PAAVAI ENGINEERING COLLEGE, NAMAKKAL – 637 018
(AUTONOMOUS)
B.E. ELECTRICAL AND ELECTRONICS ENGINEERING
CHOICE BASED CREDIT SYSTEM

CURRICULUM I - VIII SEMESTERS

REGULATIONS 2016

SEMESTER VII

S.No	Category	Course Code	Course Title	L	T	P	C
Theory							
1	PC	EE16701	Power System Operation and Control	3	0	0	3
2	PC	EE16702	Special Electrical Machines	3	0	0	3
3	PC	EE16703	Protection and Switchgear	3	0	0	3
4	PE	****	Programme Elective II	3	0	0	3
5	OE	EE1690*	Open Elective II	3	0	0	3
6	HS	BA16151	Professional Ethics and Human Values	3	0	0	3
Practical							
7	PC	EE16704	Power System Simulation Laboratory	0	0	4	2
8	EE	EE16705	Mini Project	0	0	4	2
			TOTAL	18	0	8	22

SEMESTER VIII

S.No	Category	Course Code	Course Title	L	T	P	C
Theory							
1	PC	EE16801	Utilization of Electrical Energy	3	0	0	3
2	PE	EE1635*	Programme Elective III	3	0	0	3
3	PE	****	Programme Elective IV	3	0	0	3
Practical							
4	EE	EE16802	Project Work	0	0	12	6
			TOTAL	9	0	12	15

*** Professional Elective of UG programmes**
****** Course from the curriculum of other UG programmes**

LIST OF ELECTIVES

Category	Course Code	Course Title	L	T	P	C
PROGRAMME ELECTIVE I (PE)						
PE	EE16151	Bio Medical Engineering	3	0	0	3
PE	EE16152	Electrical Safety	3	0	0	3
PE	EE16153	Digital Control Engineering	3	0	0	3
PE	EE16154	Nano Science	3	0	0	3
PE	EE16155	Network Analysis and Synthesis	3	0	0	3
OPEN ELECTIVE I (OE)						
OE	EE16901	Micro Electro Mechanical System	3	0	0	3
OE	EE16902	Industrial Robotics	3	0	0	3
OE	EE16903	Soft Computing Techniques	3	0	0	3
OE	EE16904	Wind and Solar Energy Systems	3	0	0	3
PROGRAMME ELECTIVE II (PE)						
PE	EE16251	VLSI Design and Circuits	3	0	0	3
PE	EE16252	Power System Dynamics	3	0	0	3
PE	EE16253	Flexible AC Transmission System	3	0	0	3
PE	EE16254	Optoelectronic Devices	3	0	0	3
PE	MA16153	Operations Research	3	0	0	3
OPEN ELECTIVE II (OE)						
OE	EE16905	Embedded System Design	3	0	0	3
OE	EE16906	Solar and Wind Energy Engineering	3	0	0	3
PROGRAMME ELECTIVE III (PE)						
PE	EE16351	EHV AC and DC Transmission	3	0	0	3
PE	EE16352	Energy Auditing	3	0	0	3
PE	EE16353	High Voltage Engineering	3	0	0	3
PE	EE16354	Computer Networks	3	0	0	3
PE	EE16355	Design with PIC Microcontroller	3	0	0	3
PROGRAMME ELECTIVE IV (PE)						
PE	EE16451	Testing and Commission of Electrical Equipments	3	0	0	3
PE	EE16452	Power Quality	3	0	0	3
PE	EE16453	Virtual Instrumentation	3	0	0	3
PE	EE16454	Computer Aided Design of Electrical Machines	3	0	0	3
PE	BA16253	Total Quality Management	3	0	0	3

SEMESTER VII

EE16701 POWER SYSTEM OPERATION AND CONTROL 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the basics of power system operation and control.
- model and design power-frequency dynamics and power-frequency controller.
- characterize reactive power-voltage interaction and the control actions varying system load.
- learn the economic operations available in power system.
- comprehend computer control of SCADA and its application for real time operation and control of power systems.

UNIT I INTRODUCTION 9

Introduction of power system operation and control - structure of electrical power system- importance of load forecasting, quadratic and exponential curve fitting techniques of forecasting - plant level and system level controls.

UNIT II REAL POWER FREQUENCY CONTROL 9

Basics of speed governing mechanism and modeling - speed - load characteristics – load sharing between two synchronous machines in parallel - control area concept - LFC control of a single - area system - static and dynamic analysis of uncontrolled and controlled cases - two-area system - modeling - static analysis of uncontrolled - state variable model

UNIT III REACTIVE POWER VOLTAGE CONTROL 9

Introduction of excitation systems and its types - generation and absorption of reactive power- methods of voltage control: tap changing transformer, SVC (TCR + TSC) and STATCOM

UNIT IV UNIT COMMITMENT AND ECONOMIC DISPATCH 9

Formulation of economic dispatch problem - I/O cost characterization - incremental cost curve - coordination equations without and with loss (No derivation of loss coefficients) - solution by direct method and λ-iteration method - statement of unit commitment problem - priority-list method - forward dynamic programming.

UNIT V COMPUTER CONTROL OF POWER SYSTEMS 9

Needs for computer control of power systems - energy control centre: functions, system monitoring, data acquisition and control - SCADA and EMS functions: contingency analysis - state transition diagram showing various state transitions and control strategies

TOTAL PERIODS 45

COURSE OUTCOMES

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

- elucidate the basics of power system control.
- model and design power frequency controllers.
- create power voltage interaction for various loads.
- perform analysis for economic dispatch and unit commitment
- enumerate and discuss on the computer control of power systems

TEXT BOOKS

1. I J Nagarath and D P Kothari, "Modern Power System Analysis" Tata McGraw Hill Education Pvt. Ltd, 3rd Edition, 2017
2. Allen J Wood and Woollenberg, **"**Power generation, operation and control" John Wiley and Sons Second Edition, 2013
3. O.J Elgerd, "Electrical Energy Systems Theory" Tata McGraw Hill Education Pvt. Ltd, 2nd Edition, 2017.

