M.E POWER SYSTEMS ENGINEERING

CURRICULUM & SYLLABI 2023

(REGULAR PROGRAMME)

Department of Electrical and Electronics Engineering

FACULTY OF ENGINEERING

KARPAGAM ACADEMY OF HIGHER EDUCATION

(Deemed to be University)

(Established Under Section 3 of UGC Act, 1956)

Pollachi Main Road, Eachanari Post,

Coimbatore- 641 021,India.

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEEIRNG
FACULTY OF ENGINEEIRNG
PG PROGRAM (CBCS) – M.E POWER SYSTEMS ENGINEERING (FULL TIME)
(2023-2024 Batch and onwards)

Course Code	Name of the Course	Category	Objectives and out comes		Instruction hours / week			Credit(s)	Maximum Marks			Page No.
			PEOs	POs	L	T	P		CIA	ESE	Total	
SEMESTER I												
23MEPS101	Power System Analysis	PCC	1,2,3	a,b, d,f	**3**	**0**	**0**	**3**	**40**	**60**	**100**	7
23MEPS102	Power System Dynamics-I	PCC	1,2,4	a,b, d,f	**3**	**0**	**0**	**3**	**40**	**60**	**100**	8
23MEPS103 A/B/C/D	Renewable Energy System/ Smart Grids/ High Power Converters/ Wind and Solar Systems	PE	1,2,4	a,b, d,f	**3**	**0**	**0**	**3**	**40**	**60**	**100**	9/10/ 12/1 3
23MEPS104 A/B/C/D	Electrical Power Distribution System/ Mathematical Methods for Power Engineering/ Pulse Width Modulation for PE Converters/ Electric and Hybrid Vehicles	PE	1,2,4	a,b, d,f	**3**	**0**	**0**	**3**	**40**	**60**	**100**	14/1 6/18/ 19

23MEPS105	Research Methodology and IPR	HSMC	1,2,4	a,b, d,f	**3**	**0**	**0**	**2**	**40**	**60**	**100**	21
23MEPS111	Power System Steady State Analysis Lab	PCC	1,2,3	a,b, d,f	**0**	**0**	**3**	**2**	**40**	**60**	**100**	23
23MEPS112 A/B	Power System Dynamics Lab/ Renewable Energy Lab	PCC	1,2,3	a,b, d,f	**0**	**0**	**3**	**2**	**40**	**60**	**100**	24
VAC 23MEPS151 A/B/C/D (Audit 1)	English for Research Paper Writing/ Disaster Management/ Sanskrit for Technical Knowledge/ Value Education	OE	1,2,3	a,b, d,f	**0**	**0**	**3**	**2**	**100**	**0**	**100**	
Total					**15**	**0**	**9**	**20**	**380**	**420**	**800**	
SEMESTER II												
23MEPS201	Digital Protection of Power System	PCC	1,2,3	a,b, d,f	**3**	**0**	**0**	**3**	**40**	**60**	**100**	25
23MEPS202	Power System Dynamics-II	PCC	1,2,3	a,b, d,f	**3**	**0**	**0**	**3**	**40**	**60**	**100**	27
23MEPS203 A/B/C/D	Restructured Power Systems/ Advanced Digital Signal Processing/ Dynamics of Electrical Machines/ Power Apparatus Design	PE	1,2,3	a,b, d,f	**3**	**0**	**0**	**3**	**40**	**60**	**100**	28/29/31/33

23MEPS204 A/B/C/D	Advanced Micro-Controller Based Systems/ SCADA System and Applications/ Power Quality/ Artificial Intelligence Techniques	PE	1,2,3	a,b, d,f	**3**	**0**	**0**	**3**	**40**	**60**	**100**	35/ 37/ 39/ 41
23MEPS211 A/B/C	Power System Protection Lab/ Power Quality Lab/ Artificial Intelligence Lab/	PCC	1,2, 3	a,b, d,f	**0**	**0**	**3**	**2**	**40**	**60**	**100**	42
VAC 23MEPS251 A/B/C/D (Audit 2)	Constitution of India/ Pedagogy Studies/ Stress Management by Yoga/ Personality Development through Life Enlightenment Skills	HS MC	1,2, 3	a,b, d,f	**0**	**0**	**3**	**2**	**100**	**0**	**100**	
Total					**12**	**0**	**6**	**16**	**300**	**300**	**600**	
SEMESTER- III												
23MEPS301 A/B/C	Power System Transients/ FACTS and Custom Power Devices/ Industrial Load Modeling and Control	PCC	1,2,3	a,b, d,f	**3**	**0**	**0**	**3**	**40**	**60**	**100**	43/ 45/ 47
23MEPS302 A/B/C/D/E/F	Business Analytics/ Industrial Safety/ Operations Research/ Cost Management of Engineering Projects/ Composite	OE	1,2,3	a,b, d,f	**3**	**0**	**0**	**3**	**40**	**60**	**100**	48/ 50/ 52/ 54/ 56/ 58

	Materials/ Waste to Energy											
23MEPS391	Phase – I Dissertation	PCC			**0**	**0**	**9**	**10**	**40**	**60**	**100**	
Total					**6**	**0**	**9**	**16**	**120**	**180**	**300**	
SEMESTER -IV												
23MEPS491	Phase-II Dissertation	PCC			**0**	**0**	**18**	**12**	**120**	**180**	**300**	
Total					**0**	**0**	**18**	**12**	**120**	**180**	**300**	
Program Total					**33**	**0**	**42**	**64**	**920**	**1080**	**2000**	

L: Lecture Hour **T**: Tutorial Hour **CIA**: Continuous Internal Assessment

P: Practical Hour **C**: No. of Credits **ESE**: End Semester Examinations

PCC – Programme Core Course **PE** - Program Elective

OE – Open Elective **HSMC**-Humanities, Social Science and Management Course

**--Skill Development

**--Employability

**--Entrepreneurship

Program Outcomes:

On successful completion of the programme,

a. Graduates will be able to demonstrate the principles and practices of the electrical power industry regarding generation, transmission, distribution and electrical machines and their controls.
b. Graduates will be able to apply their knowledge of electrical power principles, as well as mathematics and scientific principles, to new applications in electrical power.
c. Graduates will be able to perform, analyze, and apply the results of experiments to electrical power application improvements.
d. Graduates will be able to look at all options in design and development projects and creativity and choose the most appropriate option for the current project.
e. Graduates will function effectively as a member of a project team.
f. Graduates will be able to identify problems in electrical power systems, analyze the problems, and solve them using all of the required and available resources.
g. Graduates will be able to effectively communicate technical project information in writing or in personal presentation and conversation.
h. Graduates will be engaged in continuously learning the new practices, principles, and techniques of the electrical power industry.
i. Graduates will work on application software packages for power system analysis and design.
j. Graduates will develop indigenous software packages for power system planning and operational problems of utilities.

Program Specific Outcomes (PSOs)

k. Graduates will be able to demonstrate the principles and practices of the electricalpower industry regarding generation, transmission, distribution and electrical machines and their controls.
l. Graduates will be able to apply their knowledge of electrical power principles, as well as mathematics and scientific principles, to new applications in electrical power.
m. Graduates will be engaged in continuously learning the new practices, principles, and techniques of the electrical power industry.

Programme Educational Objectives (PEOs)

PEO 1: To prepare the students to have career in the electrical power Industry/research organization/teaching.

PEO 2: To provide good foundation in mathematics and computational technology to analyze and solve problems encountered in electrical power industry.

PEO 3: Pursue lifelong learning and continuous improvement of their knowledge in the electrical power industry.

PEO 4: To understand the national and global issues related to the electrical power industry and to be considerate of the impact of these issues on the environment and within different cultures.

PEO 5:Apply the highest professional and ethical standards to their activities in the electrical power industry.

PEO 6:To provide the students with knowledge to be involved with the technology advancements and future developments in power generation, control and management as well as with alternate and new energy resources.

Program Educational Objective	Program Outcome												
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**m**
PEO 1	√	√	√	√	√	√	√	√	√	√	√	√	√
PEO 2	√	√	√	√	√			√	√	√	√	√	√
PEO 3								√			√	√	√
PEO 4	√		√	√		√		√	√	√	√	√	√
PEO 5	√	√	√	√		√		√	√	√	√	√	√
PEO 6	√	√	√	√	√	√	√	√	√	√	√	√	√
PEO 7	√	√	√	√		√		√	√	√	√	√	√

23MEPS101	**POWER SYSTEM ANALYSIS**	**Semester– I**
		3H-3C
Instruction Hours/week: L:3 T:0 P:0	**Marks: Internal:40 External:60 Total:100**	
	End Semester Exam:3 Hours	

Course Objectives:

1. Study of load flow analysis
2. Study and Development of fault analysis
3. Modeling of security analysis
4. open conductors' faults
5. Tracking state estimation
6. power flow solution

Course Outcomes:

Students will be able to:

1. Understand the fast-decoupled methods
2. Analyze Simultaneous faults
3. Understand Security state diagram
4. Carry out REI equivalents
5. Understand Voltage Stability
6. Analyze optimal multiplies load flow

Unit I

Load flow: Overview of Newton-Raphson, Gauss-Siedel - fast decoupled methods, on vergence properties, sparsity techniques, handling Q- max violations in constant matrix, inclusion in frequency effects - AVR in load flow, handling of discrete variable in load flow.

Unit II

Fault Analysis: Simultaneous faults, open conductors' faults, generalized method of fault analysis.

Unit III

Security Analysis: Security state diagram, contingency analysis, generator shift distribution factors, line outage distribution factor, multiple line outages, overload index ranking

Unit IV

Power System Equivalents: WARD – REI equivalents - State Estimation: Sources of errors in measurement - Virtual and Pseudo, Measurement, Observability

Unit V

Tracking state estimation,WSL method, bad data correction - Voltage Stability : Voltage collapse, P-V curve, multiple power flow solution, continuation power flow, optimal multiplies load flow, voltage collapse proximity indices.

Suggested reading

1. J.J. Grainger &W.D.Stevenson, "Power system analysis ", McGraw Hill ,2003
A. R. Bergen & Vijay Vittal , "Power System Analysis" ,Pearson ,2000
L.P. Singh , "Advanced Power System Analysis and Dynamics", New Age International,2006
G.L. Kusic, "Computer aided power system analysis" ,Prentice Hall India,1986
A.J. Wood, " Power generation, operation and control" , John Wiley,1994
P.M. Anderson, "Faulted power system analysis" , IEEE Press ,1995

23MEPS102	**POWER SYSTEM DYNAMICS - I**	**Semester– I**
		3H-3C
Instruction Hours/week: L:3 T:0 P:0	**Marks: Internal:40 External:60 Total:100**	
	End Semester Exam:3 Hours	

Course Objectives:

1. Study of system dynamics and its physical interpretation
2. Development of mathematical models for synchronous machine
3. Modeling of induction motor
4. Understand the stability analysis with power system stabilizer
5. Carry out stability analysis without power system stabilizer(PSS)
6. Understand the load modeling in power system

Course Outcomes:

Students will be able to:

1. Understand the modeling of synchronous machine in details
2. Understand the formulation of state space equation
3. Carry out simulation studies of power system dynamics using MATLAB-SIMULINK, MI POWER
4. Carry out stability analysis with power system stabilizer(PSS)
5. Carry out stability analysis without power system stabilizer(PSS)
6. Understand the load modeling in power system

Unit I **8**

Synchronous Machines: Per unit systems, Park's Transformation (modified), Flux-linkage equations.

