solving Integral Equations of the 2nd kind. The Numann Series.

Books:

1. Taha H A :Operations research-An introduction , Macmillan publishing Co.
2. Simmons DM : Nonlinear Programming for Operations Research, PHI
3. Bazara, Shetty and Sherali : Nonlinear Programming
4. S SRao : Optimization Techniques, Wiley Eastern
5. Francis B Hildebrand : Methods of Applied Mathematics,1992

PED-112: ArtificialNeuralNetwork :

Overview of Artificial Intelligence, AI Programming Languages – LISP/PROLOG

Knowledge Representation - Formalized Symbolic Logics. Dealing with Inconsistencies, and Uncertainties.Probabilistic Reasoning.

Structured Knowledge: Graphs, Frames, andRelated Structures.Object-Oriented Representations.Search and Control Strategies, General Problem solving, Production systems,

Control strategies: forward and backward chaining Exhaustive searches: Depth first Breadth

first search, Heuristic search techniques: Hill climbing, Branch and Bound technique, Best first search and A* algorithm, AND/OR Graphs, Problem reduction and AO*, algorithm, Constraint Satisfaction problems Game Playing Minmax search procedure, Alpha-Beta cutoffs, Additional Refinements, Matching Techniques. Knowledge Organization and Management

Basic understanding of Fuzzy Logic, Artificial Neural Network, Perceptron, NaturalLanguage Processing, Pattern Recognition, overview on Expert Systems

Application of ANN in Power Electronics, Drives, control system and instrumentation

Text Books:

1. Introduction to Artificial Intelligence and Expert Systems by D.W. Patterson
2.Artificial Intelligence: A Modern Approach - 3rd edition by Stuart Russell &PeterNorvig
3.Artificial intelligence by Elaine Rich&Kevin Knight
4.Principles ofArtificial Intelligence by J. Nilsson, Narosa Publishing House

PED-113: Embedded System :

Introduction to Embedded systems: Introduction – Features – Microprocessors – ALU - Von Neumann and Harvard Architecture - CISC and RISC - Instruction pipelining.
Microcontroller: characteristics and Features, Overview and architectures of Atmel 89C52 and Microchip PIC16F877 and 18F452.
Examples of embedded Systems: Bar-code scanner, Laser printer, Underground tank monitoring.
PIC Microcontroller: PIC Microcontrollers: 16F877 Architecture and Instruction Set. External Interrupts, Timers, watch-dog timer, I/O port Expansion, analog-to-digital converter, UART, I2C and SPI Bus for Peripheral Chips, Accessories and special features
Software architecture and RTOS: Software Architecture: Round Robin- Round Robin with interrupts -Function Queue. Scheduling
Architecture RTOS: Architecture -Tasks and Task States -Tasks and Data -Semaphores and Shared Data - Message Queues -Mail Boxes and pipes -Timer Functions -Events -Memory Management, Interrupt , Routines
Basic design using a real time operating system: Overview. General principles.Design of an embeddedsystem.
Software development tools and debugging techniques: Development Tool: Cross-Compiler, Cross-Assemblers,Linker/locator. PROM Programmers, ROM Emulator, In-Circuit Emulators. Debugging Techniques. Instruction set simulators. The assert macro. Testing using laboratory tools.
Application of Embedded System in Power Electronics, Drives, control system and instrumentation

Books:

1. Embedded Systems Architecture, Programming and Design, RalKamalTMH, 2008.
2. An Embedded Software Primer, D.E. Simon. Pearson Education, 1999.
3. Design with PIC Microcontrollers, J.B. Peatman,Pearson Education, 1998
4. Embedded Systems Design, Heath Steve, Second Edition-2003, Newnes,
5. Computers as Components; Principles of EmbeddedComputing System Design, Wayne Wolf Harcourt India, Morgan Kaufman Publishers, First Indian Reprint. 2001.
6. Embedded Systems Design – A unified Hardware /Software Introduction, Frank Vahid and Tony Givargis, John Wiley,

PED-114: NONLINEAR DYNAMICSAND CHAOS:

Dynamics in State Space of One and Two Dimensions : Introduction, State Space, Systems Described by First-Order Differential Equations, The No-Intersection Theorem , Dissipative Systems and Attractors One-Dimensional State Space, Taylor Series Linearization Near Fixed Points, Trajectories in a One-Dimensional State Space, Two-Dimensional State Space, Dynamics and Complex Characteristic Values, Dissipation and the Divergence Theorem, The Jacobian Matrix for Characteristic Values, Limit Cycles, Poincare Sections and the Stability of Limit Cycles, Bifurcation Theory .
Three-Dimensional State Space and Chaos: Overview, Routes to Chaos, Three-Dimensional Dynamical Systems, Fixed Points in Three Dimensions, Limit Cycles and Poincare Sections, Quasi-Periodic Behavior,
The Routes to Chaos: Period-Doubling, Quasi-Periodicity, Intermittency and Crises, Chaotic Transients and Homoclinic Orbits, Homoclinic Tangles and Horseshoes, Lyapunov Exponents and Chaos.
Iterated Maps: Introduction, Poincare Sections and Iterated Maps, One-Dimensional Iterated Maps, Bifurcations of Smooth Maps, Pitchfork Bifurcation, Saddle-Node Bifurcation, Period-Doubling Bifurcation, Neimark Bifurcation, Chaos, Lyapunov Exponents, Qualitative Universal Behavior: The U-Sequence, Feigenbaum Universality , Tent Map, Shift Maps and Symbolic Dynamics The Gaussian Map, Two-Dimensional Iterated Maps, The Smale Horseshoe Map.
Quasi-Periodicity and Chaos: Introduction, Quasi-Periodicity and Poincare Sections, Quasi-Periodic Route to Chaos, Universality in the Quasi-Periodic Route to Chaos, Frequency-Locking, Circle Map, The Devil's Staircase and the Farey Tree, Continued Fractions and Fibonacci Numbers, Chaos and Universality.
Intermittency and Crises: Intermittency, The Cause of Intermittency, Quantitative Theory of Intermittency, Types of Intermittency, Crises.
Quantifying Chaos: Introduction,Time-Series of Dynamical Variables, Lyapunov Exponents, Universal Scaling of the LyapunovExponent, Invariant Measure, Fractal Dimension(s), Correlation Dimension.
Bifurcations in Piecewise-Smooth Maps: Normal Form, Bifurcations in the One-Dimensional Normal Form, Border Collision Pair Bifurcation, Border-Crossing Bifurcations, Bifurcations in the Two-Dimensional Normal Form,

Classification of Border Collision Bifurcations, Border Collision Pair Bifurcation, Border-Crossing Bifurcations, Nonstandard Bifurcations in Discontinuous Maps.

Control of Chaos: The OGY Method, Review of the OGY Method, Pyragas Methods, A Combination of OGY and Pyragas Methods, Controlling Border-Collision Bifurcations, Time-Delay Control of Chaos, TDAS for the Current-Mode Boost Converter.

Books:

1. Chaos and Nonlinear Dynamics:An Introduction for Scientists and Engineers Second Edition, Robert C. Hilborn, Oxford University Press.
2. Nonlinear Dynamics And Chaos: With Applications To Physics, Biology, Chemistry, And Engineering (Studies in Nonlinearity) ,Steven H. Strogatz.
3. NONLINEAR PHENOMENA IN POWER ELECTRONICS :Attractors, Bifurcations, Chaos, and Nonlinear Control, Soumitro Banerjee, George C. Verghese, Wiley.
4. CHAOS: An Introduction to Dynamical Systems, by Kathleen T. Alligood,Tim D. Sauer,James A. Yorke, Springer.
5. DIFFERENTIAL EQUATIONS,DYNAMICAL SYSTEMS, AND AN INTRODUCTION TO CHAOS by Hirch, Smale, Devaney, Elsavier.
6. An Introduction to Chaotic Dynamical System, 2nd Edition, byDevaney, Addison Wiseley.
7. Nonlinear Oscillations, Dynamical Systems, and Bifurcations of Vector Fields by John Guckenheimer , Philip Holmes , Springer.
8. Elements of Applied Bifurcation Theory,Second Edition by Yuri A. Kuznetsov, Springer.
9. Introduction to Applied Nonlinear Dynamical Systems and Chaos by Stephen Wiggins**, Springer.**
10. Controlling Chaos: Suppression, Synchronization and Chaotification by Huaguang Zhang, Derong Liu, Zhiliang Wang, Springer.