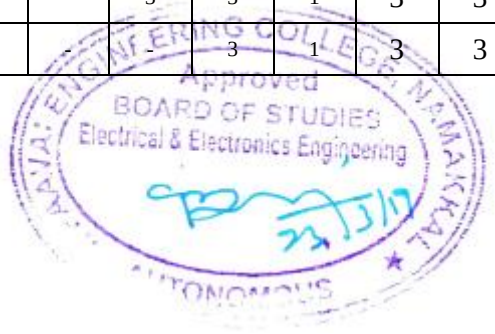
REFERENCES

1. Kundur P "Power System Stability and Control" Tata McGraw Hill Education Pvt. Ltd., New Delhi, Fifth Edition, 2014.
2. Abhijit Chakrabarti and Sunita Halder, "Power System Analysis, Operation and Control" PHI, Second Edition, 2010
3. G.L.Kusic, "Computer Aided Power System Analysis" PHI, 2010.
4. B.M.Weedy and B.J. Cory, "Electric Power Systems", Wiley Fifth Edition, 2012
5. R.N. Dhar, "Computer Aided Power System Operation and Analysis" Tata McGraw-Hill, 2012.

CO-PO MAPPING:

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

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



EE16702 SPECIAL ELECTRICAL MACHINES 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the construction, principle of operation, control and performance of stepping motors.
- acquire knowledge on the construction, principle of operation, control and performance of switched reluctance motors.
- know about the construction, principle of operation and performance of synchronous reluctance motors
- update their knowledge on the construction, principle of operation, control and performance of permanent magnet brushless DC motors.
- identify the construction, principle of operation and performance of permanent magnet synchronous motors.

UNIT I STEPPER MOTORS 9

Constructional features - principle of operation - variable reluctance motor - hybrid motor - single and multi stack configurations - torque equations - modes of excitation - characteristics - drive circuits - microprocessor control of stepper motors - closed loop control- applications.

UNIT II SWITCHED RELUCTANCE MOTORS 9

Constructional features - rotary and linear switched reluctance motor - principle of operation - torque production - steady state performance prediction- analytical method -power converters and their controllers - methods of rotor position sensing - sensor less operation - characteristics and closed loop control - applications.

UNIT III SYNCHRONOUS RELUCTANCE MOTORS 9

Constructional features - types, axial and radial flux motors - operating principles - variable reluctance motors - voltage and torque equations , phasor diagram, performance characteristics - applications.

UNIT IV PERMANENT MAGNET BRUSHLESS D.C. MOTORS 9

Permanent magnet materials - minor hysteresis loop and recoil line-magnetic characteristics - permeance coefficient - principle of operation - types - magnetic circuit analysis - EMF and torque equations - commutation - power converter circuits and their controllers - motor characteristics and control - applications.

UNIT V PERMANENT MAGNET SYNCHRONOUS MOTORS (PMSM) 9

Principle of operation - ideal PMSM - EMF and torque equations - armature MMF - synchronous reactance - sine wave motor with practical windings - phasor diagram - torque/speed characteristics - power controllers - converter volt-ampere requirements - applications.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- describe the construction, control and performance of stepping motors.
- enumerate the construction, control and performance of switched reluctance motors.
- model and analyze synchronous reluctance motors and their application.
- distinguish the concepts of permanent magnet brushless D.C. motors and their application.
- acquire knowledge in construction and performance analysis of permanent magnet synchronous motors and their application.

TEXT BOOKS

1. K.Venkataratnam, "Special Electrical Machines", Universities Press (India) Private Limited, 2013.
2. T.J.E. Miller, "Brushless Permanent Magnet and Reluctance Motor Drives" Clarendon Press, Oxford, 2014.
3. T. Kenjo, "Stepping Motors and Their Microprocessor Controls" Clarendon Press London, 2015.

REFERENCES

1. R.Krishnan, "Switched Reluctance Motor Drives – Modeling, Simulation, Analysis, Design and Application", CRC Press, New York, 2014.
2. P.P. Aearnley, "Stepping Motors – A Guide to Motor Theory and Practice", Pete Perengrinus London, 2015.
3. T. Kenjo and S. Nagamori, "Permanent Magnet and Brushless DC Motors", Clarendon Press, London, 2014.
4. E.G. Janardanan, "Special electrical machines", PHI learning Private Limited, Delhi, 2014.

CO-PO MAPPING:

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

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

EE16703 **PROTECTION AND SWITCHGEAR** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

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

UNIT I PROTECTIVE RELAYS **9**

Principles and need for protective schemes - methods of neutral grounding- zones of protection and essential qualities of protection - construction and characteristics of relays - over current relays , directional, distance and differential relays ,under frequency relays ,negative sequence relays.

UNIT II APPARATUS PROTECTION **9**

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

UNIT III THEORY OF CIRCUIT INTERRUPTION **9**

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

UNIT IV CIRCUIT BREAKERS **9**

Types of circuit breakers - air blast, oil, SF6 and vacuum circuit breakers - comparative merits of different circuit breakers - testing of circuit breakers - circuit breaker ratings.

UNIT V STATIC RELAYS AND NUMERICAL PROTECTION **9**

Static relays - phase, amplitude comparators - synthesis of various relays using static comparators - block diagram of numerical relays - over current protection, transformer differential protection and distant protection of transmission lines.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- recapitulate the construction and operation of protective relays.
- describe the general protection schemes of the electrical apparatus.
- evaluate the theory of circuit interruption.

- identify the circuit breakers based on the operation and characteristics.
- perform synthesis of numerical protection of transmission line using static comparator.

TEXT BOOKS

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

REFERENCES

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

CO-PO MAPPING:

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

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

BA16151 PROFESSIONAL ETHICS AND HUMAN VALUES 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the basic human values for a professional.
- discuss the significance of ethics in engineering and the theories related to it.
- familiarize oneself with the role of engineer as responsible experimenters.
- expose their roles and responsibilities in assessing safety and reducing risks.
- illustrate the global issues in ethics and role of engineers as manager and consultants.

UNIT I HUMAN VALUES 9

Morals, values and ethics - integrity - work ethic - service learning - civic virtue - respect for others - living peacefully, caring , sharing , honesty , courage, valuing time , cooperation, commitment, empathy , self-confidence, character, spirituality.

UNIT II ENGINEERING ETHICS 9

Senses of 'Engineering Ethics' - variety of moral issues - types of inquiry - moral dilemmas- moral autonomy - Kohlberg's theory - Gilligan's theory - consensus and controversy - models of professional roles - theories about right action - self-interest - customs and religion - uses of ethical theories.

UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION 9

Engineering as experimentation - engineers as responsible experimenters - codes of ethics - a balanced outlook on law - the challenger case study.

UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS 9

Safety and risk - assessment of safety and risk - risk benefit analysis and reducing risk - the three mile Island and Chernobyl case studies. collegiality and loyalty - respect for authority - collective bargaining - confidentiality - conflicts of interest - occupational crime - professional rights - employee rights - intellectual property rights (IPR) - discrimination.

UNIT V GLOBAL ISSUES 9

Multinational corporations - environmental ethics - computer ethics - weapons development - engineers as managers-consulting engineers-engineers as expert witnesses and advisors - moral leadership - sample code of ethics like ASME, ASCE, IEEE, Institution of Engineers(India), Indian institute of materials management, institution of electronics and telecommunication engineers(IETE), India, etc.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- describe the basic human values for a professional.
- signify of ethics in engineering and the theories related to it.
- familiar with the role of engineer as responsible experimenters.
- acquire knowledge about their roles and responsibilities in assessing safety and reducing risks.
- converse the global issues in ethics and role of engineers as manager and consultants.

TEXT BOOKS

1. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw Hill, New York 2005.
2. Charles E Harris, Michael S Pritchard and Michael J Rabins, "Engineering Ethics –Concepts and Cases", Thompson Learning, 2000.

REFERENCES

1. Charles D Fleddermann, "Engineering Ethics", Prentice Hall, New Mexico, 2005.
2. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, 2003.
3. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, 2001.
4. Prof. (Col) P S Bajaj and Dr. Raj Agrawal, "Business Ethics – An Indian Perspective", Biztantra, New Delhi, 2004.
5. David Ermann and Michele S Shauf, "Computers, Ethics and Society", Oxford University Press, 2003.

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

EE16704 POWER SYSTEM SIMULATION LABORATORY 0 0 4 2

COURSE OBJECTIVES

To enable the students to

- impart knowledge about load flow analysis through digital simulation.
- study the dynamic mechanisms behind angle and voltage stability problems in electric power systems, including physical phenomena and modelling issues.
- perform the estimation of different states of a power system.
- understand dispatching schemes in power systems

LIST OF EXPERIMENTS

1. Computation of transmission lines parameter.
2. Formation of bus admittance matrices and solution of networks.
3. Formation of bus impedance matrices and solution of networks.
4. Solution of load flow and related problems using Gauss-Seidel method.
5. Solution of load flow and related problems using Newton-Raphson.
6. Solution of load flow and related problems using Fast-Decoupled methods.
7. Electromagnetic transients in power system.
8. Small signal stability analysis single machine infinite bus system.
9. Small signal stability analysis multi machine infinite bus system.
10. Economic dispatch in power systems.

TOTAL PERIODS 60

COURSE OUTCOMES

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

- investigate the power flow studies.
- reproduce the electromagnetic and electromechanical phenomena in the synchronous generator.
- enumerate the compensations schemes available in power systems.
- develop generation dispatching schemes in power systems.

CO-PO MAPPING:

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

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

EE16705 **MINI PROJECT** **0 0 4 2**

COURSE OBJECTIVES

To enable the students to

- gain knowledge on literature review.
- categorize the requirements for the project
- develop the ability to implement their engineering knowledge to build products.
- train the students in preparing project reports and to face reviews and viva voce examination

The student in a group of 3 to 4 works on a topic approved by the Head of the Department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL PERIODS 60

COURSE OUTCOMES

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

- apply the basic fundamentals
- analyze the requirements for the project.
- implement concepts of engineering in developing hardware modules.
- demonstrate the working model.

CO-PO MAPPING:

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

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

SEMESTER VIII

EE16801 UTILIZATION OF ELECTRICAL ENERGY 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- impart knowledge principle and application of electric drives and traction.
- illustrate the principle and design of Illumination systems.
- emphasize the basic principle and methods of heating and welding and the concept of electroplating.
- understand the basic principle and operation of refrigeration and air conditioning.
- impart knowledge economics of electrical energy utilization.

UNIT I ELECTRIC DRIVES AND TRACTION 9

Fundamentals of electric drive - choice of an electric motor - application of speed control in industrial drives, electric vechicle - introduction - requirements of ideal traction system - supply systems - mechanics of train movement - traction motors and control - multiple units - braking - current collection systems - recent trends in electric traction - applications of braking in traction.

UNIT II ILLUMINATION 9

Importance of lighting - properties of good lighting scheme - nature of radiation - definition - laws - photometry - types of lamps - lighting calculations - basic design of illumination systems - residential, industrial, commercial, health care, street lightings, sports ground .- energy efficiency lamps.

UNIT III HEATING AND WELDING 9

Methods of heating- requirement of heating material - design of heating element - furnaces - welding generator - welding transformer and its characteristics- electro-plating: methods - estimation of power and current for depositing metals - current and energy efficiency - electro-deposition and electroforming - power supply for electrolysis.

UNIT IV ELECTRICAL CIRCUITS USED IN REFRIGERATION AND AIR CONDITIONING AND WATER COOLER 9

Principle of air conditioning - vapour pressure - refrigeration cycle - eco-friendly refrigerants - description of electrical circuit used in refrigerator - air-conditioner, and water cooler - BEE star rating.

UNIT V ECONOMICS OF ELECTRICAL ENERGY UTILIZATION 9

Economic aspects of power generation - load and load duration curves - number and size of units - cost of electrical energy – tariff - economics of power factor improvement - power capacitors - power quality - importance of electrical energy conservation - methods - energy efficient equipments. introduction to energy auditing.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- gain the knowledge regarding the concept of electric drives and traction systems.
- expand the knowledge regarding design of illumination systems.
- reproduce the concepts of basic principle and methods of heating and welding.
- put on their knowledge regarding refrigeration and air conditioning.
- learn the energy utilization and consumption and economics.

TEXT BOOKS

1. Dr.N.V.Suryanarayana, "Utilisation of Electric power", Wiley Eastern Limited, New Age International Limited, 2018.
2. S.L. Uppal, "Electrical Power", Khanna Publishers, 2017.
3. R.K.Rajput, "Utilisation of Electrical Power", Laxmi publications (P) Ltd., 2018.

REFERENCES

1. H.Partab, "Art and Science of Utilisation of Electrical Energy", Dhanpat Rai and Co., New Delhi – 2016.
2. C.L. Wadhwa, "Generation, Distribution and Utilization of Electrical Energy", New Age International Pvt.Ltd, 2016.
3. J.B. Gupta, "Utilization of Electric Power and Electric Traction", S.K.Kataria and Sons, 2015.
4. B.R. Gupta, "Generation of Electrical Energy", Eurasia Publishing House Ltd, New Delhi, 2015.
5. Gopal.K.Dubey, "Fundamentals of Electrical Drives", Narosa Publishing House, New Delhi, 2016.