Unit II **8**

Voltage and current equations, Formulation of State-space equations, Equivalent circuit.

Unit III **6**

Sub-transient and transient inductance and Time constants, Simplified models of synchronous machines

Unit IV **10**

Small signal model: Introduction to frequency model, Excitation systems and Philips-Heffron model, PSS Load modeling.

Unit V **6**

Modeling of Induction Motors, Prime mover controllers.

Suggested reading:-

1. P. M. Anderson &A. A. Fouad "Power System Control and Stability", Galgotia , New Delhi, 1981
2. J Machowski, J Bialek& J. R W. Bumby, "Power System Dynamics and Stability", John Wiley & Sons,1997
3. P.Kundur, "Power System Stability and Control", McGraw Hill Inc.,1994.
4. E.W. Kimbark, "Power system stability", Vol. I & III, John Wiley & Sons, New York2002

23MEPS103A	RENEWABLE ENERGY SYSTEM	Semester– I 3H-3C
Instruction Hours/week: L:3 T:0 P:0	Marks: Internal:40 External:60 Total:100	End Semester Exam:3 Hours

Course Objectives:

1. To learn various renewable energy sources
2. To gain understanding of integrated operation of renewable energy sources
3. To understand Power Electronics Interface with the Grid
4. Power Electronic Interface
5. Impact of Distributed Generation
6. Protection of Distributed Generators

Course Outcomes:

Students will be able to:

1. Knowledge about renewable energy
2. Understand the working of distributed generation system in autonomous/grid connected modes
3. Know the Impact of Distributed Generation on Power System
4. Understand the concept of DG
5. Knowledge about Impact of Distributed Generation
6. Understand the concept of Transmission System Operation

Unit I **8**

Introduction, Distributed vs Central Station Generation, Sources of Energy such as Micro-turbines, Internal Combustion Engines.

Unit II **8**

Introduction to Solar Energy, Wind Energy, Combined Heat and Power, Hydro Energy, Tidal Energy, Wave Energy, Geothermal Energy, Biomass and Fuel Cells.

Unit III

Power Electronic Interface with the Grid

Unit IV **8**

Impact of Distributed Generation on the Power System, Power Quality Disturbances

Unit V **8**

Transmission System Operation, Protection of Distributed Generators - Economics of Distributed Generation

Suggested reading

1. RanjanRakesh, Kothari D.P, Singal K.C, “Renewable Energy Sources and Emerging Technologies”,
2nd Ed. Prentice Hall of India ,2011
2. Math H.Bollen, Fainan Hassan, “Integration of Distributed Generation in the Power System”, July 2011,
Wiley –IEEE Press
3. Loi Lei Lai, Tze Fun Chan, “Distributed Generation: Induction and Permanent Magnet Generators”,
October 2007, Wiley-IEEE Press.
4. Roger A.Messenger, Jerry Ventre, “Photovoltaic System Engineering”, 3rd Ed, 2010

23MEPS103B	SMART GRIDS	Semester– I 3H-3C
Instruction Hours/week: L:3 T:0 P:0		Marks: Internal:40 External:60 Total:100 End Semester Exam:3 Hours

Course Objectives:

1.Understand concept of smart grid and its advantages over conventional grid
2.Know smart metering techniques
3.Learn wide area measurement techniques
4.Understanding the problems associated with integration of distributed generation & its solution through smart grid.
5. Learn Web based Power Quality monitoring
6. Understand Wide Area Network (WAN)

Course Outcomes

Students will be able to:

1.Appreciate the difference between smart grid & conventional grid
2.Apply smart metering concepts to industrial installations
3. Apply smart metering concepts to commercial installations
4.Formulate solutions in the areas of smart substations,distributed generation and wide area measurements
5.Come up with smart grid solutions using modern communication technologies
6. Understand the concept of Power Quality & EMC in Smart Grid

Unit I **8**

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

Unit II **8**

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.

Unit III

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) 8

Unit IV

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 8

Unit V

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, Advanced Metering Infrastructure (AMI), Home Area Network (HAN), Neighborhood Area, Network (NAN), Wide Area Network (WAN)

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 Borlase, "Smart Grid: Infrastructure, Technology and solutions " CRC Press
5.A.G.Phadke, "Synchronized Phasor Measurement and their Applications", Springer

23MEPS103C	**HIGH POWER CONVERTERS**	**Semester– I**
		3H-3C
Instruction Hours/week: L:3 T:0 P:0	**Marks: Internal:40 External:60 Total:100**	
	End Semester Exam:3 Hours	

Course Objectives:

1.Understand the requirements of high-power rated converters
2.Understand the different topologies involved for these converters
3.Able to understand the design of protection circuits for these converters
4. To get exposure to Phase shifting transformers
5. To get exposure to Diode clamped multilevel inverters
6. 6.To get exposure to Cyclo-converters

Course Outcomes: -

Students will be able to:

1.Learn the characteristics of PSDs such as SCRs, GTOs, IGBTs and use them in practical systems
2.Knowledge of working of multi-level VSIs,
3. Knowledge of working of DC-DC switched mode converters,
4. Knowledge of working of cyclo-converters and PWM techniques and the ability to usethem properly
5. Acquire knowledge of power conditioners and their applications
6. Ability to design power circuit and protection circuit of PSDs and converters

Unit I

Power electronic systems, An overview of PSDs, multipulse diode rectifier, multipulse, SCR rectifier. 6

Unit II

Phase shifting transformers, multilevel voltage source inverters: two level voltage source inverter,cascaded, H bridge multilevel inverter. 8

Unit III

Diode clamped multilevel inverters, flying capacitor multilevel inverter 6

Unit IV

PWM current source inverters,DC to DC switch mode converters, AC voltage controllers : Cyclo-converters, matrix converter,Power conditioners and UPS. 8

Unit V

Design aspects of converters, protection of devices and circuits 6

Suggested reading

1.N. Mohan, T. M. Undeland and W. P. Robbins, “Power Electronics: Converter, Applications and Design”,John Wiley and Sons, 1989
2.M.H. Rashid, “Power Electronics”, Prentice Hall of India, 1994
3.B. K .Bose, “Power Electronics and A.C. Drives”, Prentice Hall, 1986
4.Bin Wu, “High power converters and drives”, IEEE press, Wiley Enter science

23MEPS103D	WIND AND SOLAR SYSTEMS	Semester– I 3H-3C
Instruction Hours/week: L:3 T:0 P:0	Marks: Internal:40 External:60 Total:100 End Semester Exam:3 Hours	

Course Objectives:

1. To get exposure to wind and solar systems
2. To understand the factors involved in installation and commissioning of a Solar or Wind plant.

Learning the

3. dynamics involved when interconnected with power system grid
4. Impacts on power system dynamics
5. PV power generation
6. Designing the solar system for small installations.

Course Outcomes: -

Students will be able to:

1. Appreciate the importance of energy growth of the power generation from the renewable energy sources and participate in solving these problems
2. Demonstrate the knowledge of the physics of wind power and solar power generation and all associated issues so as to solve practical problems
3. Demonstrate the knowledge of physics of solar power generation and the associated issues

4.Identify, formulate and solve the problems of energy crises using wind and solar energy

5. Understand the concept of Isolated wind systems
6. Understand the concept of Energy Storage device

Unit I

Historical development and current status, characteristics of wind power generation, network integration issues

Unit II

Generators and power electronics for wind turbines,power quality standards for wind turbines,Technical regulations for interconnections of wind farm with power systems.

Unit III

Isolated wind systems,reactive power and voltage control,economic aspects.

Unit IV

Impacts on power system dynamics,power system interconnection

Unit V

Introduction of solar systems,merits and demerits, concentrators, various applications.Solar thermal power generation,PV power generation,Energy Storage device.Designing the solar system for small installations.

Suggested reading

1. Thomas Ackermann, Editor, “Wind power in Power Systems”, John Willy and sons ltd.2005
2. Siegfried Heier, “Grid integration of wind energy conversion systems”, John Willy and sons ltd., 2006
3. K. Sukhatme and S.P. Sukhatme, “Solar Energy”. Tata MacGraw Hill, Second Edition, 1996

23MEPS104A ELECTRICAL POWER DISTRIBUTION SYSTEM Semester– I
3H-3C

Instruction Hours/week: L:3 T:0 P:0 Marks: Internal:40 External:60 Total:100
End Semester Exam:3 Hours

Course Objectives:

1. Learning about power distribution system
2. Learning of SCADA System Understanding
3. Distribution Automation
4. SCADA
5. Calculation of Optimum Number of Switches
6. AI techniques applied to Distribution Automation

Course Outcomes:

Students will be able to:

1. Knowledge of power distribution system
2. Study of Distribution automation and its application in practice
3. To learn SCADA system
4. To learn Interconnection of Distribution
5. To understand SCADA
6. Study of Calculation of Optimum Number of Switches

Unit I 8

Distribution of Power, Management, Power Loads, Load Forecasting Short-term & Long- term, Power System Loading, Technological Forecasting.