PED- 115: Electrical Machines Analysis :

Basic Principles for Analysis: Introduction, Magnetically coupled circuit, Electromechanical Energy Conversion, Machine windings and Air gap MMF, Winding inductances and voltage equations.

Reference Frame Theory:Introduction, Basic idea of Reference Frame, Synchronously rotating Reference Frame andGeneralized Theory, Kron's primitive Machine and its mathematical Model, equation of voltage, power and torque, Other
standard reference frames, Equation of transformation: change of variables, Transformation between reference frames, transformation of a balanced set, balanced steady state phasor relationship and voltage equations.

Induction Machines: Introduction, Voltage and torque equations in machine variables, Equations of Transformation for rotor
circuit, Voltage and Torque Equations in Arbitrary reference Frame Variables, Analysis of steady stateoperation, Freeacceleration characteristics viewed from other reference frame, Dynamic performance during sudden change in load torque, Linearized model, Eigen values and small displacement stability, Reduced order equations and dynamics.

Synchronous Machines: Introduction, Voltage and torque equations in machine variables, Voltage and Torque Equations in Arbitrary reference Frame Variables, Voltage and Torque Equations in Rotor Reference Frame Variables, Torque Equations in Substitute variables, Analysis of steady state operation, Dynamic Performance during a sudden change in Input torque, Linearized model, Eigen values and small displacement stability, Reduced order equations and dynamics.

DC Machines: Introduction, Voltage and torque equations in machine variables, Basic types of the machine, Dynamic characteristics of permanent magnet and DC Shunt Motors, Time domain Block Diagrams and state equations, Solution of Dynamic equation by Laplace Transformation.

Texts:

1. P.C. Krause, "Analysis of electric machinery andDrives", McGraw Hill, New York, 1986 References:
1. Ong Moon Lee "Dynamics Simulation of ElecticalMachines" Prentice Hall
2. Bimbhra P.S., "Generalized Circuit Theory of Electrical Machines", Khanna Publishers, Delhi, 5th Edition, 1995.
3. Adkins B., " The General Theory of Electrical Machines", John Wiley Sons, 1957.
4. Seely S., "Electro-Mechanical Energy Conversion", McGraw Hill, 1962.

RMI-101: Research Methodology and IPR:

Unit-1: Meaning of research problem, Sources of research problem, Criteria Characteristics ofa good research problem, Errors in selecting a research problem, Scope and objectives ofresearch problem.Approaches of investigation of solutions for research problem, data collection, analysisinterpretation, Necessary instrumentations

Unit 2: Effective literature studies approaches, analysisPlagiarism, Research ethics,

Unit 3: Effective technical writing, how to write report, PaperDeveloping a Research Proposal, Format of research proposal, a presentation and assessmentby a review committee

Unit 4: Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process ofPatenting and Development: technological research, innovation, patenting, development.International Scenario: International cooperation on Intellectual Property. Procedure for grantsof patents, Patenting under PCT.

Unit 5: Patent Rights: Scope of Patent Rights. Licensing and transfer of technology.Patentinformation and databases.Geographical Indications.

Unit 6: New Developments in IPR: Administration of Patent System. New developments inIPR; IPR of Biological Systems, Computer Software etc.Traditional knowledge Case Studies,IPR and IITs.

References:

- Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"
- Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
- Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
- Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
- Mayall , "Industrial Design", McGraw Hill, 1992.
- Niebel , "Product Design", McGraw Hill, 1974.
- Asimov , "Introduction to Design", Prentice Hall, 1962.
- Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.
- T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

AUD-101 (one subject from the pool in 1st semester) & AUD-201 (another second subject in 2nd semester):
Audit course 1 & 2

(a) ENGLISH FOR RESEARCH PAPER WRITING

1. Planning and Preparation, Word Order, Breaking up long sentences,Structuring Paragraphs and Sentences, Being Concise and RemovingRedundancy, Avoiding Ambiguity and Vagueness
2. Clarifying Who Did What, Highlighting Your Findings, Hedging andCriticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts.Introduction
3. Review of the Literature, Methods, Results, Discussion, Conclusions, TheFinal Check.
4. Key skills are needed when writing a Title, key skills are needed whenwriting an Abstract, key skills are needed when writing an Introduction,skills needed when writing a Review of the Literature,
5. Skills are needed when writing the Methods, skills needed when writing theResults, skills are needed when writing the Discussion, skills are neededwhen writing the Conclusions
6. Useful phrases, how to ensure paper is as good as it could possibly be thefirst- time submission

Suggested Studies:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook .
4.AdrianWallwork , English for Writing Research Papers, Springer New York DordrechtHeidelberg London, 2011

(b) DISASTER MANAGEMENT :

1 **Introduction:** Disaster: Definition, Factors And Significance; Difference Between HazardAnd Disaster; Natural And Manmade Disasters: Difference, Nature, Types AndMagnitude.

2 **Repercussions Of Disasters And Hazards**: Economic Damage, Loss OfHuman And Animal Life, Destruction Of Ecosystem.Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods,Droughts And Famines, Landslides

And Avalanches, Man-made disaster:Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills,Outbreaks Of Disease And Epidemics, War And Conflicts.

3 **Disaster Prone Areas In India:** Study of Seismic Zones; Areas Prone To Floods And Droughts, LandslidesAnd Avalanches; Areas Prone To Cyclonic And Coastal Hazards With SpecialReference To Tsunami; Post-Disaster Diseases And Epidemics

4 **Disaster Preparedness And Management:** Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard;

Evaluation of Risk: Application of Remote Sensing, Data FromMeteorological And Other Agencies, Media Reports: Governmental AndCommunity Preparedness.

5 **Risk Assessment:** Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global AndNational Disaster Risk Situation. Techniques Of Risk Assessment, Global Cooperation In Risk Assessment And Warning, People's Participation In RiskAssessment. Strategies for Survival.

6 **Disaster Mitigation:** Meaning, Concept And Strategies of Disaster Mitigation, Emerging Trends InMitigation. Structural Mitigation And Non-Structural Mitigation, Programs ofDisaster Mitigation In India.

SUGGESTED READINGS:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'NewRoyal book Company.
2.Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall ofIndia, New Delhi.
3. Goel S. L. , Disaster Administration And Management Text And Case Studies" ,Deep &DeepPublication Pvt. Ltd., New Delhi.

(c) SANSKRIT FOR TECHNICAL KNOWLEDGE:

1. Alphabets in Sanskrit,Past/Present/Future Tense,Simple Sentences
2. OrderIntroduction of rootsTechnical information about Sanskrit Literature
3. Technical concepts of Engineering-Electrical, Mechanical,Architecture, Mathematics

Suggested reading

1. "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" PrathamaDeeksha-VempatiKutumbshastri, Rashtriya SanskritSansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

(d)VALUE EDUCATION

1 Values and self-development –Social values and individualattitudes.Work ethics, Indian vision of humanism. Moral and non- moral valuation.Standards and principles.Value judgements

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

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

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

Suggested reading

1.Chakroborty, S.K. "Values and Ethics for organizations Theory and practice", Oxford UniversityPress, New Delhi

(e) CONSTITUTION OF INDIA

1. **History of Making of the Indian Constitution:**HistoryDrafting Committee, (Composition & Working)
2. **Philosophy of the Indian Constitution:**PreambleSalient Features

3. **Contours of Constitutional Rights & Duties:**Fundamental Rights Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational RightsRight to Constitutional Remedies, Directive Principles of State PolicyFundamental Duties.
4. **Organs of Governance:**ParliamentCompositionQualifications and DisqualificationsPowers and FunctionsExecutivePresident, GovernorCouncil of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications
   Powers and Functions
5. **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: ZilaPachayat.Elected officials and their roles, CEO ZilaPachayat: Position and role.Block level: Organizational Hierarchy (Different departments),Village level: Role of Elected and Appointed officials,Importance of grass root democracy
6. **Election Commission:**Election Commission: Role and Functioning.Chief Election Commissioner and Election Commissioners.tate Election Commission: Role and Functioning.Institute and Bodies for the welfare of SC/ST/OBC and women.