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

EE16802 **PROJECT WORK** **0 0 12 6**

COURSE OBJECTIVES

To enable the students to

- develop their ability to solve a specific problem right from its identification.
- literature review till the successful solution of the same.
- categorize the requirements for the project
- train the students in preparing project reports and to face reviews and viva voce examination

The student in a group of 3 to 4 works on a topic approved by the Head of the Department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL PERIODS 180

COURSE OUTCOMES

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

- apply the basic fundamentals
- analyze the requirements for the project.
- take up any challenging practical problems.
- find solution by formulating proper methodology.

CO-PO MAPPING:

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

PROGRAMME ELECTIVE II

EE16251 VLSI DESIGN AND CIRCUITS 3 0 0 3

COURSE OBJECTIVES

To enable the students to

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

UNIT I MOS TECHNOLOGY AND CIRCUITS 9

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

UNIT II MOS CIRCUIT DESIGN PROCESS 9

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

UNIT III COMBINATIONAL LOGIC CIRCUITS 9

Design of half adder - full adder- multiplexer - demultiplexer, transmission gates - Elmores delay model - static CMOS design-power dissipation - low power design principles - comparison of circuit families.

UNIT IV SUBSYSTEM DESIGN PROCESS 9

Sheet resistance, area capacitance of layers, propagation of delays, some clocked sequential circuits - adders - ripple carry adder, carry bypass adder, carry skip adder, carry look-ahead adder – multiplier - dividers - barrel shifters - speed and area trade off.

UNIT V IMPLEMENTATION STRATEGIES 9

Full custom and semi custom ASIC design - classification of gate arrays - programmable logic devices (PLD) - programming of PAL- FPGA building block architectures - ASIC design flow.

TOTAL PERIODS 45

COURSE OUTCOMES

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

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

TEXT BOOKS

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

REFERENCES

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

CO-PO MAPPING:

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

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

EE16252 **POWER SYSTEM DYNAMICS** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- know the basics of mathematical description of a synchronous machine.
- acquire the knowledge of speed governing systems.
- understand the concept of excitation system and its control and protective schemes.
- know the stability analysis of various power system networks.
- analyse basic concept related to voltage stability in transmission system.

UNIT I SYNCHRONOUS MACHINE MODELING 9

Synchronous machine - physical and mathematical description of a synchronous machine. basic equations of a synchronous machine - dq0 transformation. per unit representation - equivalent circuits for direct and quadrature axes.

UNIT II SMALL-SIGNAL STABILITY ANALYSIS 9

Classification of stability - basic concepts and definitions: Rotor angle stability - fundamental concepts of stability of dynamic systems: state-space representation - stability of dynamic system - linearization, eigen properties of the state matrix - single-machine infinite bus (SMIB) configuration: classical machine model stability analysis with numerical example - Small signal stability of multi-machine system.

UNIT III EXCITATION SYSTEMS AND IT'S MODELLING 9

Excitation system modeling - excitation system requirements - types of excitation- dynamic performance measures: large signal and small signal performance measures - control and protective functions - modelling of excitation system: per unit system - modelling of excitation system components - modeling of complete excitation system - field testing for model development and verification.

UNIT IV STABILITY ANALYSIS 9

Introduction - factors influencing transient stability - simulation of power system dynamic response: structure of power system model, synchronous machine representation, excitation system representation, transmission network and load representation, overall system equations, solution for overall system equation - analysis of unbalanced faults: introduction to symmetrical components - sequence impedance of synchronous machine, transmission lines and transformers - simulation of different types of faults.

UNIT V VOLTAGE STABILITY 9

Basic concepts related to voltage stability - transmission system characteristics, generator and load characteristics - characteristics of reactive compensating devices - voltage collapse: modelling requirement, dynamic and static analysis - determination of shortest distance to instability, the continuous power flow analysis - prevention of voltage collapse: system design measures, system operating measures.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- deliver the basic design consideration of synchronous machine.
- describe the fundamental dynamic behaviour and controls of power systems to perform basic stability analysis.
- acquire knowledge on excitation system and its design modelling.
- interpret results of system stability studies.
- acquire knowledge on voltage collapse and modelling requirement.

TEXT BOOKS

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

REFERENCES

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

CO-PO MAPPING:

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

EE16253 FLEXIBLE AC TRANSMISSION SYSTEM 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the concepts of FACTS.
- expose the applications of FACTS controllers in power systems.
- learn about shunt and series compensation schemes.
- study the operation of controllers for enhancing the transmission capability.
- understand the modern controller for FACTS devices.

UNIT I REACTIVE POWER COMPENSATOR 9

Reactive power control in electrical power transmission lines - uncompensated transmission line - series compensation - basic concepts of static VAR Compensator (SVC) - thyristor controlled series capacitor (TCSC) - unified power flow controller (UPFC).

UNIT II STATIC VAR COMPENSATOR (SVC) AND APPLICATIONS 9

Voltage control by SVC - advantages of slope in dynamic characteristics - influence of SVC on system voltage - design of SVC voltage regulator – applications - enhancement of transient stability - steady state power transfer - enhancement of power system damping - prevention of voltage instability.

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

Operation of the TCSC - different modes of operation - modelling of TCSC - variable reactance model - modelling for stability studies - applications - improvement of the system stability limit - enhancement of system damping - voltage collapse prevention.

UNIT IV EMERGING FACTS CONTROLLERS 9

Static synchronous compensator (STATCOM) - principle of operation - V-I characteristics – applications - steady state power transfer - enhancement of transient stability - prevention of voltage instability - unified power flow controller (UPFC) - principle of operation - modes of operation - applications - modelling of UPFC for power flow studies.

UNIT V CO-ORDINATION OF FACTS CONTROLLERS 9

Controller interactions - SVC - SVC interaction - Co-ordination of multiple controllers using linear control techniques - control coordination using genetic algorithms.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- analyze the concept of FACTS.
- design various FACTS controllers
- explain the application of various FACTS controllers.
- describe the various emerging FACTS controllers
- apply the control techniques for FACTS controllers using genetic algorithms

TEXT BOOKS

1. K.R. Padiyar, "FACTS Controllers for Power Transmission and Distribution" New Age International Publishers, 2016.
2. Mohan Mathur R, Rajiv K Varma, "Thyristor – Based Facts Controllers for Electrical Transmission Systems", IEEE press and John Wiley and Sons, Inc., 2002, Reprint 2017.