Unit II 8

Advantages of Distribution Management System (D.M.S.), Distribution Automation: Definition, Restoration / Reconfiguration of Distribution Network, Different Methods and Constraints, Power Factor Correction

Unit III 8

Interconnection of Distribution, Control & Communication Systems, Remote Metering, Automatic Meter Reading and its implementation 8

Unit IV 8

SCADA: Introduction, Block Diagram, SCADA Applied To Distribution Automation - Common Functions of SCADA, Advantages of Distribution Automation through SCADA

Unit V 8

Calculation of Optimum Number of Switches, Capacitors, Optimum Switching Device Placement in Radial, Distribution Systems, Sectionalizing Switches – Types, Benefits, Bellman's Optimality Principle, Remote Terminal Units, Energy efficiency in electrical distribution & Monitoring, Maintenance of Automated Distribution Systems Difficulties in Implementing Distribution. Automation in Actual Practice, Urban/Rural Distribution, Energy Management, AI techniques applied to Distribution Automation 6

Suggested reading

1. A.S. Pabla, "Electric Power Distribution", Tata McGraw Hill Publishing Co. Ltd., FourthEdition.

2. M.K. Khedkar, G.M. Dhole, “A Text Book of Electrical power Distribution Automation”, University Science Press, NewDelhi
3. Anthony J Panseni, “Electrical Distribution Engineering”, CRCPress
4. James Momoh, “Electric Power Distribution, automation, protection & control”, CRCPress

23MEPS104B	**MATHEMATICAL METHODS FOR POWER ENGINEERING**	**Semester– I 3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks: Internal:40 External:60 Total:100**
End Semester Exam:3 Hours

Course Objectives:

1. To understand the relevance of mathematical methods to solve engineering problems.
2. To understand how to apply these methods for a given engineering problem.To learn
3. Vector spaces
4. Eigen values and Eigen vectors of linear operator
5. Unconstrained Problems
6. Independent Random Variables

Course Outcomes:

Students will be able to:

1. Knowledge about vector spaces, linear transformation, eigenvalues and eigenvectors of linear operators
2. To learn about linear programming problems and understanding the simplex method for solving linear programming problems in various fields of science and technology
3. Acquire knowledge about nonlinear programming and various techniques used for solving constrained and unconstrained nonlinear programming problems
4. Understanding the concept of random variables, functions of random variable and their probability distribution
5. Understand stochastic processes
6. Understand the chastic classification

Unit I

Vector spaces - Linear transformations - Matrix representation of linear - transformation

Unit 2

Eigen values and Eigen vectors of linear operator - Linear Programming Problems - Simplex Method – Duality -Non-Linear Programming problems

Unit 3

Unconstrained Problems - Search methods - Constrained Problems - Lagrange method - Kuhn-Tucker conditions - Random Variables - Distributions

Unit 4

Independent Random Variables

Unit 5

Marginal and Conditional distributions - Elements of stochastic processes

Suggested reading

1. Kenneth Hoffman and Ray Kunze, “Linear Algebra”, 2nd Edition, PHI, 1992
2. Erwin Kreyszig, “Introductory Functional Analysis with Applications”, John Wiley & Sons, 2004
3. Irwin Miller and Marylees Miller, John E. Freund’s “Mathematical Statistics”, 6th Edn, PHI, 2002
4. J. Medhi, “Stochastic Processes”, New Age International, New Delhi., 1994

5. A Papoulis, “Probability, Random Variables and Stochastic Processes”, 3rd Edition, McGraw Hill, 2002
6. John B Thomas, “An Introduction to Applied Probability and Random Processes”, John Wiley, 2000

23MEPS104C	**PULSE WIDTH MODULATION FOR PE CONVERTERS**	**Semester-I 3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks: Internal:40 External:60 Total:100**
End Semester Exam:3 Hours

Course Objectives:

1. To understand Necessity and Importance of PWM techniques
2. Implementation of PWM controllers

To Learn

3. Modulation of single phase
4. Zero space vector placement modulation strategies
5. programme modulation strategies
6. Effect of minimum pulse width and dead time

Course Outcomes:

Students will be able to:

1. Appreciate importance of PWM techniques
2. Implement PWM using different strategies
3. Control CSI using PWM
4. Control VSI using PWM
5. Pulse width modulation for multilevel inverters
6. Compare performance of converter for different PWM techniques

Unit I 8

Introduction to PE converters, Modulation of one inverter phase leg, Modulation of single phase - VSI and 3 phase VSI

Unit II 8

Zero space vector placement modulation strategies, Losses-Discontinuous modulation, Modulation of CSI

Unit III 8

Over modulation of converters, programme modulation strategies

Unit IV 8

Pulse width modulation for multilevel inverters - Implementation of modulation controller

Unit V 8

Continuing developments in modulation as random PWM, PWM for voltage unbalance, Effect of minimum pulse width and dead time

Suggested reading

1.D. Grahame Holmes, Thomas A. Lipo, “Pulse width modulation of Power Converter: Principles and Practice”, John Wiley & Sons, 03-Oct-2003
2. Bin Vew, “High Power Converter”, Wiley Publication
3. Marian K. Kazimicrczuk, “Pulse width modulated dc-dc power converter”, Wiley Publication

23MEPS104D ELECTRIC AND HYBRID VEHICLES Semester-I
3H-3C

Instruction Hours/week: L:3 T:0 P:0 Marks: Internal:40 External:60 Total:100
End Semester Exam:3 Hours

Course Objectives:

1.To understand upcoming technology of hybrid system
2.To understand different aspects of drives application
3.Learning the electric Traction
To learn
4. Basics of vehicle performance
5. Fuel efficiency analysis.
6. drive system efficiency

Course Outcomes :-

Students will be able to:
1.Acquire knowledge about fundamental concepts, principles, analysis and design of hybrid and electric vehicles.
2.To learn electric drive in vehicles / traction.
3. Basic concept of hybrid traction
4. Configuration and control of DC Motor drives
5. drive system efficiency
6. Classification of different energy management strategies

Unit I **8**

History of hybrid and electric vehicles,Social and environmental importance of hybrid and electric vehicles Impact of modern drive-trains on energy supplies, Basics of vehicle performance,vehicle power sourcecharacterizationTransmission characteristics, Mathematical models to describe vehicle performance

Unit II 8

Basic concept of hybrid traction,Introduction to various hybrid drive-train topologies, Power flow control in hybrid drive-train topologies, Fuel efficiency analysis.

Unit II **8**

Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Introduction Motor drives configuration and control of Permanent Magnet Motor drives Configuration and control of Switch Reluctance, Motor drives, drive system efficiency

Unit IV **8**

Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics Selecting the energystorage technology, Communications, supporting subsystems,

Unit V 8

Introduction to energy management and their strategies used in hybrid and electric vehicle, Classification of different energy management strategies

Comparison of different energy management strategies Implementation issues of energy strategies

Suggested reading

1. Sira -Ramirez, R. Silva Ortigoza, "Control Design Techniques in Power Electronics Devices", Springer.
2. Siew-Chong Tan, Yuk-Ming Lai, Chi Kong Tse, "Sliding mode control of switching Power Converters"

23MEPS105 RESEARCH METHODOLOGY AND IPR Semester-I
3H-2C

Instruction Hours/week: L:3 T:0 P:0 Marks: Internal:40 External:60 Total:100
End Semester Exam:3 Hours

Course Objectives:

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

1. Understand research problem formulation.
2. Analyze research related information
3. Follow research ethics
4. Understand IPR
5. Understand Patent Rights
6. New Developments in IPR

Course Outcomes:

1. Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
2. Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
3. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.
4. Effective technical writing
5. Nature of Intellectual Property
6. Patent Rights

Unit 1

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

Unit 2

Effective literature studies approaches, analysis Plagiarism, Research ethics,

Unit 3

Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

Unit 4

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

Unit 5

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

Suggested reading

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

23MEPS111 POWER SYSTEM STEADY STATE ANALYSIS LAB Semester-I
3H-2C

Instruction Hours/week: L:0 T:0 P:3 Marks: Internal:40 External:60 Total:100
End Semester Exam:3 Hours

Experiments

1. Power Systems & Power Electronics Lab
2. Computer Simulation Lab
3. Simulation of IGBT Inverters.
4. Simulation of Thyristor Converters.
5. Transient Stability Studies.
6. Short Circuit Studies.
7. Load Flow Studies
8. Load Forecasting and Unit Commitment

23MEPS112A	POWER SYSTEM DYNAMICS LAB	Semester – I 3H-2C
Instruction Hours/week: L:0 T:0 P:3	Marks: Internal:40 External:60 Total:100 End Semester Exam:3 Hours	

S.No	Experiments
1	Power Curves
2	Build a Wind Farm
3	Test the Capabilities of the Hydrogen Fuel Cells and Capacitors

23MEPS112B	RENEWABLE ENERGY LAB	Semester – I 3H-2C
Instruction Hours/week: L:0 T:0 P:3	Marks: Internal:40 External:60 Total:100 End Semester Exam:3 Hours	

S.No	Experiments
1	Effect of Temperature on Solar Panel Output
2	Variables Affecting Solar Panel Output
3	Effect of Load on Solar Panel Output
4	Wind Turbine Output: The Effect of Load
5	Test the Capabilities of Solar Panels and Wind Turbines

23MEPS201 DIGITAL PROTECTION OF POWER SYSTEM Semester– II
3H-3C

Instruction Hours/week: L:3 T:0 P:0 Marks: Internal:40 External:60 Total:100
End Semester Exam:3 Hours

Course Objectives:

1. Study of numerical relays
2. Developing mathematical approach towards protection
3. Study of algorithms for numerical protection
4. Sample and first derivative (Mann and Morrison) algorithm
5. Digital Line Differential Protection
6. Recent Advances in Digital Protection of Power Systems

Course Outcomes

1. Learn the importance of Digital Relays
2. Apply Mathematical approach towards protection
3. Learn to develop various Protection algorithms
4. Learn to develop various Digital filtering.
5. Learn Walsh function-based algorithm
6. Understand Digital Line Differential Protection

Unit I

Evolution of digital relays from electromechanical relays-Performance and operational characteristics of digital protection

Unit II

Mathematical background to protection algorithms - Finite difference techniques

Unit III

Interpolation formulae-• Forward, backward and central difference interpolation- Numerical differentiation - Curve fitting and smoothing-Least squares method -Fourier analysis - Fourier series and Fourier transform - Walsh function analysis - Basic elements of digital protection - Signal conditioning: transducers, surge protection, analog filtering, analogmultiplexers

Unit IV

Conversion subsystem: the sampling theorem, signal aliasing- Error, sample and hold circuits, multiplexers, analog to digital conversion - Digital filtering concepts,The digital relay as a unit consisting of hardware and software - Sinusoidal wave based algorithms - Sample and first derivative (Mann and Morrison) algorithm.