Suggested reading

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

(f) PEDAGOGY STUDIES

1. **Introduction and Methodology:**Aims and rationale, Policy background, Conceptual framework and terminologyTheories of learning, Curriculum, Teacher education.Conceptual framework, Research questions**.**Overview of methodology and Searching.
2. **Thematic overview**: Pedagogical practices are being used by teachers informal and informal classrooms in developing countries.Curriculum, Teacher education.
3. **Evidence on the effectiveness of pedagogical practices:**Methodology for the in depth stage: qualityassessment of included studies.How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?Theory of change.Strength and nature of the body of evidence for effective pedagogicalpractices.Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.
4. **Professional development**: Alignment with classroom practices and followup support.Peer Support from the head teacher and the community.Curriculum and assessmentBarriers to learning: limited resources and large class sizes
5. **Research gaps and future directions:** Researchdesign, ContextsPedagogyTeacher educationCurriculum and assessment, Dissemination and research impact.

Suggested reading:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2):245-261.
2.Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal ofCurriculum Studies, 36
3.Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning ofbasicmaths and reading in Africa: Does teacher preparation count? International JournalEducational Development, 33 272–282. 5.Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education.Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

(g) STRESS MANAGEMENT BY YOGA:

1. Definitions of Eight parts of yog. (Ashtanga)
2. Yam and NiyamDo`s and Don't's in life.i) Ahinsa, satya, astheya, bramhacharya and aparigrahaii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan
3. Asan and Pranayami) Various yog poses and their benefits for mind &bodyii)Regularization of breathing techniques and its effects-Types of pranayama

Suggested reading:

1. 'Yogic Asanas for Group Tarining-Part-I" :Janardan Swami YogabhyasiMandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, AdvaitaAshrama(Publication Department), Kolkata

(h) PERSONALITY DEVELOPMENTTHROUGH LIFE ENLIGHTENMENT SKILLS:

1. Neetisatakam-Holistic development of personality, Verses- 19,20,21,22 (wisdom), Verses- 29,31,32 pride & heroism), Verses- 26,28,63,65 (virtue), Verses- 52,53,59 (dont's), Verses- 71,73,75,78 (do's),
2. Approach to day to day work and duties. ShrimadBhagwadGeeta : Chapter 2-Verses 41, 47,48,. Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35, . Chapter 18-Verses 45, 46, 48.
3. Statements of basic knowledge.ShrimadBhagwadGeeta: Chapter2-Verses 56, 62, 68. Chapter 12 -Verses 13, 14, 15, 16,17, 18. Personality of Role model. ShrimadBhagwadGeeta:Chapter2-Verses 17, Chapter 3-Verses 36,37,42,. Chapter 4-Verses 18, 38,39. Chapter18 – Verses 37,38,63.

Suggested reading;

1. "Srimad Bhagavad Gita" by Swami SwarupanandaAdvaita Ashram (Publication2. Department), Kolkata.
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath,
3. Rashtriya Sanskrit Sansthanam, New Delhi.

PED-191: Electrical Engineering-I Laboratory:

List of experiments: for PED-191 & PED-291

1. Study of Thyristor controlled D.C Drive.
2. Study of Chopper Fed DC Motor.
3. Study of A.C single phase motor speed control using TRIAC.
4. PWM inverter fed three phase induction motor control using PSPICE/MATLAB/PSIMsoftware.
5. VSI/CSI fed induction motor drive analysis using MATLAB/PSPICE/PSIM software.
6. Study of V/f control operation of three phase induction motor.
7. Study of permanent magnet synchronous motor drive fed by PWM inverter using software.
8. Regenerative/ Dynamic breaking operation for DC motor study using software.
9. Regenerative/ Dynamic breaking operation for AC motor study using software.
10. PC/PLC based AC/DC motor control operation.
11. Load test on dc shunt motor to draw speed – torque and horse power – efficiency characteristics.
12. Field Test on dc series machines.
13. Speed control of dc shunt motor by armature and field control.
14. Swinburne's Test on dc motor.
15. Retardation test on dc shunt motor.
16. Regenerative test on dc shunt machines.
17. Load test on three phase induction motor.
18. No load and Blocked rotor test on three phase induction motor to draw (i) equivalent circuit and(ii) circle diagram. Determination of performance parameters at different load conditions from(i) and (ii).
19. Load test on induction generator.
20. Load test on single phase induction motor to draw output versus torque, current, power and efficiency characteristics.
21. Conduct suitable tests to draw the equivalent circuit of single phase induction motor anddetermine performance parameters.

22. Conduct an experiment to draw V and curves of synchronous motor at no load and loadconditions.
23. To study the effect of non linear loads on power quality.
24. To demonstrate the voltage and current distortions experimentally.
25. To reduce the current harmonics with filters.
26. To study the voltage sag due to starting of large induction motor.
27. To study the capacitor switching transients.
28. To study the effect of balanced non linear load on neutral current , in a three phase circuit
29. To study the effect of ground loop.
30. To study the effect of voltage flicker .
31. To calculate the distortion power factor.
32. Study the effect of harmonics on energy meter reading.
33. To study effect of voltage sag on electrical equipment.
34. To obtain the current harmonics drawn by power electronics interface using PSCAD software
35. To study V-I characteristics of SCR and measure latching and holding currents.
36. To study UJT trigger circuit for half wave and full wave control.
37. To study single-phase half wave controlled rectified with (i) resistive load (ii) inductive load with and without freewheeling diode.
38. To study single phase (i) fully controlled (ii) half controlled bridge rectifiers with resistive and inductive loads.
39. To study three-phase fully/half controlled bridge rectifier with resistive and inductive loads.
40. To study single-phase ac voltage regulator with resistive and inductiveloads.
41. To study single phase cyclo-converter.
42. To study triggering of (i) IGBT (ii) MOSFET (iii) power transistor.
43. To study operation of IGBT/MOSFET chopper circuit.
44. To study MOSFET/IGBT based single-phase series-resonant inverter.
45. To study MOSFET/IGBT based single-phase bridge inverter.
46. Writing **ASSEMBLY PROGRAMMING**
    a. Write a program to multiplication and division using MUL and DIV instructions.
    b. Write a program to transfer a block of data from internal memory to external memory.
    c. Write a program to exchange two set of eight-byte data.
    d. Write a program to find the sum of two numbers in decimal.
    e. Write a program to convert decimal number to hexadecimal.
    f. Write a program to add a number n, m number of times.
    g. Write program to find the largest from a set of n numbers.

h.Write program for sorting the given set of numbers.

47. EXPERIMENTS ON 8051 INTERFACING

a. Write an assembly language program for generating a triangular wave.
b. Write a program to find the largest from a set of ten numbers and display it usingLEDs.
c. Write a program to for displaying the decimal numbers in 7 Segment display.
d. Write a program to read the DIP switches for displaying the reading using 7 Segmentdisplay.
e. Write a program to rotate the given motor in clockwise direction.
f. Write a program to rotate the given motor in anticlockwise direction.
g. Write a program to generate a square wave.
h. Write a program to display a message in LCD display.

48. Digital Signal Processing Lab

a.Introduction to Code Composer Studio-I
b.Introduction to Code Composer Studio-II
c.Introduction to the Addressing Modes
d. FFT and Bit Reversal Operation
e. FFT and its Applications
f.Audio Codec and its Applications

g. Real Time Data Exchange
h. IR filtering by interfacing Matlab with Code Composer Studio
i. Introduction to Interrupts
j. Digital communication using Binary Phase Shift Keying

Second Semester:

PED-201: ADVANCED POWER ELECTRONIC CIRCUITS;

1. Boost type APFC and control.
2.Three phase utility interphases and control-Buck, Boost, Buck-Boost SMPSTopologies.
3. Modes of operation –Push-Pull and Forward Converter Topologies – Voltage ModeControl.Half and Full Bridge Converters.
4. Flyback Converter.Introduction to Resonant Converters.Load Resonant Converter. Zero Voltage Switching Clamped Voltage Topologies.
5. Resonant DC Link Inverters with Zero Voltage Switching.High Frequency Link Integral Half Cycle Converter.
6. Modeling and design of DC-DC Converters for various renewable energyconversion.Few power electronic circuits used in practice for controlling electric drives.