REFERENCES

1. Xiao-Ping Zhang "Flexible AC Transmission Systems" Springer ,2016.
2. Narain G.Hingorani, LaszioGyugyi, "Understanding FACTS concept and Technology", Standard Publisher, Delhi, 2015.
3. Gyugyi L., "Unified power flow control concept for flexible AC transmission ", IEEEProc-C, Vol.139, No.4, July 2016.
4. A.T.John, "Flexible A.C. Transmission Systems", Institution of Electrical andElectronic Engineers (IEEE), 2016.
5. V.K.Sood,HVDC and "FACTS controllers – Applications of Static Converters in Power System" , Kluwer Academic Publishers, 2014.

CO-PO MAPPING:

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

EE16254 OPTOELECTRONIC DEVICES 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- know the basics of solid state physics and understand the nature and characteristics of light.
- understand different methods of luminescence, display devices and laser types and their applications.
- learn the principle of optical detection mechanism in different detection devices.
- understand different light modulation techniques and the concepts and applications of optical switching.

UNIT I ELEMENTS OF LIGHT AND SOLID STATE PHYSICS 9

Wave nature of light - polarization - interference - diffraction - light source - review of quantum mechanical concept - review of solid state physics - review of semiconductor physics and semiconductor junction device.

UNIT II DISPLAY DEVICES AND LASERS 9

Introduction, photo luminescence - cathode luminescence - electro luminescence - injection luminescence - LED - plasma display - liquid crystal displays - numeric displays - laser emission, absorption – radiation - population inversion - optical feedback - threshold condition - laser modes - classes of lasers - mode locking - laser applications.

UNIT III OPTICAL DETECTION DEVICES 9

Photo detector - thermal detector - photo devices - photo conductors - photo diodes - detector performance.

UNIT IV OPTOELECTRONIC MODULATOR 9

Introduction, analog and digital modulation - electro-optic modulators - magneto optic devices - acoustoptic devices - optical, switching and logic devices.

UNIT V OPTOELECTRONIC INTEGRATED CIRCUITS 9

Introduction - hybrid and monolithic integration - application of opto electronic integrated circuits - integrated transmitters and receivers - guided wave devices.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- apply the basics of solid state physics and understand the nature and characteristics of light.
- choose the method of luminescence, display devices and laser types based on applications.
- explain the principle of optical detection mechanism in different detection devices.

- analyze light modulation techniques and apply to optical switching.
- design optoelectronic integrated circuits in transmitters and receivers.

TEXT BOOKS

1. Pallab Bhattacharya "Semiconductor Opto Electronic Devices", Prentice Hall of India Pvt., Ltd., New Delhi, 2016.
2. Jasprit Singh, "Opto Electronics – As Introduction to materials and devices", McGraw-Hill International Edition, 2017.

REFERENCES

1. S C Gupta," Opto Electronic Devices and Systems", Prentice Hal of India,2016.
2. J. Wilson and J.Haukes, "Opto Electronics – An Introduction", Prentice Hall, 2015.
3. Xun li, "Opto Electronic Devices and Applications – Design modeling and simulation" Cambridge University Press, 2016.
4. Oleg Sergiyenko, "Optoelectronic Devices and Properties", InTech, 2015.
5. M.A.Parker, "Physics of optoelectronics" CRC Press, 2015.

CO-PO MAPPING:

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

MA16153 OPERATIONS RESEARCH 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- provide the concept and an understanding of basic concepts in operations research.
- understand develop and solve mathematical model of transport and assignment problems.
- understand the techniques of optimality.
- develop an understanding and appreciation for the field of inventory and production management.
- provide the student with a rigorous framework with which to model and analyze queuing systems.

UNIT I LINEAR PROGRAMMING MODELS 9

Mathematical formulation - graphical solution of linear programming models - simplex method - big M-method - two phase method.

UNIT II TRANSPORTATION AND ASSIGNMENT MODELS 9

Mathematical formulation of transportation problem - methods for finding initial basic feasible solution - optimum solution - degeneracy - mathematical formulation of assignment models - variants of the assignment problem.

UNIT III DYNAMIC PROGRAMMING 9

Dynamic programming - principle of optimality - forward and backward recursion - applications of dynamic programming - problem of dimensionality.

UNIT IV INVENTORY MODELS AND NETWORKING MODELS 9

Inventory models - EOQ and EBQ models (with and without shortages), quantity discount models - networking models - PERT and CPM.

UNIT V QUEUEING MODELS 9

Characteristics of queuing models - poisson queues - (M / M / 1) : (FIFO / ∞ /∞), (M / M / 1) : (FIFO / N / ∞), (M / M / C) : (FIFO / ∞ / ∞), (M / M / C) : (FIFO / N / ∞) models.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- apply linear, integer programming to solve operational problem with constraints.
- apply transportation and assignment models to find optimal solution in warehousing and travelling.
- use optimization concepts in real world problems.
- apply inventory models and techniques to create and recommend appropriate stocking solutions

in various business settings.

- identify and analyze appropriate queuing model to reduce the waiting time in queue.

TEXT BOOKS

1. R.Panneerselvam," Operations research", Second edition, Prentice hall –USA-2017.
2. Operations Research by Kanthiswarup, P.K. Gupta, Manmohan 9thRevised Edition 2015, Reprint 2017. Sultan Chand and Sons, New Delhi

REFERENCES

1. Taha H.A, "Operations Research: An Introduction ", 15th Edition, Pearson Education, 2017
2. Prem Kumar Gupta, D.S. Hira, "Operations Research", S.Chand and Company Ltd, New Delhi, Third Edition , 2018
3. John W. Chinneck, "Feasibility and Infeasibility in Optimization Algorithms and Computational Methods", Springer, 2018.
4. Ravindran, Phillips, Solberg, "Operations Research: Principles and Practice", Second Edition, John Wiley and Sons, 2017.