Unit V

Fourier and Walsh based algorithms - Fourier Algorithm: Full cycle window algorithm, fractional cycle window algorithm. - Walsh function based algorithm.Least Squares based algorithms. Differential equation based algorithms.Traveling Wave based Techniques.Digital Differential Protection of Transformers. Digital Line Differential Protection.RecentAdvances in Digital Protection of Power Systems. 8

Suggested reading

1. A.G. Phadke and J. S. Thorp, “Computer Relaying for Power Systems”, Wiley/Research studies Press,2009

2. A.T. Johns and S. K. Salman, “Digital Protection of Power Systems”, IEEEPress,1999
3. Gerhard Zeigler, “Numerical Distance Protection”, Siemens Publicis Corporate Publishing, 2006 4.S.R.Bhide “Digital Power System Protection” PHI LearningPvt.Ltd.2014

23MEPS202 POWER SYSTEM DYNAMICS-II Semester– II
3H-3C

Instruction Hours/week: L:3 T:0 P:0 Marks: Internal:40 External:60 Total:100
End Semester Exam:3 Hours

Course Objectives:-

Students will be able to:

1. Study of power system dynamics
2. Interpretation of power system dynamic phenomena

Study of

3. various forms of stability
4. Multi-Machine Stability
5. Automatic Generation Control
6. Primary and Secondary Control

Course Outcomes:-

Students will be able to:

1. Gain valuable insights into the phenomena of power system including obscure ones.
2. Understand the power system stability problem.
3. Analyze the stability problems and implement modern control strategies.
4. Simulate small signal stability problems.
5. Simulate large signal stability problems.
6. Analyze Synchronous Resonance and Counter Measures

Unit - I

Basic Concepts of Dynamic Systems and Stability Definition - Small Signal Stability (Low Frequency Oscillations) of Unregulated and Regulated System

Unit - II

Effect of Damper, Flux Linkage Variation and AVR - Large Signal Rotor Angle Stability - Dynamic Equivalents And Coherency-Direct Method of Stability Assessment Stability Enhancing Techniques - Mitigation Using Power System Stabilizer 8

Unit III

Asynchronous Operation and Resynchronization - Multi-Machine Stability - Dynamic Analysis of Voltage Stability

Unit IV

Voltage Collapse - Frequency Stability - Automatic Generation Control

Unit V

Primary and Secondary Control - Sub-Synchronous Resonance and Counter Measures

Suggested reading

1. P. Kundur, “Power System Stability and Control”, McGraw Hill Inc, 1994
2. J. Machowski, Bialek, Bumby, “Power System Dynamics and Stability”, John Wiley & Sons, 1997
3. L. Leonard Grigsby (Ed.); “Power System Stability and Control”, Second edition, CRC Press, 2007
4. V. Ajjarapu, “Computational Techniques for voltage stability assessment & control”; Springer, 2006

23MEPS203A RESTRUCTURED POWER SYSTEMS Semester-II 3H-3C

Instruction Hours/week: L:3 T:0 P:0 Marks: Internal:40 External:60 Total:100
End Semester Exam:3 Hours

Course Objectives:

1. Understand what is meant by restructuring of the electricity market
2. Understand the need behind requirement for deregulation of the electricity market
3. Understand the money, power & information flow in a deregulated power system
4. Understand Risk assessment
5. To learn Tracing of power
6. Understans bidding

Course Outcomes:

Students will be able to:

1. Describe various types of regulations in power systems.
2. Identify the need of regulation
3. Identify the need of deregulation.
4. Define and describe the Technical and Non-technical issues in Deregulated Power Industry.

5 Identify and give examples of existing electricity markets.

6. Classify different market mechanisms and summarize the role of various entities in the market.

Unit I

Fundamentals of restructured system, Market architecture, Load elasticity, Social welfare maximization 8

Unit II

OPF: Role in vertically integrated systems and in restructured markets, congestion management 8

Unit III

Optimal bidding, Risk assessment, Hedging, Transmission pricing, Tracing of power 8

Unit IV

Ancillary services, Standard market design, Distributed generation in restructured markets 8

Unit V

Developments in India, IT applications in restructured markets, Working of restructured power systems, PJM, Recent trends in Restructuring 8

Suggested reading

1. LorrinPhilipson, H. Lee Willis, “Understanding electric utilities and de-regulation”, Marcel Dekker Pub.,1998.
2. Steven Stoft, “Power system economics: designing markets for electricity”, John Wiley and Sons, 2002.
3. Kankar Bhattacharya, Jaap E. Daadler, Math H.J. Boolen, “Operation of restructured power systems”, Kluwer Academic Pub., 2001.
4. Mohammad Shahidehpour, MuwaffaqAlomoush, “Restructured electrical power systems: operation, trading and volatility”, Marcel Dekker.

23MEPS203B ADVANCED DIGITAL SIGNAL PROCESSING Semester-II
3H-3C

Instruction Hours/week: L:3 T:0 P:0 Marks: Internal:40 External:60 Total:100
End Semester Exam:3 Hours

Course Objectives:

1. To understand the difference between discrete-time and continuous-time signals

To understand and apply

2. Discrete Fourier Transforms (DFT)
3. Linear convolution using DFT
4. FIR filter design
5. Arithmetic round-off errors
6. Optimum signal estimation

Course Outcomes:-

Students will be able to:

1. Knowledge about the time domain and frequency domain representations as well analysis of discrete time signals and systems
2. Study the design techniques for IIR and FIR filters and their realization structures.
3. Acquire knowledge about the finite word length effects in implementation of digital filters.
4. Knowledge about the various linear signal models and estimation of power spectrum of stationary random signals
5. Design of optimum FIR filters
6. Design of optimum IIR filters

Unit I

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 8

Unit II

Linear convolution using DFT, Computation of DFT Design of IIR digital filters from analog filters, Impulse invariance method, Bilinear transformation method 8

Unit III **8**

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 quantisation effects in IIR and FIR filters

Unit IV

A/D conversion noise- Arithmetic round-off errors, Dynamic range scaling, Overflow oscillations and zero Input limit cycles in IIR filters, Linear Signal Models 8

Unit V

All pole, All zero and Pole-zero models, Power spectrum estimation- Spectral analysis of deterministic signals Estimation of power spectrum of stationary random signals , Optimum linear filters, Optimum signal estimation, Mean square error estimation 6

Suggested reading

1. Sanjit K Mitra, “Digital Signal Processing: A computer-based approach “,TataMc Grow-Hill Edition1998
2. Dimitris G .Manolakis, Vinay K. Ingle and Stephen M. Kogon, “Statistical and Adaptive Signal Processing”, Mc Grow Hill international editions. -2000

23MEPS203C DYNAMICS OF ELECTRICAL MACHINES Semester-II 3H-3C

Instruction Hours/week: L:3 T:0 P:0 Marks: Internal:40 External:60 Total:100
End Semester Exam:3 Hours

Course Objectives:

1. Learn Performance characteristics of machine
2. To understand the dynamics of the machine
3. To understand how to determine stability of machine
4. Learn the synchronous machine

Learn the

5. Large Signal Transient
6. Synchronous Motor System

Course Outcomes: -

Students will be able to:

1:Formulation of electrodynamic equations of all electric machines and analyze the performance characteristics

2: Knowledge of transformations for the dynamic analysis of machines

3: Knowledge of determination of stability of the machines under small signal and transient conditions

4: Study about synchronous machine

5. Large Signal Transient
6. Small Oscillation Equations

Unit I

Stability,Primitive 4 Winding Commutator Machine, Commutator Primitive Machine Complete Voltage Equation of Primitive 4 Winding Commutator Machine 8

Unit II

Torque Equation Analysis of Simple DC Machines using the Primitive Machine Equations, The Three Phase Induction Motor, Transformed Equations, Different Reference Frames for Induction Motor Analysis Transfer Function Formulation 8

Unit III

Three Phase Salient Pole Synchronous Machine, Parks Transformation, Steady State Analysis 8

Unit IV

Large Signal Transient, Small Oscillation Equations in State Variable form, Dynamical Analysis of Interconnected Machines 8

Unit V

Large Signal Transient Analysis using Transformed Equations, DC Generator /DC Motor System, Alternator /Synchronous Motor System 8

Suggested reading

1. D.P. Sengupta& J.B. Lynn," Electrical Machine Dynamics", The Macmillan Press Ltd. 1980
2. R Krishnan "Electric Motor Drives, Modeling, Analysis, and Control", Pearson Education., 2001

3. P.C. Kraus, “Analysis of Electrical Machines”, McGraw Hill Book Company,1987
4. I. Boldia& S.A. Nasar,,”Electrical Machine Dynamics”, The Macmillan Press Ltd. 1992
5. C.V. Jones, “The Unified Theory of Electrical Machines”, Butterworth, London. 1967

23MEPS203D **POWER APPARATUS DESIGN** **Semester-II**
3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks: Internal:40 External:60 Total:100**
End Semester Exam:3 Hours

Course Objectives:

1.Study the modelling analysis of rotating machine.
2.Learning electromagnetic energy conversion
To know about
3. rating of machines.
4. leakage reactance and conductor size
5. electric and magnetic loadings
6. Types of alternators and comparison

Course Outcomes: -

Students will be able to:
1.To give a systematic approach for modeling and analysis of all rotating machines under both transient and steady state conditions with the dimensions and material used
2.Ability to model and design all types of rotation machines including special machines
3. Principles of Design of Machines
4. Specific loadings
5. choice of flux density and current density
6. Choice of specific electric and magnetic loadings

Unit I

Principles of Design of Machines -Specific loadings, choice of magnetic and electric loadings, Real and apparent flux densities, temperature rise calculation, Separation of main dimension for DC machines, Induction machines and synchronous machines, Design of Transformers-General considerations, output equation, emf per turn, choice of flux density and current density, main dimensions, leakage reactance and conductor size, design of tank and cooling 8

Unit II

Specific loadings, choice of magnetic and electric loadings Real and apparent flux -densities, temperature rise calculation, Separation of main dimension for DC machines
Induction machines and synchronous machines, Heating and cooling of machines, types of ventilation, continuous and intermittent rating 8

Unit III

General considerations, output equation, emf per turn, choice of flux density and current density, main dimensions, leakage reactance and conductor size, design of tank and cooling tubes, Calculation of losses, efficiency and regulation, Forces winding during short circuit 8

Unit IV

General considerations, output equation, Choice of specific electric and magnetic loadings, efficiency, power factor, Number of slots in stator and rotor, Elimination of harmonic torques 8

Unit V

Design of stator and rotor winding, slot leakage flux, Leakage reactance, equivalent resistance of Magnetizing current, efficiency from design data , squirrel cage rotor,

Types of alternators, comparison, specific loadings, output co-efficient, design of main dimensions - Introduction to Computer Aided Electrical Machine Design Energy efficient machines

10

Suggested reading

1. Clayton A.E, "The Performance and Design of D.C. Machines", Sir I. Pitman & sons, Ltd.
2. M.G. Say, "The Performance and Design of A.C. Machines ", Pitman
3. Sawhney A.K, "A course in Electrical Machine Design", DhanpatRai& Sons, 5th Edition

23MEPS204A **ADVA NCED MICRO-CONTROLLER BASED SYSTEMS** **Semester-II 3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks: Internal:40 External:60 Total:100**
End Semester Exam:3 Hours

Course Objectives:

1.To understand the architecture of advance microcontrollers
2.To understand the applications of these controllers
To get some introduction to
3. FPGA
4. Intel 8051
5. PIC 16F877
6. Digital Signal Processor

Course Outcomes: -

Students will be able to:
1.To learn how to program a processor in assembly language and develop an advanced processor based system
2.To learn configuring and using different peripherals in a digital system
3.To compile and debug a Program
4.To generate an executable file and use it
5. Intel 8051
6. PIC 16F877

Unit I

Basic Computer Organization - Accumulator based Processes-Architecture - Memory Organization-I/O Organization 8

Unit II

Micro-Controllers-Intel 8051,Intel 8056- Registers, Memories, I/O Ports, Serial Communication, Timers, Interrupts, Programming 8