Suggested reading:

1.Rashid "Power Electronics" Prentice Hall India 2007.
2. G.K.Dubey et.al "Thyristorised Power Controllers" Wiley Eastern Ltd., 2005, 06.
3. Dewan&Straughen "Power Semiconductor Circuits" John Wiley &Sons., 1975.
4.G.K. Dubey& C.R. Kasaravada "Power Electronics & Drives" Tata McGraw Hill., 1993
5.Cyril W Lander "Power Electronics" McGraw Hill., 2005.
6. B. K Bose "Modern Power Electronics and AC Drives" Pearson Education (Asia)., 2007
7. Abraham I Pressman "Switching Power Supply Design" McGraw Hill Publishing Company.,2001.

PED-202: MODELING AND ANALYSIS OF ELECTRICAL MACHINES:

1. Principles of Electromagnetic Energy Conversion.General expression of stored magnetic energy.Co-energy and force/torque, example using single and doubly excited system.
2. Basic Concepts of Rotating Machines-Calculation of air gap mmf and per phasemachine inductance using physical machine data; Voltage and torque equation ofdc machine.
3. Three phase symmetrical induction machine and salient pole synchronousmachines in phase variable form, Application of reference frame theory to three phase symmetrical induction andsynchronous machines. Dynamic direct and quadrature axis model in arbitrarily rotating reference frames.
4. Determination of Synchronous machine dynamic equivalent circuit parameters .Analysis and dynamic modeling of two phase asymmetrical induction machine andsingle phase induction machine.
5. Special Machines – Permanent magnet synchronous machine. Surface permanent magnet (square and sinusoidal back emf type) and interiorpermanent magnet machinesConstruction and operating principle. Dynamic modeling and self-controlled operation.
6. Analysis of Switch Reluctance Motors.Brushless D.C. Motor for space Applications. Recent trends.

Suggested reading.

1. Charles Kingsle,Jr., A.E. Fitzgerald, Stephen D.Umans, "Electric Machinery", Tata Mcgraw Hill
2. R. Krishnan, "Electric Motor & Drives: Modeling, Analysis and Control", Prentice Hall of India
3. Miller, T.J.E., "Brushless Permanent Magnet and Reluctance Motor Drives", Clarendon Press
4.P.C.Krause "Analysis of Electric Machine" Wiley IEEE Press 3rd Edition

PED-203: OPTIMAL AND ADAPTIVE CONTROL:

1. Optimal control problem – fundamental concepts and theorems of calculusof variations–Euler – Language equation and external of functional.
2. Variational approach to solving optimal control problems.Hamiltonian and different boundary conditions for optimal control problem.

3. Linear regulator problem –Pontryagin's minimum principle.
4. Dynamic programming – Principle of optimality and its application tooptimal control problem.
5. Hamilton-Jacobi-Bellman equation – model reference adaptive systems(MRAS) – Design hypothesis**.**
6. Introduction to design method based on the use of Liapunov function.Design and simulation of variable structure adaptive model followingcontrol.

Suggested reading:

1.Donald E. Kirk, "Optimal Control Theory, An introduction", Prentice Hall Inc., 2004
2.A.P. Sage, "Optimum Systems Control", Prentice Hall, 1977
3. HSU and Meyer , "Modern Control, Principles and Applications", McGraw Hill, 1968
4. Yoan D. Landu, "Adaptive Control (Model Reference Approach)", Marcel Dekker.1981
5.K.K.D.Young, "Design of Variable Structure Model Following Control Systems", IEEETransactions on Automatic Control, Vol. 23, pp 1079-1085, 1978.

PED-204: DIGITAL CONTROL OF POWER ELECTRONICS AND DRIVESYSTEMS:

1.Review of numerical methods. Application of numerical methods to solve transients in D.C.Switched R, L, R-L, R-C and R-L-C circuits.Extension to AC circuits.

2.Modeling of diode in simulation. Diode with R, R-L, R-C and R-L-C load with AC supply.Modeling of SCR, TRIAC, IGBT and Power Transistors in simulation. Application of numerical methods to R, L, C circuits with power electronic switches. Simulation of gate/base drive circuits, simulation of snubber circuits.

3. State space modeling and simulation of linear systems. Introduction to electrical machine modeling: induction, DC, and synchronous machines, simulation of basic electric drives, stability aspects.

4Simulation of single phase and three phase uncontrolled and controlled (SCR) rectifiers. Converters with self-commutated devices- simulation of power factorcorrection schemes.

5.Simulation of converter fed DC motor drives. Simulation of thyristor choppers with voltage. Current and load commutation schemes. Simulation of chopper fed DC motor.

6 Simulation of single and three phase inverters with thyristors and self commutated devices. Space vector representation. Pulse-width modulation methods for voltage control. Waveform control. Simulation of inverter fed induction motor drives.

Suggested reading:

1. Simulink Reference Manual, Math works, USA

PED-205: INDUSTRIAL LOAD MODELING AND CONTROL:

1.Electric Energy Scenario-Demand Side Management-Industrial Load Management. Load Curves-Load ShapingObjectives-Methodologies. Barriers; Classification of Industrial Loads- Continuous and Batch processes –Load Modeling. **2.**Electricity pricing – Dynamic and spot pricing –Models. Direct load control- Interruptible load control. Bottom up approach- scheduling- Formulation of loadmodels- Optimization and control algorithms – Case studies.

3 Reactive power management in industries-controls-power quality impactsapplication of filters Energy saving in industries.

4. Cooling and heating loads- load profiling- Modeling. Cool storage-Types- Control strategies. Optimal operation-Problem formulation- Case studies.

4. Captive power units- Operating and control strategies- Power Pooling Operation models. Energy banking-Industrial Cogeneration
5. Selection of Schemes Optimal Operating Strategies. Peak load saving-Constraints-Problem formulation-Case study. Integrated Load management for Industries.

Suggested reading:

1. C.O. Bjork "Industrial Load Management – Theory, Practice and Simulations", Elsevier, the Netherlands,1989.
2. C.W. Gellings and S.N. Talukdar, "Load management concepts," IEEE Press, New York, 1986, pp. 3-28.
3. Y. Manichaikul and F.C. Schweppe ," Physically based Industrial load", IEEE Trans. On PAS, April 1981.
4. H. G. Stoll, "Least cost Electricity Utility Planning", Wiley Interscience Publication, USA, 1989.
5. I.J.Nagarath and D.P.Kothari, .Modern Power System Engineering., Tata McGraw Hill publishers, New Delhi, 1995.
6. IEEE Bronze Book- "Recommended Practice for Energy Conservation and cost effective planningin Industrial

facilities", IEEE Inc, USA.

PED-206: SMART GRID:

1. Introduction to Smart Grid, Evolution of Electric Grid. Concept of Smart Grid, Definitions, Need of Smart Grid. Concept of Robust &Self-Healing Grid, Present development & International policies in Smart Grid

2. Introduction to Smart Meters, Real Time Prizing, Smart Appliances. Automatic Meter Reading (AMR). Outage Management System (OMS). Plug in Hybrid Electric Vehicles(PHEV).. Vehicle to Grid, Smart Sensors. Home & Building Automation, Smart Substations, Substation Automation, Feeder Automation.

3. Geographic Information System (GIS). Intelligent Electronic Devices (IED) & their application for monitoring & protection, Smart storage like Battery, SMES, Pumped Hydro. Compressed Air Energy Storage. Wide Area Measurement System (WAMS), Phase Measurement Unit (PMU).

4. Concept of micro-grid, need & applications of micro-grid. Formation of micro-grid, Issues of interconnection. Protection & control of micro-grid. Plastic & Organic solar cells, Thin film solar cells. Variable speed wind generators, fuel-cells, micro-turbines. Captive power plants, Integration of renewable energy sources.

5. 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.