CO-PO MAPPING:

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

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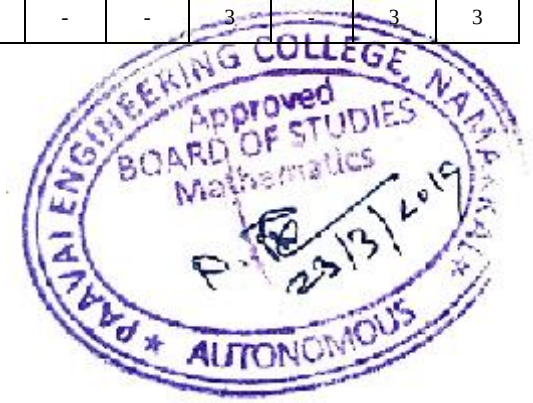
CO2	3	3	3	-	3	-	3	-	-	-	3	-	3	3
CO3	-	3	3	-	3	-	3	-	-	-	-	2	3	3
CO4	3	3	3	-	3	-	3	-	-	-	3	-	3	3
CO5	-	3	3	-	3	-	3	-	-	-	3	-	3	3



OPEN ELECTIVE II

EE16905 EMBEDDED SYSTEM DESIGN 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- initiate their knowledge embedded system and is devices, architecture of processor.
- launch the concept of bus communication in processors, Input/output interfacing.
- gain the knowledge of various embedded software tools, design and architecture of memories.
- establish basics of Real time operating system and example tutorials to discuss on one real time operating system tool.
- impart knowledge on embedded system application development.

UNIT I INTRODUCTION TO EMBEDDED SYSTEMS 9

Introduction to embedded Systems - the build process for embedded systems - structural units in embedded processor, selection of processor and memory devices- DMA - memory management methods - software architecture of embedded system.

UNIT II EMBEDDED NETWORKING 9

Embedded networking: Introduction, I/O device ports and buses - serial bus communication protocols - RS232 standard - RS422 - RS485 - CAN Bus - serial peripheral interface (SPI) - inter integrated circuits (I^2C) - parallel communication PCI/ISA.

UNIT III EMBEDDED SOFTWARE DEVELOPMENT PROCESS AND TOOLS 9

Introduction to embedded software development process and tools - host and target machines - linking and locating software - issues in hardware-software design - basic concepts of compiler, linker, loader, simulator, emulators, logic analyzer, watchdog timer and ICE.

UNIT IV RTOS BASED EMBEDDED SYSTEM DESIGN 9

Introduction to basic concepts of RTOS - task, process and threads, interrupt routines in RTOS, multiprocessing and multitasking, preemptive and non-preemptive scheduling, task communication shared memory, message passing - inter process communication - synchronization between processes - semaphores, mailbox, pipes, priority inversion, priority inheritance.

UNIT V EMBEDDED SYSTEM APPLICATION DEVELOPMENT 9

Case study of washing machine - automotive application - smartcard system.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- deliver the concepts of embedded communication.
- enumerate the concept of networking architecture.
- identify the software development process and tools of embedded system.
- know the real time based system.
- design in application of embedded system.

TEXT BOOKS

1. Rajkamal, 'Embedded System-Architecture, Programming, Design', Mc Graw Hill, 2013.
2. K.V.K.K.Prasad "Embedded /Real-Time Systems: Concepts, Design and Programming "Dream tech, Wiley 2013.
3. Peckol, "Embedded system Design", John Wiley and Sons,2015.

REFERENCES

1. Shibu. K.V, "Introduction to Embedded Systems", Tata Mcgraw Hill,2017.
2. Tammy Noergaard, "Embedded Systems Architecture", Elsevier, 2016.
3. Rajib Mall "Real-Time systems Theory and Practice" Pearson Education, 2016.

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

EE16906 SOLAR AND WIND ENERGY ENGINEERING 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- expose principles and applications of various renewable energy resources.
- impart knowledge on applications of solar energy in agriculture.
- get an idea about the photovoltaic technology.
- understand the wind mapping analysis.
- know about design and applications of windmill.

UNIT I INTRODUCTION OF RENEWABLE ENERGY 9

World energy scenario -energy sources and their availability; qualitative study of different renewable energy resources – solar, wind, ocean, biomass, fuel cell, hydrogen energy systems and hybrid renewable energy systems.

UNIT II SOLAR COLLECTORS AND APPLICATION 9

Solar radiation availability - radiation measurement - collectors types -flat-plate collector, liquid collector, air collectors (solar air heaters) , concentrating collectors -types -parabolic trough collector - mirror strip reflector-Fresnel lens collector - application of solar energy -solar thermal power station - solar furnace -solar green houses -solar stills -solar pond - solar pump - solar drier.

UNIT III PHOTOVOLTAIC TECHNOLOGY 9

Photovoltaic energy conversion – solar cells and their characteristics - PV arrays - electrical storage with batteries -inverter - selection of inverter - battery sizing - array sizing - PV applications -Stand alone inverters -charge controllers - street lighting - hybrid system - solar technology in green buildings.

UNIT IV WIND MAPPING ANALYSIS AND CHARACTERISTICS OF WIND 9

Nature of wind - wind structure and measurement -wind power laws - velocity and power duration curves -aerofoil -tip-speed ratio -torque and power characteristics -power coefficients -Betz coefficient.

UNIT V WINDMILL DESIGN AND APPLICATIONS 9

Turbines - windmill - classification -power curve; -upwind and downwind systems – transmission rotors - pumps - generators - standalone system - grid system –batteries - wind energy storage - wind farms -wheeling and banking -testing and certification procedures.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- implement the alternate energy resources.
- apply the concept of solar energy in agricultural applications.
- explain about the photovoltaic technology.
- analyse the wind mapping.
- design of windmills for required applications.

TEXT BOOKS

1. Rai., G.D. “Solar Energy Utilization” Khanna publishers, New Delhi, 2015.
2. More, H.S and R.C. Maheshwari, “Wind Energy Utilization in India” CIAE Publication - Bhopal, 2016.
3. Rao. S and B.B. Parulekar, “Energy Technology -Non conventional, Renewable and Conventional”,Khanna Publishers, Delhi, 2015.

REFERENCES

1. Mathew Buresch, “Photovoltaics Energy Systems”, McGraw-Hill Book Company, London, 2015.
2. JuiSheng Hsieh. “Solar Energy Engineering”, Prentice Hall, London, 2014.
3. TanyBurtar, “Hand book of wind energy.”,John Wiley and Sons, 2017,
4. J.G.McGowan, Manwell, J.F. and A.L.Rogers ,“Wind Energy Explained -Theory Design and Application”, John Wiley and Sons Ltd, 2014.
5. Rai. G.D. “Non Conventional Sources of Energy”, Khanna Publishers, New Delhi, 2012.