Unit III

Intel 8051 – Assembly language programming, Addressing-Operations, Stack & Subroutines Interrupts-DMA 8

Unit IV

PIC 16F877- Architecture Programming, Interfacing Memory/ I/O Devices, Serial I/O and data communication 8

Unit V

Digital Signal Processor (DSP), Architecture – Programming, Introduction to FPGA - 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 Pub., 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 PIC18FSeries”, Elsevier, 2008

23MEPS204B SCADA SYSTEM AND APPLICATIONS Semester-II
3H-3C

Instruction Hours/week: L:3 T:0 P:0 Marks: Internal:40 External:60 Total:100
End Semester Exam:3 Hours

Course Objectives:

1. To understand what is meant by SCADA and its functions
2. To know SCADA communication
3. To get an insight into its application

To learn

4. SCADA applications
5. Industries SCADA System Components
6. SCADA Architecture

Course Outcomes: -

Students will be able to:

1Describe the basic tasks of Supervisory Control Systems (SCADA) as well as their typical applications

2Acquire knowledge about SCADA architecture, various advantages and disadvantages of each system

3 Knowledge about single unified standard architecture IEC 61850

4: To learn about SCADA system components: remote terminal units, PLCs, intelligent electronic devices, HMI systems, SCADA server

5: Learn and understand about SCADA applications in transmission and distribution sector, industries etc

6. SCADA Communication

Unit I

Introduction to SCADA - Data acquisition systems - Evolution of SCADA - Communication technologies 8

Unit II

Monitoring and supervisory functions - SCADA applications in Utility Automation - Industries SCADA 6

Unit III

Industries SCADA System Components - Schemes- Remote Terminal Unit (RTU) - Intelligent Electronic Devices (IED) - Programmable LogicController (PLC) - Communication Network, SCADA Server, SCADA/HMI Systems 8

Unit IV

SCADA Architecture - Various SCADA architectures, advantages and disadvantages of each system - single unified standard architecture -IEC 61850. 8

Unit V

SCADA Communication - various industrial communication technologies - wired and wireless methods and fiber optics - Open standard communication protocols - SCADA Applications: Utility applications - Transmission and

Distribution sector operations, monitoring, analysis and improvement - Industries - oil, gas and water, Case studies, Implementation, Simulation Exercises 10

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

23MEPS204C POWER QUALITY Semester-II
3H-3C

Instruction Hours/week: L:3 T:0 P:0 Marks: Internal:40 External:60 Total:100
End Semester Exam:3 Hours

Course Objectives:

1. Understand the different power quality issues to be addressed
2. Understand the recommended practices by various standard bodies like IEEE,IEC, etc on voltage& frequency, harmonics
3. Understanding STATIC VAR Compensators

To learn about

4. power quality problems
5. Power factor improvement
6. Impedance Scan Analysis

Course Outcomes: -

Students will be able to:

1: Acquire knowledge about the harmonics, harmonic introducing devices and effect of harmonics on system equipment and loads

2: To develop analytical modeling skills needed for modeling and analysis of harmonics in networks and components

3: To introduce the student to active power factor correction based on static VAR compensators and its control techniques

4: To introduce the student to series and shunt active power filtering techniques for harmonics.

5. Static VAR compensators
6. Uninterruptible power supplies

Unit I 8

Introduction-power quality-voltage quality-overview of power quality phenomena, classification of power quality issues-power quality measures and standards-THD-TIF-DIN-C, message weights-flicker factor transient phenomena-occurrence of power quality problems, power acceptability curves-IEEE guides, standards and recommended practices.

Unit II 8

Harmonics-individual and total harmonic distortion, RMS value of a harmonic waveform-Triplex harmonics-important harmonic introducing devices-SMPS-Three phase power converters-arcing devices saturable devices-harmonic distortion of fluorescent lamps-effect of power system harmonics on power system equipment and loads.

Unit III 8

Modeling of networks and components under non-sinusoidal, conditions transmission and distribution systems, Shunt capacitors- transformers-electric machines-ground, systems loads that cause power quality problems, power quality problems created by drives and its impact on drive

Unit IV 8

Power factor improvement- Passive Compensation, Passive Filtering, Harmonic, Resonance, Impedance Scan Analysis- Active Power Factor Corrected Single Phase Front End,Control Methods for Single Phase APFC, Three Phase APFC and Control Techniques, PFC, Based on Bilateral Single Phase and Three Phase Converter

Unit V 10

Static VAR compensators-SVC and STATCOM Active Harmonic Filtering-Shunt Injection, Filter for single phase, three-phase three-wire and three-phase four- wire systems, d-q domain control of three phase shunt active filters uninterruptible power supplies constant voltage - transformers - series active power filtering techniques for harmonic cancellation and isolation, Dynamic Voltage Restorers for sag , swell and flicker problems. Grounding and wiring introduction - NEC grounding requirements-reasons for grounding
- typical grounding and wiring problems solutions to grounding and wiring problems

Suggested reading

1. G.T. Heydt, “Electric power quality”, McGraw-Hill Professional, 2007
2. Math H. Bollen, “Understanding Power Quality Problems”, IEEE Press, 2000
3. J. Arrillaga, “Power System Quality Assessment”, John wiley, 2000
4. J. Arrillaga, B.C. Smith, N.R. Watson & A. R.Wood ,”Power system Harmonic Analysis”, Wiley, 1997

23MEPS204D ARTIFICIAL INTELLIGENCE TECHNIQUES Semester-II
3H-3C

Instruction Hours/week: L:3 T:0 P:0 Marks: Internal:40 External:60 Total:100
End Semester Exam:3 Hours

Course Objectives:

1. Understanding fuzzy logic, ANN Understanding
2. GA & EP
3. Fuzzy Logic
4. Fuzzy Neural Networks
5. Genetic algorithm
6. Introduction to evolutionary program

Course Outcomes: -

Students will be able to:

1. Learn the concepts of biological foundations of artificial neural networks
2. Learn Feedback networks and radial basis function networks and fuzzy logics
3. Identifications of fuzzy and neural network
4. Acquire the knowledge of GA
5. Fuzzy Neural Networks
6. Genetic algorithm example

Unit I 8

Biological foundations to intelligent Systems, Artificial Neural Networks, Single layer and Multilayer Feed Forward NN, LMS and Back Propagation Algorithm, Feedback networks and Radial Basis Function Networks

Unit II 8

Fuzzy Logic, Knowledge Representation and Inference Mechanism, Defuzzification Methods

Unit III 10

Fuzzy Neural Networks, some algorithms to learn the parameters of the network like GA, System Identification using Fuzzy and Neural Network

Unit IV 8

Genetic algorithm, Reproduction cross over, mutation, Introduction to evolutionary program

Unit V 8

Applications of above-mentioned techniques to practical problems

Suggested reading

1. J M Zurada , “An Introduction to ANN”,Jaico Publishing House
2. Simon Haykins, “Neural Networks”, Prentice Hall
3. Timothy Ross, “Fuzzy Logic with Engg.Applications”, McGraw. Hill
4. Driankov, Dimitra, “An Introduction to Fuzzy Control”, Narosa Publication
5. Golding, “Genetic Algorithms”, Addison-Wesley Publishing Com

23MEPS211A POWER SYSTEM PROTECTION LAB Semester – II
3H-2C

Instruction Hours/week: L:0 T:0 P:3 Marks: Internal:40 External:60 Total:100
End Semester Exam:3 Hours

S.No	List of experiments:
1	Introduction to Power System Protection
2	Impact of Induction Motor Starting on Power System
3	Modelling of Differential Relay using MATLAB
4	Radial Feeder Protection

23MEPS211B POWER QUALITY LAB Semester –II
3H-2C

Instruction Hours/week: L:0 T:0 P:3 Marks: Internal:40 External:60 Total:100
End Semester Exam:3 Hours

1	Parallel Feeder Protection
2	Principle of Reverse Power Protection
3	Differential Protection of Transformer
4	To the study time vs voltage characteristics of over voltage induction relay

23MEPS211C ARTIFICIAL INTELLIGENCE LAB Semester – II
3H-2C

Instruction Hours/week: L:0 T:0 P:3 Marks: Internal:40 External:60 Total:100
End Semester Exam:3 Hours

1. Write a program to simulate a perceptron network for pattern classification and function approximation.
2. Write a program to solve a XOR function using feed-forward neural network trained using back-propagation algorithm.
3. Write a program to implement adaptive noise cancellation using ADALINE neural network.
4. Given the region to be de-fuzzified, write programs to discuss the various methods that might be chosen.
5. Implementation of simple Over Current Relay using fuzzy logic.
6. Simulation and comparison of fuzzy PID controller with conventional PID controller for a given plant.
7. Solve optimal relay coordination as a linear programming problem using Genetic Algorithm.
8. Solve optimal relay coordination as a non-Linear programming problem using Genetic algorithm.
9. Solve economic load dispatch problem using Genetic algorithm.

Write a program to simulate a perceptron network for pattern classification and function approximation.

23MEPS301A **POWER SYSTEM TRANSIENTS** **Semester - III**
3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks: Internal:40 External:60 Total:100**
End Semester Exam:3 Hours

Course Objectives

1. Learn the reasons for occurrence of transients in a power system
2. Understand the change in parameters like voltage & frequency during transients
3. To know about the lightning phenomenon and its effect on power system
4. Computation of power system transients
5. Physical phenomena of lightning
6. over voltages induced by faults

Course Outcomes

Students will be able to

1. Knowledge of various transients that could occur in power system and their mathematical formulation
2. Ability to design various protective devices in power system for protecting equipment and personnel
3. Coordinating the insulation of various equipment's in power system 4: Modelling the power system for transient analysis

Understand the concepts of

4. Travelling waves on transmission line
5. Insulation co-ordination
6. substation earthling

Units I **8 Hours**

Fundamental circuit analysis of electrical transients, Laplace Transform method of solving simple Switching transients, Damping circuits - Abnormal switching transients, Three-phase circuits and transients - Computation of power system transients 8

Unit II **8 Hours**

Principle of digital computation – Matrix method of solution - Modal analysis- Z transform- Computation using EMTP - Lightning, switching and temporary over voltages, Lightning - Physical phenomena of lightning.