6. Advanced Metering Infrastructure (AMI), Home Area Network (HAN). Neighbourhood Area Network (NAN), Wide Area Network (WAN). Bluetooth, ZigBee, GPS, Wi-Fi, Wi-Max based communication. Wireless Mesh Network. Basics of CLOUD Computing &Cyber Security for Smart Grid. Broadband over Power line (BPL). IP based protocols .

Suggested reading

1. Ali Keyhani, "Design of smart power grid renewable energy systems", Wiley IEEE,2011.
2. Clark W. Gellings, "The Smart Grid: Enabling Energy Efficiency and Demand Response", CRC Press, 2009.]
3. JanakaEkanayake, Nick Jenkins, KithsiriLiyanage, "Smart Grid: Technology and Applications", Wiley 2012.
4. Stuart Borlas'e, "Smart Grid:Infrastructure, Technology and solutions "CRC Press.
5. A.G.Phadke , "Synchronized Phasor Measurement and their Applications",Springer.

PED-207: ADVANCED DIGITAL SIGNAL PROCESSING:

1.Discrete time signals. Linear shift invariant systems- Stability and causality. Sampling of continuous time signals-. Discrete time Fourier transform- Discrete Fourier series- Discrete Fourier transform. Z transform-Properties of different transforms

2.Linear convolution using DFT. Computation of DFT Design of IIR digital filters from analog filters. Impulse invariance method . Bilinear transformation method

3.FIR filter design using window functions. Comparison of IIR and FIR digital filters. Basic IIR and FIR filter realization structures. Signal flow graph representations Quantization process and errors. Coefficient quantization effects in IIR and FIR filters

4.A/D conversion noise-Arithmetic round-off errors. Dynamic range scaling. Overflow oscillations and zero Input limit cycles in IIR filters. Linear Signal Models

5.All pole, All zero and Pole-zero models. Power spectrum estimation- Spectral analysis of deterministic signals. Estimation of power spectrum of stationary random signals

6.Optimum linear filters. Optimum signal estimation. Mean square error estimation. Optimum FIR and IIR Filters 6

Suggested reading:

1. Sanjit K Mitra, "Digital Signal Processing: A computer-based approach ",TataMc Grow-Hill Edition 1998
2. Dimitris G .Manolakis, Vinay K. Ingle and Stephen M. Kogon, "Statistical and Adaptive Signal Processing", Mc Grow Hill international editions .-2000

PED-208: ADVANCED MICRO-CONTROLLER BASED SYSTEMS:

1.Basic Computer Organization. Accumulator based processes-Architecture-Memory. Organization-I/O Organization.
2.Micro-Controllers-Intel 8051, Intel 8056- Registers, Memories.. I/O Ports, Serial Communication. Timers, Interrupts,

Programming.
3.Intel 8051 – Assembly language programming-Addressing-OperationsStack&Subroutines,Interrupts-DMA.
4.PIC 16F877- Architecture Programming. Interfacing Memory/ I/O Devices, Serial I/Oand data communication
5.Digital Signal Processor (DSP) – Architecture – Programming, Introduction to FPGA.
6.Microcontroller development for motor control applications. Stepper motor control using micro controller.

Suggested reading:

1. John.F.Wakerly: "Microcomputer Architecture and Programming", John Wiley and Sons 1981.
2. Ramesh S.Gaonker: "Microprocessor Architecture, Programming and Applications with the 8085", Penram International Publishing (India), 1994.
3. Raj Kamal: "The Concepts and Features of Microcontrollers", Wheeler Publishing, 2005.
4. Kenneth J. Ayala, "The 8051 microcontroller", Cengage Learning, 2004.
5. John Morton," The PIC microcontroller: your personal introductory course", Elsevier, 2005.
6. Dogan Ibrahim," Advanced PIC microcontroller projects in C: from USB to RTOS with the PIC18F Series", Elsevier,
7. Microchip datasheets for PIC16F877.

PED-209: DISTRIBUTED GENERATION:

1.Need for Distributed generation. Renewable sources in distributed generation and current scenario in Distributed Generation.
2.Planning of DGs.. Sitting and sizing of DGs optimal placement of DG sources in distribution systems.. Grid integration of DGs Different types of interfaces, Inverter based DGs and rotating machine based interfaces. Aggregation of multiple DG units.
3.Technical impacts of DGs. Transmission systems Distribution Systems De-regulation Impact of DGs upon protective relaying. Impact of DGs upon transient and dynamic stability of existing distribution systems, Steady-state and Dynamic analysis.
4.Economic and control aspects of DGs Market facts. Issues and challenges Limitations of DGs, Voltage control techniques. Reactive power control, Harmonics Power quality issues, Reliability of DG based systems.
5.Introduction to micro-grids. Types of micro-grids: autonomous and non-autonomous grids Sizing of micro-grids. Modeling & analysis of Micro-grids with multiple DGs.Micro-grids with power electronic interfacing units.
6.Transients in micro-grids, Protection of micro-grids, Case studies, Advanced topics.

Suggested reading:

1. H. Lee Willis, Walter G. Scott, "Distributed Power Generation – Planning and Evaluation", Marcel Decker Press.
2. M.GodoySimoes, Felix A.Farret, "Renewable Energy Systems – Design and Analysis with Induction Generators", CRC press.
3. Stuart Borlase. "Smart Grid: Infrastructure Technology Solutions" CRC Press

PED-210:Energy Efficient Motor:

1. Introduction : Energy efficiency and its impacts on social life.
2. Energy-Efficient Motors: Standard Motor Efficiencies for various motors, Why More Efficient Motors?, What Is Efficiency? What Is an Energy-Efficient Motor?, Efficiency Determination. Motor Efficiency Labeling, NEMA Energy-Efficient MotorStandards
3. Fundamentals of Electric Motor Drives, Power electronic devices, electric motor drives, controlled rectifier,phase controlled AC controller, DC motor control using DC-DC converter.
4. Power Factor and its definition under various practical conditions, Power Factor and its definition for ideal sinusoidal system. Improvement of factor : Reasons and methods. The Power Factor with Nonlinear Loads, Harmonics and thePower Factor, Power Factor Motor Controllers.
5. Energy efficient induction motor under different input parametersand applications, Varying Duty Applications, Voltage Unbalance ,Voltage Variation, Poly-phase Induction Motors Supplied by Adjustable-Frequency PowerSupplies.
6. Adjustable-Speed Drives their Advantages and Benefits fromEfficiency Point of View. The Impact of Motor Efficiency, Advantages of Variable-SpeedMotors. Adjustable-Speed Drive Applications.
7. Induction Motor Variable Seed Drive System a Case Study .

8. Brushless DC motor Drive a Case Study.
9. Switched Reluctance Motor Drives a Case Study .
10. Permanent Magnet Synchronous Motor Drive a Case Study.

[1] Ali Emadi "Energy efficient electric motors" 3rd Edition, revised and expanded, MarcelDekker, 2005.
[2] John C. Andreas "Energy-Efficient Electric Motors Selection and Application" MarcelDekker, 1982.
[3] Wei Tong "Mechanical Design of Electric Motors" CRC Press, 2014.
[4] B.N. Chaudhari and B.G. Fernandes, "Permanent magnet synchronous motor forgeneral purpose energy efficient drive,"*IEEE Power Engineering Society WinterMeeting*, 2000, vol.1, pp.213-218.
[5] P. Pillay, "Practical considerations in applying energy efficient motors in thepetrochemical industry," *42nd AnnualPetroleum and Chemical Industry ConferenceIndustry Applications Society, 1995*, pp.197-207.
[6] A. H. Bonnett, "Quality and reliability of energy efficient motors,"*IEEEIndustryApplications Magazine*, vol.3, no.1, pp.22-31, 1997.
[7] Kao Chen, "The impact of energy efficient equipment on system power quality," IEEE*Industry Applications Conference, 2000*, vol.5, no., pp.3240-3247.

PED-211:FACTS AND CUSTOM POWER DEVICES:

1. Reactive power flow control in Power Systems – Control of dynamic power unbalances in Power System. Power flow control -Constraints of maximum transmission line loading – Benefits of FACTS Transmission line compensation. Uncompensated line -Shunt compensation - Series compensation –Phase. angle control. Reactive power compensation. Shunt and Series compensation principles – Reactive compensation at transmission and distribution level .