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	Programme Outcomes PO’s												PSO’s	
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CO3	3	3	3	2	2	1	-	-	-	-	3	-	3	3
CO4	3	3	3	2	2	1	-	-	-	-	3	-	3	3
CO5	3	3	3	2	2	1	-	-	-	-	3	-	3	3

PROGRAMME ELECTIVE III

EE16351 EHV AC AND DC TRANSMISSION 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- impart knowledge on EHV AC transmission.
- comprehend the line and ground parameter calculations.
- identify about the effect of electric and magnetic fields of EHV lines.
- understand the planning of DC power transmission and to analyze HVDC converters.
- study about the HVDC system control.

UNIT I INTRODUCTION TO EHV AC TRANSMISSION AND LINE TRENDS 9

Role of EHV AC transmission- standard transmission voltages – average values of line parameters - power-handling capacity and line loss - costs of transmission lines and equipment – mechanical considerations in line performance.

UNIT II CALCULATION OF LINE AND GROUND PARAMETERS 9

Resistance of conductors - temperature rise of conductors and current - carrying capacity - properties of bundled conductors - calculation of L and C parameters - sequence inductances and capacitances - line parameters for modes of propagation - effect of grounding in electrical systems.

UNIT III ELECTROSTATIC AND MAGNETIC FIELDS OF EHV LINES 9

Electric shock - threshold currents - calculation of electrostatic fields and magnetic fields of AC and DC lines - effect of fields on living organism - electrical field measurement.

UNIT IV INTRODUCTION AND ANALYSIS OF HVDC CONVERTERS 9

Comparison of AC and DC transmission - description of DC transmission system - planning for HVDC transmission - modern trends - application - choice of converter configuration - converter bridge characteristics - characteristics of twelve pulse converters.

UNIT V CONVERTER AND HVDC SYSTEM CONTROL 9

Principles of DC link - converter control characteristic - system control hierarchy - firing angle control - current and extinction angle control - starting and stopping of DC link - power control -higher level controllers.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- examine the role of EHV AC transmission and its basic principles..
- evaluate the line and ground parameters of EHV lines.
- identify the components of electrostatic and magnetic field effects of EHV lines.
- describe the principles of HVDC system and features of converters.
- deliberate the characteristic and control of HVDC system.

TEXT BOOKS

1. RakoshDas Begamudre " Extra high voltage AC transmission Engineering", New Age International Publishers, Third Edition, Reprint 2016.
2. K R Padiyar "HVDC Power Transmission Systems",New Age International Publishers, First Edition, Reprint 2017.

REFERENCES

1. S Kamakshaiah and V Kamaraju "HVDC Transmission", Tata McgrawHilll Publishers, 2016.
2. Sunil S. Rao,"EHV-AC, HVDC Transmission and Distribution Engineering", Third Edition, Khanna Publishers, 2016.
3. Edward Wilson Kimbark, "Direct Current Transmission", Vol. I, Wiley interscience, New York, London, Sydney, 2016.
4. Colin Adamson and Hingorani N G, "High Voltage Direct Current Power Transmission", Garraway Limited, London, 2016.
5. P.Kundur" Power System stability and control", Tata McgrawHilll Publishers, 2017.

CO-PO MAPPING:

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

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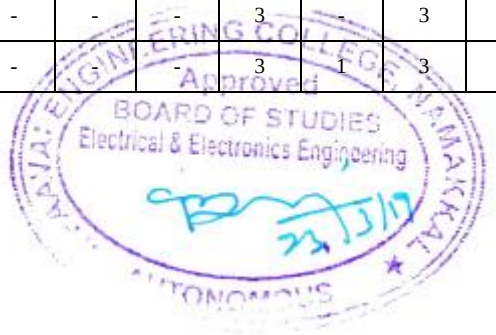
CO3	1	3	3	1	3	-	3	-	-	-	-	2	3	3
CO4	3	3	3	-	3	-	3	-	-	-	3	-	3	3
CO5	1	3	3	-	3	-	3	-	-	-	3	1	3	3



EE16352 ENERGY AUDITING 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- learn basic concepts, calculation rules and systems for energy savings calculations.
- implement the concept behind economic analysis and load management.
- emphasize the energy management on various electrical equipment.
- identify the various metering for energy management.
- illustrate the concepts of lighting systems and cogeneration.

UNIT I INTRODUCTION 9

Need for energy management - energy basics - designing and starting an energy management program - energy accounting - energy monitoring, targeting and report - energy audit process.

UNIT II ENERGY COST AND LOAD MANAGEMENT 9

Important concepts in an economic analysis - economic models - time value of money - utility rate structures - cost of electricity - loss evaluation load management: demand control technique - utility monitoring and control system - HVAC and energy management - economic justification.

UNIT III ENERGY MANAGEMENT FOR MOTORS, SYSTEMS AND ELECTRICAL EQUIPMENT 9

Systems and equipment - electric motors - transformers and reactors - capacitors and synchronous machines.

UNIT IV METERING FOR ENERGY MANAGEMENT 9

Relationships between parameters - units of measure - typical cost factors - utility meters - timing of meter disc - for kilowatt measurement - demand meters - paralleling of current transformer - Instrument transformer burdens Multitasking solid state meters - Metering location vs requirements - metering techniques and practical examples.

UNIT V LIGHTING SYSTEMS AND COGENERATION 9

Concept of lighting systems - the task and the working space - light sources - ballasts - luminaries - lighting controls - optimizing lighting energy - power factor and effect of harmonic on power quality - cost analysis technique and energy standards. cogeneration: forms of cogeneration - feasibility of cogeneration - electrical interconnection.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- describe the concepts of energy management and auditing.
- deliver the concepts of economic analysis and load management.
- replicate about the choice and rating of electrical machineries for selected applications.
- illustrate about metering methods, cost analysis techniques and suitable energy standards
- implement knowledge regarding the lighting systems and cogeneration.

TEXT BOOKS

1. Barney L. Capehart, Wayne C. Turner, and William J. Kennedy, "Guide to Energy Management", Fifth Edition, the Fairmont Press, Inc., 2016

2. Arry C. White, Philip S. Schmidt, David R. Brown, Hemisphere "Industrial Energy Management Systems" Publishing Corporation, New York,2016

3. Albert Thumann, "Fundamentals of Energy Engineering" Prentice Hall Inc, Englewood Cliffs, New Jersey, 2017.

REFERENCES

1. L.C. Witte, P.S. Schmidt, D.R. Brown, "Industrial Energy Management and Utilisation" Hemisphere Publ, Washington, 2017.