Unit III **8 Hours**

Interaction between lightning and power system - Influence of tower footing resistance and Earth Resistance - Switching: Short line or kilometric fault - Energizing transients - closing and re-closing of lines - line dropping, load rejection – over voltages induced by faults

Unit IV **8 Hours**

Switching HVDC line Travelling waves on transmission line - Circuits with distributed Parameters Wave Equation - Reflection, Refraction, Behavior of Travelling waves at the line terminations - Lattice Diagrams – Attenuation and Distortion - Multi-conductor system - and Velocity wave

Unit V **8 Hours**

Insulation co-ordination: Principle of insulation co-ordination in Air Insulated substation (AIS) and Gas Insulated Substation (GIS) Co- ordination between insulation and protection

Level Statistical approach - Protective devices - Protection of system against over voltages lightning arresters, substation earthling 6

Suggested reading

Allan Greenwood, “Electrical Transients in Power System”, Wiley & Sons Inc. New York, 1991

23MEPS301B FACTS AND CUSTOM POWER DEVICES Semester - III
3H-3C

Instruction Hours/week: L:3 T:0 P:0 Marks: Internal:40 External:60 Total:100
End Semester Exam:3 Hours

Course Objectives

1. To learn the active and reactive power flow control in power system
2. To understand the need for static compensators
3. To develop the different control strategies used for compensation
4. To learn Compensator control
5. To develop Unified Power Flow Controller
6. To learn Simulation of FACTS controllers

Course Outcomes

1. Acquire knowledge about the fundamental principles of Passive and Active Reactive Power Compensation Schemes at Transmission and Distribution level in Power Systems.
2. Learn various Static VAR Compensation Schemes like Thyristor/GTO Controlled Reactive Power Systems, PWM_Inverter based Reactive Power Systems and their controls.
3. To develop analytical modeling skills needed for modeling and analysis of such Static VAR Systems.
4. Acquire knowledge about TCPAR Operation and Control
5. Understand shunt , series and hybrid and their control
6. To learn IEEE standards on power quality.

Unit I **8 Hours**

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

Unit II **8 Hours**

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

Unit III **8 Hours**

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

Unit IV **8 Hours**

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

Unit V **8 Hours**

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 - • 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 InternationalPublishers,2007
2. X P Zhang, C Rehtanz, B Pal, "Flexible AC Transmission Systems- Modelling and Control", SpringerVerlag, Berlin,2006
3. N.G. Hingorani, L. Gyugyi, "Understanding FACTS: Concepts and Technology ofFlexible
4. ACTransmission Systems", IEEE Press Book, Standard Publishers and Distributors, Delhi, 2001.
5. K.S.Sureshkumar,S.Ashok , "FACTS Controllers & Applications", E-book edition, Nalanda DigitalLibrary, NITCalicut,2003
6. G T Heydt, "Power Quality", McGraw-Hill Professional,2007
7. T J E Miller, "Static Reactive Power Compensation", John Wiley and Sons, Newyork,1982.

23MEPS301C INDUSTRIAL LOAD MODELING AND CONTROL Semester – III
3H-3C

Instruction Hours/week: L:3 T:0 P:0 Marks: Internal:40 External:60 Total:100
End Semester Exam:3 Hours

Course Objectives

1. To understand the energy demand scenario
2. To understand the modeling of load and its ease to study load demand industrially
3. To know Electricity pricing models
4. Study Reactive power management in Industries
5. Energy saving in industries
6. Captive power units

Course Outcomes

Students will be able to:

1. Knowledge about load control techniques in industries and its application
2. Learn different types of industrial processes and optimize the process using tools like LINDO and LINGO
3. Apply load management to reduce demand of electricity during peak time
4. Apply different energy saving opportunities in industries
5. Apply the concept of Integrated Load management for Industries
6. To learn Selection of Schemes Optimal Operating Strategies

Unit I **8 Hours**

Electric Energy Scenario-Demand Side Management-Industrial Load Management - Load Curves-Load Shaping Objectives - Methodologies-Barriers - Classification of Industrial – Loads - Continuous and Batch processes -Load Modeling

Unit II **8 Hours**

Electricity pricing – Dynamic and spot pricing –Models - Direct load control- Interruptible - load control - Bottom up approach- scheduling- Formulation of load – Models - Optimization and control algorithms - Case studies

Unit III **8 Hours**

Reactive power management in industries - controls-power quality impacts - application of filters Energy saving in industries

Unit IV **8 Hours**

Cooling and heating loads - Captive power units - Operating and control strategies - Power Pooling- Operation models - Energy banking - Industrial Cogeneration

Unit V **8 Hours**

Selection of Schemes Optimal Operating Strategies - Peak load saving - Constraints Problem formulation- Case study - Integrated Load management for Industries 6

Reference:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da InformationServices.
2. Maintenance Engineering, H. P. Garg, S. Chand andCompany.

23MEPS302A BUSINESS ANALYTICS Semester – III
3H-3C

Instruction Hours/week: L:3 T:0 P:0 Marks: Internal:40 External:60 Total:100
End Semester Exam:3 Hours

Course objective

1. Understand the role of business analytics within an organization.
2. Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.
3. To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
4. To become familiar with processes needed to develop, report, and analyze business data.
5. Use decision-making tools/Operations research techniques.
6. Understand the business process using analytical and management tools.

Course Outcomes

1. Students will demonstrate knowledge of data analytics.
2. Students will demonstrate the ability of think critically in making decisions based on data and deep analytics.
3. Students will demonstrate the ability to use technical skills in predicative and prescriptive modeling to support business decision-making.
4. Students will demonstrate the ability to translate data into clear, actionable insights.
5. Mange business process using analytical and management tools.
6. Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

Unit I 9 Hours

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 modelling, sampling and estimation methods overview.

Unit II 8 Hours

Trendiness and Regression Analysis: Modelling 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 III 9 Hours

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 Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

Unit IV 10 Hours

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 V **12 Hours**

Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.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 FTPress.
2. Business Analytics by James Evans, personsEducation.

23MEPS302B	**Industrial Safety**	**Semester – III**
		3H-3C
Instruction Hours/week: L:3 T:0 P:0	**Marks: Internal:40 External:60 Total:100**	
	End Semester Exam:3 Hours	

Course Objectives

1. Understand industrial safety problems
2. Learn Fundamentals of maintenance engineering
3. Introduction to Wear and Corrosion and their prevention
4. Fault tracing and Periodic and preventive maintenance
5. Concept of maintenance engineering
6. To learn Wear and Corrosion and their prevention

Course Outcomes

Students will be able to

1. Know the concept and steps of problem solving – industrial safety
2. Knowledge and understanding of maintenance engineering
3. Wear and Corrosion and their prevention
4. Periodic and preventive maintenance
5. Understand the Fault tracing
6. Understand the Periodic and preventive maintenance

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,

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:

3. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
4. Maintenance Engineering, H. P. Garg, S. Chand and Company.
5. Pump-hydraulic Compressors, Audels, Mcgrew HillP ublication.
6. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & HallLondon.

23MEPS302C Operations Research Semester – III
3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks: Internal:40 External:60 Total:100**
End Semester Exam:3 Hours

Course Objectives

1. Understand the optimization techniques, models and LR formulation
2. Formulate LPP
3. Analyze Nonlinear programming problem
4. Formulate parametric programming
5. Understand Geometric Programming
6. To learn Game Theory Simulation

Course Outcomes

The student should be able to

1. apply the dynamic programming to solve problems of discreet and continuous variables.
2. apply the concept of non-linear programming
3. carry out sensitivity analysis
4. model the real world problem and simulate it.
5. Understand Geometric Programming
6. To learn Game Theory Simulation

Unit I

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

Unit II

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

Unit III

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

Unit IV

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

Unit V

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 India2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India2010

23MEPS302D Cost Management of Engineering Projects Semester – III
3H-3C

Instruction Hours/week: L:3 T:0 P:0 Marks: Internal:40 External:60 Total:100
End Semester Exam:3 Hours

Course Objectives

1. Acquire and fine-tune the skills and techniques for the 4 phases in the life cycle of a typical project: initiating, planning, executing and closing
2. Gain an understanding of essential principles associated with effective project management and how to apply these principles in the day-to-day business environment
3. Familiarize yourself with commonly available computer software tools
4. Understand and apply methods for solving and avoiding common difficulties associated with project management.
5. Apply project selection methods to evaluate the feasibility of projects.
6. Assess project contribution to business strategy, purpose and plans.

Course Outcomes

1. Apply project selection methods to evaluate the feasibility of projects.
2. Assess project contribution to business strategy, purpose and plans.
3. Determine and document project goals and performance requirements by working closely with project stakeholders.
4. Define and document product or service deliverables.
5. Select appropriate project management practices, tools, and methodologies.
6. Define, analyze, refine, and document project requirements, assumptions, and constraints.

Unit I

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

Unit II

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and non- technical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance.

Unit III

Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and processCost 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.

Unit IV

Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets;Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

Unit V

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

References

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

23MEPS302E	**Composite Materials**	**Semester – III**
		3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks: Internal:40 External:60 Total:100**
End Semester Exam:3 Hours

Course Objectives

1. Ability to solve mechanics of composite materials problems using classical methods
2. Ability to do research and present on an advanced material topic
3. Ability to analyze problems on micromechanical behavior of lamina
4. Ability to analyze problems on macro mechanical behavior of laminate
5. Ability to analyze problems on bending, buckling, and vibration of laminated plates and beams
6. Ability to obtain laminate behavior using a computer program

Course Outcomes

1. Some understanding of types, manufacturing processes, and applications of composite materials
2. Ability to analyze problems on macro mechanical behavior of lamina
3. Ability to analyze problems on macro mechanical behavior of laminate
4. Ability to analyze problems on bending, buckling, and vibration of laminated platesand beams
5. Ability to obtain laminate behavior using a computer program
6. Ability to perform literature search on a selected advanced material topic and givingclass presentation

UNITI

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.

UNITII

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. Isostrain and Isostress conditions.

UNITIII

Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. 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.

UNITIV

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.

UNITV

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 CompositeMaterials-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.

23MEPS302F **Waste to Energy** **Semester – III**
3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks: Internal:40 External:60 Total:100**
End Semester Exam:3 Hours

Course objectives

1. To enable students to understand of the concept of Waste Management, Minimization and Utilization.
2. To link legal, technical and management principles for effective waste management.
3. To learn about the best available technologies for waste processing.
4. Manufacture of charcoal
5. To analysis of case studies for understanding success and failures.
6. To facilitate the students in developing skills in the decision-making process

Course Outcomes

At the end of the course the student would have gained knowledge and understanding on

1. Various aspects of waste management, minimization and utilization.
2. Classification of waste as fuel
3. Manufacture of charcoal
4. Downdraft and updraft gasifiers
5. some exotic designs
6. Biogas plant technology

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. WereKo-Brobby and E. B. Hagan, John Wiley & Sons,1996.

KARPAGAM ACADEMY OF HIGHER EDUCATION

(Deemed to be University)

(Established Under Section 3 of UGC Act 1956)

(Accredited with A+ Grade by NAAC in the Second cycle)

Coimbatore – 641 021. INDIA

FACULTY OF ENGINEERING

POST–GRADUATE PROGRAMME
REGULAR PROGRAMME
REGULATIONS 2023-2024
(CHOICE BASED CREDIT SYSTEM)

These Regulations are effective from the academic year 2023-2024 and applicable to the students admitted to M. E. / M. Tech. Programmes during the academic year 2023-2024 and onwards.