2. Static versus passive VAR compensator, Static shunt compensators: SVC and STATCOM - Operation and control of TSC, TCR and STATCOM - Compensator control.. Comparison between SVC and STATCOM.

3. Static series compensation: TSSC, SSSC -Static voltage and phase angle regulators – TCVR and TCPAR Operation and Control –Applications,Static series compensation – GCSC,TSSC, TCSC and Static synchronous series compensators and their Control.

4. SSR and its damping Unified Power Flow Controller: Circuit Arrangement, Operation and control of UPF. Basic Principle of P and Q control- Independent real and reactive power flow control- Applications.

5. Introduction to interline power flow controller. Modeling and analysis of FACTS Controllers – Simulation of FACTS controllers Power quality problems in distribution systems, harmonics. Loads that create harmonics, modeling, harmonic propagation, series and parallel resonances, mitigation of harmonics, passive filters, active filtering – shunt , series and hybrid and their control.

6. Voltage swells, sags, flicker, unbalance and mitigation of these problems by power line conditioners- IEEE standards on power quality.

Suggested reading:

1. K R Padiyar, "FACTS Controllers in Power Transmission and Distribution", New Age International publishers, 2007**.**
2. X P Zhang, C Rehtanz, B Pal, "Flexible AC Transmission Systems- Modeling and Control",SpringerVerlag, Berlin,
3. N.G. Hingorani, L. Gyugyi, "Understanding FACTS: Concepts and Technology of Flexible ACTransmission Systems", IEEE Press Book, Standard Publishers and Distributors, Delhi, 2001.
4. K.S.Sureshkumar, S.Ashok , "FACTS Controllers & Applications", E-book edition, Nalanda Digital Library, NIT Calicut, 2003.
5. G. T.Heydt, "Power Quality", McGraw-Hill Professional, 2007.
6. T. J. E. Miller, "Static Reactive Power Compensation", John Wiley and Sons, Newyork, 1982.

PED-212: FPGA BASED DESIGN:

INTRODUCTION TO ASICS, CMOS LOGIC AND ASIC LIBRARY DESIGN: Types of ASICs – Design Flow – CMOS transistors, CMOS design rules – Combinational Logic Cell – Sequentiallogic cell – Data path logic cell – Transistors as Resistors – Transistor Parasitic Capacitance – Logical effort –Library cell design –Library architecture.

PROGRAMMABLE LOGIC CELLS AND I/O CELLS: Anti fuse – static RAM – EPROM and EEPROM technology – PREP bench marks – Actel ACT – Xilinx LCA –Altera FLEX – Altera MAX DC & AC inputs and outputs – Clock and power inputs – Xilinx I/O blocks.

INTERCONNECTS AND ASIC DESIGN SOFTWARE: Actel ACT – Xilinx LCA – Xilinx EPLD – Altera MAX 5000 and 7000 – Altera MAX 9000 Altera FLEX – Designsystems – Logic Synthesis – Half Gate ASIC – Schematic entry – Low level design language – PLA tools – EDIF –CFI design representation.

LOGIC SYNTHESIS, SIMULATION AND TESTING: Verilog and logic synthesis – VHDL and logic synthesis - Types of simulation – Boundary scan test – Faultsimulation – Automatic test pattern generation Built-in self test.

FLOOR PLANNING, PLACEMENT AND ROUTING: System partition – FPGA partitioning – partitioning methods – floor planning – placement – physical design flow –global routing – detailed routing – special routing – circuit extraction – DRC.

REFERENCE BOOKS

1. M.J.S. SMITH, "Application Specific Integrated Circuits", Addison Wesley Longman Inc., 1997.
2. Wolf Wayne, "FPGA Based System Design", Pearson Education India, 2004.
3. Mohammed Ismail and Terri Fiez, "Analog VLSI Signal and Information Processing", McGraw Hill, 1994.
4. Design manuals of Altera, Xilinx and Actel. (From the web).

PED- 213: Power Electronics Control:

Modeling of DC-to-DC Power Converters: Buck Converter, Boost Converter, Buck-Boost Converter, Non-inverting Buck-Boost Converter, C´uk Converter, Sepic Converter, Zeta Converter, Quadratic Buck Converter, Boost-Boost Converter, Double Buck-Boost Converter, Power Converter Models with Non-ideal Components, A General Mathematical Model for Power Electronics Devices.

Controller Design Methods: Sliding Mode Control, Variable Structure Systems, Control of the Buck Converter , Control of the Boost Converter, Control of the Buck-Boost Converter, Control of the C´uk Converter, Control of the Zeta Converter, Control of the Quadratic Buck Converter, Multi-variable Case, Control of the Boost-Boost Converter, Control of the Double Buck-Boost Converter, $\Sigma-\Delta$Modulation.

Approximate Linearization in the Control of PowerElectronics Devices: Linear Feedback Control, Buck Converter, Boost Converter, Buck-Boost Converter, Non-inverting Buck-Boost Converter, C´uk Converter, Sepic Converter, Zeta Converter, Quadratic Buck Converter, Boost-Boost Converter.

Nonlinear Methods in the Control of Power Electronics Devices : Feedback Linearization, Passivity Based Control, Exact Error Dynamics Passive Output Feedback Control,Error Dynamics Passive Output Feedback, Control via Fliess' Generalized Canonical Form, Nonlinear Observers for Power Converters, Reduced Order Observers, GPI Sliding Mode Control.

Applications: DC-to-AC Power Conversion-Nominal Trajectories in DC-to-AC Power Conversion, An Approximate Linearization Approach, A Flatness Based Approach, A Sliding Mode Control Approach, Exact Tracking Error Dynamics Passive Output Feedback control.

AC Rectifiers: Boost Unit Power Factor Rectifier, Three Phase Boost Rectifier, A Unit Power Factor Rectifier-DC Motor System, A Three Phase Rectifier-DC Motor System.

Books:

Control DesignTechniques in PowerElectronics Devices, HeberttSira-Ramírez andRamón Silva-Ortigoza, Springer.

PED-291: Electrical Engineering Laboratory-II;

List of Experiments are given in the first semester block.

PED-281: Mini Project with Seminar: Mini Project will be carried out by the students and they have to deliver seminar on the it.

AUD-101 (one subject from the pool in 1st semester) & AUD-201 (another second subject in 2nd semester): Audit course 1 & 2: list 1st semester block

3rd Semester:

PED-301(a):SCADA SYSTEM AND APPLICATIONS:

1 . Introduction to SCADA: Data acquisition systems, Evolution of SCADA, Communication technologies.

2. Monitoring and supervisory functions, SCADA applications in Utility Automation, Industries SCADA

3. Industries SCADA System Components: Schemes- Remote Terminal Unit (RTU), Intelligent Electronic Devices IED), Programmable Logic Controller(PLC), Communication Network, SCADA Server, SCADA/HMI Systems

4. SCADA Architecture: Various SCADA architectures, advantages and disadvantages of each system - single unified standard architecture –IEC 61850.

5. SCADA Communication: various industrial communication technologies -wired and wireless methods and fiber optics. open standard communication protocols.

6. SCADA Applications: Utility applications- Transmission and Distribution sector. operations, monitoring, analysis and improvement. Industries - oil, gas and water. Case studies, Implementation, Simulation Exercises.

Suggested reading: 1. Stuart A. Boyer: "SCADA-Supervisory Control and Data Acquisition", Instrument Society of America Publications, USA,2004.

2. Gordon Clarke, Deon Reynders: "Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems", Newnes Publications, Oxford, UK,2004.

3. William T. Shaw, "Cybersecurity for SCADA systems", PennWell Books, 2006.

4. David Bailey, Edwin Wright, "Practical SCADA for industry", Newnes, 2003.5. Wiebe, "A guide to utility automation: AMR, SCADA, and IT systems for electric power",PennWell 1999.

PED-301(b):ADVANCED FPGA BASED DESIGN:

INTRODUCTION TO ASICs, CMOS LOGIC AND ASIC LIBRARY DESIGN: Types of ASICs - Design Flow - CMOS transistors, CMOS design rules - Combinational Logic Cell – Sequentiallogic cell - Data path logic cell - transistors as resistors - transistor parasitic capacitance - Logical effort - Library celldesign - Library architecture.

PROGRAMMABLE LOGIC CELLS AND I/O CELLS: Digital clock Managers-Clock management- Regional clocks-Block RAM – Distributed RAM-Configurable LogicBlocks-LUT based structures – Phase locked loops- Select I/O resources –Anti fuse - static RAM - EPROM andEEPROM technology

DEVICE ARCHITECTURES: Device Architecture-Spartan 6 -Vertex 4 architecture- Altera Cyclone and Quartus architectures.

DESIGN ENTRY AND TESTING

Verilog and VHDL -logic synthesis - Types of simulation –Faults- Fault simulation - Boundary scan test -Automatic test pattern generation. Built-in self test. – scan test.

FLOOR PLANNING, PLACEMENT AND ROUTING

System partition - FPGA partitioning - partitioning methods - floor planning - placement - physical design flow -global routing - detailed routing - special routing - circuit extraction - DRC.

REFERENCE BOOKS

1. M.J.S. SMITH, "Application Specific Integrated Circuits", Addison Wesley Longman Inc., 1997
2. Wolf Wayne, "FPGA Based System Design", Pearson Education.
3. Design manuals of Altera, Xilinx and Actel.

PED-301(c): HVDC:

1 Development of HVDC Technology, DC versus AC Transmission, Selection of converter configuration.

2 Rectifier and Inverter operation, Digital Simulation of converters, Control of HVDC converters and Systems.

3 Individual phase control, Equidistant firing controls, Higher level controls. Characteristics and non-characteristics harmonics filter design. Fault development and protection.

4 Interaction between AC-DC power systems.Over voltages on AC/DC side, multi-terminal HVDC systems, control of MTDC systems.

5 Modeling of HVDC systems, per unit system, Representation for power flow solution, representation for stability studies.

6 Introduction to relevant national and international standards, safe clearances for HV, Study regulations for HV tests, Digital techniques in HV measurements.

Suggested reading:

1. J. Arrillaga, "High Voltage Direct Transmission", Peter Peregrinus Ltd. London, 1983.
2. K. R. Padiyar, "HVDC Power Transmission Systems", Wiley Eastern Ltd., 1990.
3. E. W. Kimbark, "Direct Current Transmission", Vol. I, Wiley Interscience, 1971.
4. Erich Uhlmann, "Power Transmission by Direct Current", B.S. Publications, 2004.

PED- 301(d):Intelligent Control of Drives:

INTRODUCTION TO NEURAL NETWORKS :Introduction – biological neurons – Artificial neurons – activation function – learning rules – feed forward networks – supervisedlearning – perception networks – adaline – madaline – back propagation networks – learning factors – linear separability –Hopfield network – discrete Hopfield networks.

ARCHITECTURE – TYPES:Recurrent auto association memory – bi-directionalassociative memory – temporal associative memory – Boltzmann machine Hamming networks – self – organizing feature maps – adaptive resonance theory network – Instar – Outsar model – counter propagation network– radial basis function networks

INTRODUCTION TO FUZZY SETS AND SYSTEMS: Crisp set – vaguness – uncertainty and imprecision – fuzzy set – fuzzy operation- properties – crisp versus fuzzy relations – fuzzy relation – cardinality operations, properties – fuzzy Cartesian product and composition – non – interactive fuzzy sets – tolerance and equivalence relations – fuzzy ordering relations – fuzzy morphism – composition of fuzzy relations

FUZZY LOGIC CONTROLLER: Fuzzyto crisp conversion – Lambda cuts for fuzzy sets and relations – definition methods – structure of fuzzy logic controller – database – rule base – Inference engine

APPLICATION AND DESIGN:Applications of Neural network and Fuzzy system for single phase fully controlled converter, single phase ac voltage controller, DC Drive and ACDrive

Designing of controllers using Simulation Software Fuzzy Logic Toolbox – Modeling of DC Machines usingSimulation Software and Simulink Toolbox

Books:

1. Lawrence Fausatt, "Fundamentals of neural networks", Prentice Hall of India, New Delhi, 1994.
2. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", McGraw Hill International Edition, USA, 1997.
3. Bart kosko, " Neural Networks and Fuzzy Systems", Prentice Hall of India, New Delhi, 1994

PED-301(e): Modeling and Control of Wind Energy Generation :

Electricity Generation from Wind Energy- Wind Farms , Wind Energy-generating Systems , Wind Turbines , Wind Turbine Architectures , Wind Generators Compared with Conventional Power Plant, impacts, Grid Code Regulations for the Integration of Wind Generation ,

Power Electronics for Wind Turbines: Soft-starter for FSIG Wind Turbines, Voltage Source Converters (VSCs), Application of VSCs for Variable-speed Systems, VSC with a Diode Bridge,

Modeling of Synchronous Generators, Generator Equations in thedqFrame, control.

Fixed-speed Induction Generator (FSIG)-based WindTurbines.FSIG Model as a Voltage Behind a Transient, Dynamic Performance of FSIG Wind Turbines, Small Disturbances, performance.

Doubly Fed Induction Generator (DFIG)-based Wind Turbines: Configuration, Characteristics, Control Strategies for a DFIG, Steady-state, Control for Optimum Wind Power Extraction, Dynamic Performance Assessment, Fully Rated Converter-based (FRC) Wind Turbines, FRC Induction Generator-based (FRC-IG) Wind Turbine.

Influence of Rotor Dynamics on Wind Turbine Operation: Blade Bending Dynamics , derivation, example, assessment.

Influence of Wind Farms on Network DynamicPerformance, Dynamic Stability and its Assessment .

Books:

WIND ENERGY GENERATION: Modeling and Control, Olimpo Anaya-Lara, University of Strathclyde, Glasgow, UK, Nick Jenkins, Cardiff University, UK, JanakaEkanayake, Cardiff University, UK, Phill Cartwright, Rolls-Royce plc, UK, Mike Hughes, Consultant and Imperial College London, UK, A John Wiley and Sons, Ltd., Publication,

PED-301(f)Modeling and Simulation of Systems Using MATLAB and Simulink :

Introduction to Systems: System ,Boundary, Components, Interactions, Classification of Systems, Analysis of Systems, Synthesis of Systems,

Systems Modeling: Introduction , need, method, Classification- Physical , Abstract Model, Mathematical , Descriptive ,Static, Dynamic , Steady State, Transient , Open, Feedback, Deterministic, Stochastic , Continuous, Discrete Model, Model Evaluation, Mathematical Modeling of Mechanical, Electrical, Electromechanical Systems.
Formulation of State Space Model of Systems: Computation of Parameters of a Component, Single Port and Multiport Systems, Techniques of System Analysis, Formulation of System Model for Physical Systems, Development of State Model of Degenerative System, Solution of State Equations, Controllability, Observability, Sensitivity, Liapunov Stability.
Model Order Reduction: Need, principle, method, application.
Analogous of Linear Systems: D'Alembert'sPrinciple,Force–Voltage Analogy, Force–Current analogy
Interpretive Structural Modeling: Graph Theory, modeling.
System Dynamics Techniques: System dynamics , Traditional Management, Sources of Information, System Dynamics Technique, Dynamo Equations.
Simulation: Introduction, Advantages, Numerical Methods, Comparison, error.
Nonlinear and Chaotic System: Linear vs. Nonlinear System , Types of Nonlinearities, Nonlinearities in Flight Control of Aircraft, different controllers (P, I, D, PD, PI, PID, and Fuzzy) design, Chaotic System, Bifurcations, Lorenz Equation: A Chaotic Water Wheel.
Modeling with Artificial Neural Network: Neuron, Characteristics, Selection ,Testing Phase, application.
Modeling Using Fuzzy Systems: Sets, features, operations, characteristics, relation, Approximate Reasoning, Defuzzification Methods, Fuzzy Rule-Based Systems, Applications of Fuzzy Systems to System Modeling, Steady State DC Machine Model, Transient Model of a DC Machine.
Discrete-Event Modeling and Simulation: Definitions, Queuing System, Discrete-Event System Simulation, Components, Modeling, test.
Books :
Modeling and Simulation of Systems Using MATLAB and Simulink , Dr. D.K. Chaturvedi, CRC press.