1.PROGRAMMES OFFERED, MODE OF STUDY AND ADMISSION REQUIREMENTS.

PROGRAMMES OFFERED: M. E. and M. Tech.

The various P.G. Programmes offered by the Karpagam Academy of HigherEducation are listed in Table 1.

Table – 1

M. E./M. TECH. DEGREE (REGULAR) PROGRAMMES

Sl. No.	Name of the Programme
DEPARTMENT OF COMPUTER SCIENCE ANDENGINEERING	
1.	M.E Computer Science and Engineering
DEPARTMENT OF CIVIL ENGINEERING	
1.	M.E Structural Engineering.
DEPARTMENT OF ELECTRICAL ANDELECTRONICS ENGINEERING	
1.	M.E. Power Systems Engineering
DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING	
1.	M.E VLSI Design
DEPARTMENT OF MECHANICAL ENGINEERING	
1.	M.E CAD/CAM Robotics

MODE OF STUDY:

Full–Time:

Candidates admitted under 'Full–Time' should be available in the Karpagam Academy of Higher Education during the complete working hours for curricular, co–curricular and extra– curricular activities assigned to them.

Change from one programme to another programme is not permitted.

ADMISSION REQUIREMENTS:

Candidates for admission to the Master's Degree Programme shall be required to have passed an appropriate Degree Examination of any University accepted by the Board of Management of Karpagam Academy of Higher Education as equivalent thereto. Admission shall be offered only to the candidates who possess the qualification prescribed against each course, given in the Table–2.

Table – 2

M. E. / M.TECH. PROGRAMMES QUALIFICATIONS FOR ADMISSION

S. No.	Degree and branch ofstudy	Qualification for Admission
1.	M.E Computer Science and Engineering	B.E./B. Tech. – Computer Science and Engineering/ Information Technology/ ArtificialIntelligence and Data Science/ Cyber Security/ Computer Science and Business System/ Computer Science and Design
2.	M.E Structural Engineering.	B.E./B. Tech. – Civil Engineering
3.	M. E. Power SystemsEngineering	B. E./B.Tech. – Electrical and Electronics Engineering / Electronics and Communication Engineering
4.	M.E VLSI Design	B.E/B.Tech. – Electrical and Electronics Engineering / Electronics and Communication Engineering
5.	M.E CAD/CAM Robotics	B.E/B.Tech Mechanical Engineering

2 DURATION OF THE PROGRAMMES:

The minimum and maximum period for completion of the P.G. Programmes are given below:

Programme	Min. No. of Semesters	Max. No. of Semesters
M. E./M. Tech.	4	8

Each semester shall normally consist of 90 working days or 360 hours for full–time mode of study. The Dean and HOD shall ensure that every teacher imparts instruction as per the number of periods specified in the syllabus and that the teacher teaches the full content of the specified syllabus for the course being taught.

The prescribed credits required for the award of degree shall be within the limits specified below.

PROGRAMME	PRESCRIBED CREDIT RANGE
M. E./M. Tech.	**65 to 75**

Credits will be assigned to the courses for different modes of study as given below: No. of credits per lecture period per week 1

No. of credits per tutorial period per week 1

No. of credits for 3 periods of laboratory course per week 2

No. of credits for 3 periods of project work per week 2

3. STRUCTURE OF THE PROGRAMME

Every programme will have a curriculum and syllabi consisting of core theory courses, elective courses, seminars / practical courses and project work.

The elective courses from the curriculum are to be chosen with prior approval from the Head of the Department.

The medium of instruction for all courses, examinations, seminar presentations and project thesis shall be English**.**

Choice Based Credit System is implemented offering choice in professional core and professional electives.

MAXIMUM MARKS

The maximum marks assigned to different courses shall be as given below:

Each of the theory and practical course (excluding project work) shall carry maximum of 100 marks of which 40 marks will be through Continuous Internal Assessment (CIA) and 60 marks through End Semester Examination (ESE).

PROJECT WORK

The project work for M. E./ M. Tech. consists of two Phases, Phase– I and Phase – II. Phase – I is to be undertaken during III semester and Phase – II during IV semester.

All the students are advised to do their project work within the campus. However, as a special case, if a student is able to get a project from a government organization or private or public sector company with a turnover of about Rs.50 crore, he/she may be permitted to do his/her project work in that institution/research organization/industry.

4. EVALUATION OF PROJECT WORK

The evaluation of Project Work for Phase I & Phase II shall be done independently in the respective semesters. The total marks for project work including Phase I and II are 400. The project work pertained to Phase I is evaluated through Continuous Internal Assessment only. No End Semester Examination will be conducted for the Phase I. The maximum internal marks for Phase I is 100. For Phase – II, the maximum internal mark is 120 and the maximum End Semester Examination mark is 180. The total marks for Phase – II is 300. The overall passing minimum is 50%.

The Project Report prepared according to approved guidelines and duly signed by the supervisor(s) and the Head of the Department shall be submitted to the CoE through the HoD and the Dean.

The evaluation of the Project work Phase – I will be purely internal by forming a committee by HoD/ Dean. During CIA of Phase – I, there will be a Viva–Voce Examination by a team consisting of the Supervisor, and an Internal Examiner (other than the Supervisor). The evaluation of the Project work Phase – II will be based onthe project report submitted in Phase – II and a Viva–Voce Examination by a team consisting of the Supervisor, an Internal Examiner and an External Examiner for each programme. The External Examiner shall be appointed by the Karpagam Academy of Higher Education for Phase – II evaluation.

If a candidate fails to submit the project report on or before the specified deadline, he/she is deemed to have failed in the project work and shall re–enroll for the same in the subsequent semester.

If a candidate fails in the Viva–Voce examinations of Phase–I, he/she has to resubmit the project report within 30 days from the date of declaration of the results. If he/she fails in the Viva–Voce examination of Phase–II of project work, he/she shall resubmit the project report within 60 days from the date of declaration of the results. For this purpose, the same Internal and External Examiner shall evaluate the resubmitted report.

Every candidate shall publish a paper of his or her findings in a peer reviewed journal or present in an International Conference or apply for a patent out of his / her project work. Reprints of the journal publication / acceptance letter from the journal publisher or Proceedings of the International conference/ acceptance letter from the Conference Organizer or application of patent shall be attached to the report of the project work. Such acknowledgements shall be sent to the Controller of Examinations along with the evaluation marks by the team of examiners without which the thesis shall not be accepted.

A copy of the approved project report after the successful completion of Viva– Voce Examination shall be kept in the respective department as well as in the Karpagam Academy of Higher Education library.

5 REQUIREMENTS FOR COMPLETION OF THE SEMESTER

A candidate will be permitted to take the End Semester Examination of any semester,if

i) the candidate secures not less than 75% of attendance during the semester and

ii) the conduct of the candidate has been satisfactory

A candidate who has secured attendance between 65% and 74% (both included), due to medical reasons (Hospitalization / Accident / Specific Illness) or due to participation in Karpagam Academy of Higher Education / District / State / National / International level sports or due to participation in Seminar / Conference / Workshop / Training Programme /Voluntary Service / Extension activities or similar programmes with prior permission from the Registrar shall be given exemption from prescribed attendance requirements and shall be permitted to take the examination on the recommendation of the concerned Head of the Department and Dean to condone the lack of attendance. The Head of the

Department has to verify and certify the genuineness of the case before recommending to the Dean.

However, a candidate who has secured attendance less than 65% in the current semester shall not be permitted to appear for the current ESE. But he/she will be permitted to appear for his/her arrear examination if any and he/she has to re do the course by rejoining the semester in which attendance is less than 65% with proper approval of the "Students' Affairs Committee" and Registrar.

6 CLASS ADVISORS

To help the students in planning their courses of study and for general advice on the academic programme, the Head of the Department will attach a certain number of students to a teacher of the Department who shall function as Class Advisor for those students throughout their period of study. Such Class Advisors shall advise the students and monitor the courses undergone by the students, check the attendance and progress of the students attached to him/her and counsel them periodically. If necessary, the Class Advisor may display the cumulative attendance particulars in the Department Notice Board.

7 CLASS COMMITTEE

Every class shall have a class committee consisting of teachers of the class concerned, student representatives [two boys and two girls] and the concerned Head of the Department. It is like the 'Quality Circle' with the overall goal of improving the teaching–learning process. The functions of the class committee include

- Solving problems experienced by students in the class room and in the laboratories.
- Clarifying the regulations of the degree programme and the details of rules therein particularly Clause 2 and 3 which should be displayed on department Notice–Board.
- Informing the student representatives, the details of Regulations regarding weightage used for each assessment.
- Informing the student representatives, the academic schedule including the dates of assessments and the syllabus coverage for each assessment.
- In the case of practical courses (laboratory / project work, etc.) the breakup of marks for each experiment / exercise / module of work, should be clearly discussed in the class committee meeting and informed to the students.

- Analyzing the performance of the students of the class after each test and finding the ways and means of solving problems, if any.
- Identifying the weak students, if any, and requesting the teachers concerned to provide some additional academic support to them.
- The class committee shall be constituted within the first week of each semester.

At least 4 student representatives (usually 2 boys and 2 girls) shall be included in the class committee.

The Chairperson of the Class Committee may convene the meeting of the class committee.

The Dean may participate in any Class Committee of the Faculty.

The Chairperson is required to prepare the minutes of every meeting, submit the same to Dean within two days of the meeting and arrange to circulate it among the students and teachers concerned. If there are some points in the minutes requiring action by the Management, the same shall be brought to the notice of the Registrar by the HOD through the Dean.

The first meeting of the Class Committee shall be held within one week from the date of commencement of the semester, in order to inform the students about the nature and weightage of assessments within the framework of the regulations. Two or three subsequent meetings may be held in a semester at suitable intervals. During these meetings the student members representing the entire class, shall meaningfully interact and express their opinions and suggestions of the other students of the class in order to improve the effectiveness of the teaching–learning process.

8. COURSE COMMITTEE FOR COMMON COURSES

Each common theory course offered to more than one discipline or group, shall have a "Course Committee" comprising all the teachers handling the common course with one of them nominated as Course Coordinator. The nomination of the Course Coordinator shall be made by the Dean depending upon whether all the teachers teaching the common course belong to a single department or to several departments. The 'Course Committee' shall meet in order to arrive at a common scheme of evaluation for the test and shall ensure a uniform evaluation of the tests. Where ever feasible, the Course Committee may also prepare a common question paper for the Internal Assessment test(s).

9. PROCEDURE FOR AWARDING MARKS FOR INTERNAL ASSESSMENT

Every teacher is required to maintain an 'ATTENDANCE AND ASSESSMENT RECORD' which consists of attendance marked in each theory or practical or project work class, the test marks and the record of class work (topic covered), separately for each course.