PED-301(g): CONDITION MONITORING OF ELECTRICAL EQUIPMENTS

1. **Introduction:**Review of Today's Industry and Role of Condition Monitoring. 01
2. **Maintenance Management and Applied Strategies:**Maintenance Management Systems, Basic Principals of Maintenance Strategies – Preventive Maintenance, Predictive Maintenance, Proactive Maintenance, Reliability Centered Maintenance, Total Productive Maintenance. Structure of the Maintenance Management System – Maintenance Objectives, Assets Management, Human Resources in Maintenance, Spare Parts Management, Determination of Maintenance (Strategy) Per Equipment. 03
3. **Condition Monitoring and Diagnostics of Transformer:**Introduction, Transformer Diagnostics, Transformer Maintenance.**Dissolved Gas Analysis** – Background, Transformer Diagnosis Using Individual and Total Dissolved Key Gas Concentrations, Diagnosing a Transformer Problem Using Dissolved Gas Analysis and the Duval Triangle, Expertise Needed. **Oil Physical / Chemical Tests** – Transformer Oil Tests that should be performed annually with the Dissolved Gas Analysis, Dielectric Strength, Interfacial Tension (IFT), Acid Number, Furans, Oxygen, Oxygen Inhibitor, Oil Power Factor, Moisture. **Age Test on Insulation** – Insulation Power Factor Test, Capacitance Tests, Excitation Current Test, Bushing Tests, Percentage Impedance / Leakage Reactance Test, Sweep Frequency Response Analysis Tests.**Dielectric Response Measurement:** Polarization Mechanisms in Dielectrics, Dielectric Response in Time-Domain. **Polarisation and Depolarisation Current (PDC) Measurement, PDC Measurement** – Test Set Up and Typical Results.Recovery Voltage Measurement (RVM), RVM Fundamentals, Polarization Spectrum, Typical RVM Results. Frequency Domain Spectroscopy (FDS), FDS equipment and analysis. Visual Inspection – Background, Temperature Indicators Online, Temperature Indicators Offline, Conservator, Conservator Breather, Nitrogen, Oil Leaks, Pressure Relief Device, Oil Pumps, Fans and Radiators, Buchholz Relay, Bladder Failure Relay. 15
4. **Condition Monitoring of Rotating Electrical Machines:Construction, operation and failure modes of electrical machines –** Introduction, Materials and temperature, Construction of electrical machines –**Structure of**

electrical machines and their types, Machine specification and failure modes, **Insulation ageing mechanism** – General, Thermal ageing, Electrical ageing, Mechanical Ageing, Environmental ageing, Synergism between ageing stresses. **Insulation Failure modes** – General, Stator winding insulation, Stator winding faults, Rotor winding faults.Other failure modes – Stator core faults, Connection faults (High-voltage motors and generators), Water coolant faults (all machines), Bearing faults, Shaft voltages. Conclusion.Instrumentation requirements – Introduction, Temperature measurement, Vibration measurement – General, Displacement transducers, Velocity transducers, Accelerometers. Force and torque measurement, Electrical and magnetic measurement, Wear and debris measurement, Signal conditioning, Data acquisition Conclusion. **Temperature Monitoring** – Introduction, Local temperature measurement, Hot-spot measurement and thermal images, Bulk measurement, conclusion**. Vibration monitoring –** Introduction, Stator core response – General, Calculation of natural modes, Stator electromagnetic force wave.Stator end-winding response, Rotor response – Transverse response, Torsional response.Bearing response – General, Rolling element bearings, Sleeve bearings. Monitoring techniques – Overall level monitoring, Frequency spectrum monitoring, Faults detectable from the stator force wave, Torsional oscillation monitoring, Shock pulse monitoring. Conclusion.**Electrical techniques: current, flux and power monitoring-** Introduction, Generator and motor stator faults – Generator stator winding fault detection, Stator current monitoring for stator faults, Brush gear fault detection, Rotor-mounted search coils. Generator rotor faults – General, Earth leakage faults on-line, and Turn-to-turn and earth leakage faults off-line. Motor rotor faults – General, Airgap search coils, Stator current monitoring for rotor faults, Rotor current monitoring. 15

5. **Recent developments in the field of Condition Monitoring**:Use of Statistical, Digital Signal Processing and data processing tools in condition assessment and health monitoring of electrical equipments. 12

Reference Books:

1. ZhaklinaStamboliska, Eugeniusz Rusinski, PrzemyslawMoczko, “Proactive Condition Monitoring of Low-Speed Machines”, Springer International Publishing Switzerland 2015.
2. Hydroelectric Research and Technical Services Group, “Facilities Instructions, Standards, and Techniques (FIST) Volume 3-31, Transformer Diagnostics”, United States Department of the Interior, Bureau of Reclamation, June 2003.
3. Peter Tavner, Li Ran, Jim Penman, Howard Sedding, “Condition Monitoring of Rotating Electrical Machines”, The Institution of Engineering and Technology, London, United Kingdom, 2008.
4. Hamid A. Toliyat, Subhasis Nandi, Seungdeog Choi, HomayounMeshgin-kelk “Electric Machines Modeling, Condition Monitoring and Fault Diagnosis”, CRC Press, Taylor & Francis Group.
5. Kulkarni S. V. and Khaparde S. A., “Transformer Engineering – Design, Technology and Diagnostics” 2nd Edition, CRC Press, New York.

OEL-301: One from the pool of Open Elective subjects

OPEN ELECTIVES:

(a) Business Analytics: Unit1: Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organisation, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modeling, sampling and estimation methods overview.

Unit 2: Trendiness and Regression Analysis: Modeling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

Unit 3: Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring, Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modeling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modeling, nonlinear Optimization.

Unit 4: Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.
Unit 5: Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.
Unit 6: Recent Trends in : Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.
Reference:
1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans,Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education.

OPEN ELECTIVES:
(b) Industrial Safety: Unit-I: Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.
Unit-II: Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.
Unit-III: Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.
Unit-IV: Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, iv. Electrical motors, Types of faults in machine tools and their general causes.
Unit-V: Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance
Reference:
1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

Open Elective:
(c) Cost Management of Engineering Projects: Introduction and Overview of the Strategic Cost Management Process Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity. cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.
Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities.Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts.Types and contents. Project execution Project cost control. Bar

charts and Network diagram. Project commissioning: mechanical and process Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems.Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector.Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints.Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis.Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets.Measurement of Divisional profitability pricing decisions including transfer pricing. Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

References:

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4.Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

Open Elective:

(d) Composite Materials:

UNIT–I: INTRODUCTION: Definition – Classification and characteristics of Composite materials. Advantages and application of composites.Functional requirements of reinforcement and matrix.Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT – II: REINFORCEMENTS: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. IsostrainandIsostress conditions.

UNIT – III: Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostaticpressing.Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

UNIT–IV: Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

UNIT – V: Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

TEXT BOOKS:

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

References:

1. Hand Book of Composite Materials-ed-Lubin.
2. Composite Materials – K.K.Chawla.
3. Composite Materials Science and Applications – Deborah D.L. Chung.
4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

Open Elective:

(e) Waste to Energy:

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

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

Unit-III: Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.
Unit-IV: Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.
Unit-V: Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion . Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production -Urban waste to energy conversion - Biomass energy programme in India.

References:

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. Were Ko-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

OPEN ELECTIVES:

(f) Operations Research:

Unit 1: Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models
Unit 2 Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method sensitivity analysis - parametric programming
Unit 3: Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT
Unit 4: Scheduling and sequencing - single server and multiple server models - deterministic inventory models- probabilistic inventory control models - Geometric Programming.
Unit 5: Competitive Models,Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation.

References:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5.Pannerselvam, Operations Research: Prentice Hall of India 2010

Third Semester:

PED-381: Major Project Phase-I Dissertation

Project work will be done by the students. At the end of the semester a seminar is to be given on the progress of the project work.

Fourth Semester:

PED-481: Major Project Phase-II Dissertation

Given project work is to be completed and there will be a seminar after the completion of the project work.