Continuous Internal Assessment (CIA):

The performance of students in each subject will be continuously assessed by the respective teachers as per the guidelines given below:

THEORY COURSES:

S. No.	CATEGORY	MAXIMUM MARKS
1.	Paper Presentation *****	15
2.	Attendance	5
3.	Test – I **#**	10
4.	Test – II **#**	10
	TOTAL	40

***** One refereed journal paper related to the subject and approved by the teacher should be critically presented. The Paper Presentation should be evaluated by a committee and marks should be entered in Automation software on or before 60th working day of the semester.

The test scripts should be evaluated and marks should be entered in Automation software on or before 4th working day after the last test.

PATTERN OF TEST QUESTION PAPER:

INSTRUCTION	REMARKS
Maximum Marks	60
Duration	2 Hours
Part- A	1 to 9 Two Mark Questions, uniformly covering the two units of the syllabus. All the 9 Questions are to be answered. **(9 x 2 =18Marks)**.
Part- B	Question 10 to 12 will be of either-or type, covering two units of the syllabus. Each Question may have subdivision. **(3 x 14 =42 Marks)**.

PRACTICAL COURSES:

S. No	CATEGORY	MAXIMUM MARKS
1.	Attendance	5
2.	Observation work	5
3.	Record work	5
4.	Model examination	15
5.	Viva – voce [Comprehensive]	10
	TOTAL	40

Every practical exercise / experiment shall be evaluated based on the conduct of exercise/ experiment and records maintained.

ATTENDANCE

MARKS DISTRIBUTION FOR ATTENDANCE

S. No.	Attendance %	Marks
1	91 and above	5.0
2	86-90	4.0
3	81-85	3.0
4	75-80	2.0
5	Less than 75	0

10. REQUIREMENTS FOR APPEARING FOR END SEMESTEREXAMINATION (ESE)

A candidate shall normally be permitted to appear for the ESE of any semester commencing from I semester if he/she has satisfied the semester completion requirements (Subject to Clause 5) and has registered for examination in all courses of the semester. Registration is mandatory for Semester Examinations as well as supplementary examinations failing which the candidate will not be permitted to move to the higher semester.

A candidate already appeared for a subject in a semester and passed the examination is not entitled to reappear in the same subject for improvement of grade.

11. END SEMESTER EXAMINATION

ESE will be held at the end of each semester for each subject, for 100 marks, later scaled down to 60 marks.

PATTERN OF ESE QUESTION PAPER:

INSTRUCTION	REMARKS
Maximum Marks	100 marks for all Semester Examinations.
Duration	3 Hours
Part - A	Part A will be online Examination. 20 Objective type Questions. Covering all the 5 units. **20*1= 20 Marks (Online Examination)**
Part- B	21 to 25 Two Mark Questions, uniformly covering the Five units of the syllabus. All the 5 Questions are to be answered. (**5 *2= 10Marks)**.
Part- C	Question 26 to 30 will be of either-or type, covering Five units of the syllabus. Each Question may have subdivision. **(5*14=70 Marks)**

12. PASSING REQUIREMENTS

Passing minimum: The passing minimum for CIA is 20 (i.e. out of 40 marks). The Passing minimum for End Semester Examination is 30 (i.e. out of 60 marks).

The overall passing minimum for theory/laboratory course is 50 (Sum of his/her score in internal and external examination) out of 100 marks.

If the candidate fails to secure a pass in a particular course ESE, it is mandatory that candidate shall register and reappear for the examination in that course during the subsequent semester when examination is conducted in that course. Further, the candidate should continue to register and reappear for the examination till a pass is secured in such supplementary exam within the stipulated maximum duration of the programme (Clause 2.1).

The CIA marks obtained by the candidate in his/her first or subsequent appearance where he/she secures a pass shall be retained by the office of the Controller of Examinations and considered valid for all remaining attempts till the candidate secures a pass in his/her ESE.

If a candidate fails to secure a pass in a particular course CIA, it is mandatory that candidate shall register and reappear for the CIA in that course during the subsequent

semester when CIA is conducted in that course by the faculty member assigned for that particular course during that semester by the concerned HOD. Further, the candidate should continue to register and reappear for the CIA till a pass is secured in such supplementary exam within the stipulated maximum duration of the programme (Clause 2.1).

13. AWARD OF LETTER GRADES

All assessments of a course will be done on absolute mark basis. However, for the purpose of reporting the performance of a candidate, letter grades, each carrying certain number of points, will be awarded as per the range of total marks (out of 100) obtained by the candidate in each subject as detailed below:

Letter grade	Marks Range	Grade Point	Description
O	91 - 100	10	OUTSTANDING
A+	81- 90	9	EXCELLENT
A	71-80	8	VERY GOOD
B+	66- 70	7	GOOD
B	61 – 65	6	ABOVE AVERAGE
C	55 - 60	5	AVERAGE
P	50 - 54	4	PASS
RA	<50	-	REAPPEARANCE
AB		0	ABSENT

GRADE SHEET

After results are declared, Grade sheets will be issued to each student which will contain the following details:

i) The list of courses enrolled during the semester and the grade scored.

ii) The Grade Point Average (**GPA**) for the semester and

iii) The Cumulative Grade Point Average (**CGPA**) of all courses enrolled from first semester onwards.

GPA is the ratio of the sum of the products of the number of Credits (**C**) of courses enrolled and the Grade Points (**GP**) corresponding to the grades scored in those courses, taken for all the courses to the sum of the number of credits of all the courses in the semester.

CGPA will be calculated in a similar manner, considering all the courses enrolled fromfirst semester. **RA** grade will be excluded for calculating **GPA** and **CGPA**.

REVALUATION

A candidate can apply for revaluation of his/her semester examination answer paper in a theory course, within 2 weeks from the declaration of results, on payment of a prescribed fee through proper application to the Controller of Examinations through the Head of the Department and Dean. A candidate can apply for revaluation of answer scripts for not exceeding 5 subjects at a time. The Controller of Examinations will arrange for the revaluation and the results will be intimated to the candidate through the Head of the Department and Dean. Revaluation is not permitted for Supplementary examination, Practical examination and Project Work.

14. ELIGIBILITY FOR AWARD OF DEGREE

A student shall be declared to be eligible for award of Degree if he/she has

- Successfully gained required number of total credits as specified in the curriculum corresponding to his/her programme within the stipulated time.
- No disciplinary action is pending against him/her.

The award of degree must be approved by the Board of Management of Karpagam Academy of Higher Education.

15. CLASSIFICATION OF THE DEGREE AWARDED

A candidate who qualifies for the award of the Degree (vide Clause 14) having passed the examination in all the courses in his/her first appearance within the specified minimum number of semesters (vide Clause 2.1) securing a CGPA of not less than 8.0 shall be declared to have passed the examination in First Class with Distinction.

A candidate who qualifies for the award of the Degree (vide Clause 14) having passed the examination in all the courses within the specified minimum number of semesters (vide Clause 2.1) plus one semester securing CGPA of not less than 6.5shall be declared to have passed the examination in First Class. For this purpose, the withdrawal from examination (vide Clause 16) will not be construed as an appearance. Further, the authorized break of study (vide Clause 18) will not becounted for the purpose of classification.

All other candidates (not covered in Clauses 15.1 and 15.2) who qualify for the award of the degree (vide Clause 14) shall be declared to have passed the examination in **Second Class**.

16. PROVISION FOR WITHDRAWAL FROM END–SEMESTER EXAMINATION

A candidate may for valid reasons and on prior application, be granted permission to withdraw from appearing for the examination of any one course or consecutive examinations of more than one course in a semester examination. Withdrawal application shall be valid only if the candidate is otherwise eligible to write the examination.

Such withdrawal shall be permitted only once during the entire period of study of the degree programme.

Withdrawal application is valid only if it is made within 10 days prior to the commencement of the examination in that course or courses and recommended by the Head of the Department and Dean and approved by the Registrar.

16.3.1 Notwithstanding the requirement of mandatory TEN days' notice, applications for withdrawal for special cases under extraordinary conditions will be considered on the merit of the case.\

Withdrawal shall not be construed as an appearance for the eligibility of a candidate for First Class with Distinction. This provision is not applicable to those who seek withdrawal during IV semester.

Withdrawal from the ESE is **NOT** applicable to supplementary courses.

The candidate shall reappear for the withdrawn courses during the examination conducted in the subsequent semester.

17. PROVISION FOR AUTHORISED BREAK OF STUDY

Break of Study shall be granted only once for valid reasons for a maximum of one year during the entire period of study of the degree programme. However, in extraordinary situation the candidate may apply for additional break of study not exceeding another one year by paying prescribed fee for break of study. If a candidate intends to temporarily discontinue the programme in the middle of the semester for valid reasons and to rejoin theprogramme in a subsequent year, permission may be granted based on the merits of the case provided he/she applies to the Registrar, but not later than the last date for registering for the ESE of the semester in question, through the Head of the Department and Dean

stating the reasons thereof and the probable date of rejoining the programme.

The candidate thus permitted to rejoin the programme after the break shall be governed by the curriculum and regulations in force at the time of rejoining. Such candidates may have to do additional courses, if any as per the curriculum and regulations in force at that period of time.

The authorized break of study (for a maximum of one year) will not be counted for the duration specified for passing all the courses for the purpose of classification (vide Clause15). However, additional break of study granted will be counted for the purpose of classification.

The total period for completion of the programme reckoned from, the commencement ofthe first semester to which the candidate was admitted shall not exceed the maximum period specified in Clause 2.1 irrespective of the period of break of study (vide Clause 18.1) in order that he/she may be eligible for the award of the degree.

If any student is detained for want of requisite attendance, progress and good conduct, the period spent in that semester shall not be considered as permitted 'Withdrawal' or 'Break of Study' Clause 16 and 18 respectively is not applicable for this case.

18. SPECIAL SUPPLEMENTARY ESE

After the publication of IV semester results, if a student has an arrear in any theory course of the entire programme, he/she will be permitted to apply within 15 days of the publication of results, and appear for a special supplementary examination.

19. DISCIPLINE

Every student is required to observe disciplined and decorous behavior both inside and outside the Karpagam Academy of Higher Education and not to indulge in any activity which will tend to bring down the prestige of the Karpagam Academy of Higher Education. The erring student will be referred to the Disciplinary Committee constituted by the Karpagam Academy of Higher Education, to inquire into acts of indiscipline and recommend to the Karpagam Academy of Higher Education about the disciplinary action to be taken.

If a student indulges in malpractice in any of the CIA/ESE he/she shall be liable for punitive action as prescribed by the Karpagam Academy of Higher Education from time to time.

20. REVISION OF REGULATION AND CURRICULUM

The Karpagam Academy of Higher Education may from time to time revise, amend or change the Regulations, Scheme of Examinations and syllabi if found necessary on the recommendations of Board of Studies, Academic Council and Board of Management of Karpagam Academy of Higher Education.