2. Callaghn, P.W. "Design and Management for Energy Conservation", Pergamon Press, Oxford, 2016.

3. W.R. Murphy and G. McKay "Energy Management" Butterworths, London 2017.

4. Eastop T.D and Croft D.R, "Energy Efficiency for Engineers and Technologists", Logman Scientific and Technical, ISBN-0-582-03184, 2016.

5. Amit K. Tyagi, "Handbook on Energy Audits and Management", TERI, 2016.

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EE16353 HIGH VOLTAGE ENGINEERING 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- gain knowledge on the various types of over voltages in power system and protection methods.
- know the nature of breakdown mechanism in solid, liquid and gaseous dielectrics.
- impart knowledge on generation of over voltages in laboratories
- learn measurement of over voltages.
- test power apparatus and insulation coordination.

UNIT I OVER VOLTAGES IN ELECTRICAL POWER SYSTEMS 9

Causes of over voltages and its effects on power system - lightning, switching surges and temporary over voltages, corona and its effects - reflection and refraction of travelling waves - protection against over voltages.

UNIT II DIELECTRIC BREAKDOWN 9

Gaseous breakdown in uniform and non-uniform fields - corona discharges - vacuum breakdown conduction and breakdown in pure and commercial liquids, maintenance of oil quality - breakdown mechanisms in solid and composite dielectrics.

UNIT III GENERATION OF HIGH VOLTAGES AND HIGH CURRENTS 9

Generation of high DC, AC, impulse voltages and currents - triggering and control of impulse generators.

UNIT IV MEASUREMENT OF HIGH VOLTAGES AND HIGH CURRENTS 9

High resistance with series ammeter - dividers, resistance, capacitance and mixed dividers - peak voltmeter, generating voltmeters - capacitance voltage transformers, electrostatic voltmeters - sphere gaps - high current shunts - digital techniques in high voltage measurement

UNIT V HIGH VOLTAGE TESTING and INSULATION COORDINATION 9

High voltage testing of electrical power apparatus as per international and Indian standards - power frequency, impulse voltage and DC testing of insulators, circuit breakers, bushing, isolators and transformers - insulation coordination.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- deliver the effects of over voltages and protection techniques in power systems.
- analyze the various breakdown mechanisms in different dielectric materials.
- explain the generation of high voltages and high currents.

- assess the techniques of measuring high voltages and high currents.
- express the testing and insulation mechanism in electrical apparatus.

TEXT BOOKS

1. S.Naidu and V. Kamaraju, "High Voltage Engineering", Tata McGraw Hill, Fifth Edition, 2013.
2. E. Kuffel and W.S. Zaengl, J.Kuffel, "High voltage Engineering fundamentals", Newnes Second Edition Elsevier , New Delhi, 2016.
3. Subir Ray, "An Introduction to High Voltage Engineering" PHI Learning Private Limited, New

REFERENCES

1. L.L. Alston, "High Voltage Technology", Oxford University Press, First Indian Edition, Reprint 2016.
2. C.L. Wadhwa, "High voltage Engineering", New Age International Publishers, Third Edition, Reprint 2017.

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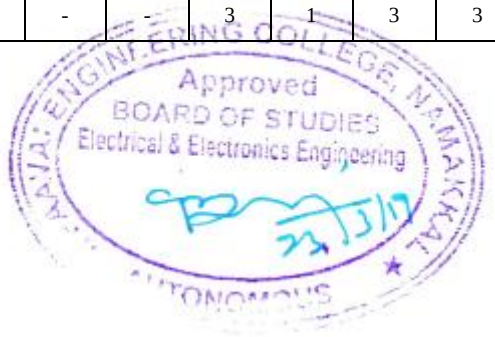

EE16354 COMPUTER NETWORKS 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the concepts of layering in networking, network architecture and classifications.
- provide the knowledge about various protocols used in different layers of networks.
- study about the switching concepts and routing protocols.
- learn about the transmission control protocol and their functions.
- gain knowledge about applications of various protocol.

UNIT I INTRODUCTION TO NETWORKS 9

Introduction to networks – network topology - types of networks - network architecture - layering - design issues - client/server model - protocols - bridges - routers - repeaters - switches.

UNIT II BASICS OF INTERNET WORKING 9

Introduction to internetworking - internetworking concepts and architectural model - internet addressing - domain name system (DNS) - address resolution protocol (ARP) - reverse address resolution protocol (RARP).

UNIT III INTERNET PROTOCOL AND ITS ROUTING 9

Introduction to IP protocol - virtual networks - concept of unreliable delivery - connectionless delivery system - purpose on internet protocol - internet data gram - datagram options. introduction to routing - IP datagram - direct and indirect delivery - table driven IP routing - next hop routing.

UNIT IV TRANSMISSION CONTROL PROTOCOL 9

Introduction to TCP - properties of reliable delivery service - TCP protocol - TCP segment format - TCP connection - TCP state machine - silly window syndrome.

UNIT V APPLICATION PROTOCOL 9

Simple mail transfer protocol (SMTP) - post office protocol (POP) - file transfer protocol (FTP) - telnet - simple network management protocol (SNMP) - internet security and firewall design.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- identify the components required to build different types of networks.
- describe the functions of layered reference models and functional component namely protocol used for data communication.
- comprehend various flow control and congestion control mechanisms.

- analyze nodes in the networks are uniquely addressed globally and various routing algorithms used for identifying the path to reach the destination.
- describe various security mechanisms used securing the data packets in a network.

TEXT BOOKS

1. Douglas E. Comer, "Internet working with TCP/IP: principles, protocols and architecture", Volume 1 ',Sixth Edition, Pearson, Reprint 2017.
2. Andrew S.Tananbaum, David J.Wetherall "Computer Networks", Fifth Edition, Prentice Hall of India/Pearson Education, Reprint 2017.

REFERENCES

1. Bechrouz A. Forouzan, "TCP/IP Protocol Suite", Fourth Edition, Tata McGraw Hill, 2017.
2. William Stallings, "Data and Computer Communications", Tenth Edition, Prentice Hall of India/ Pearson Education, 2017.
3. A.S.Kernel Explain, "Communication Network Management", Prentice Hall of India Ltd, New Delhi 2017.
4. Larry L.Peterson and Bruce S. Davie, "Computer Networks: A Systems Approach", FifthEdition, Morgan Kaufmann Publishers, 2017.

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

EE16355 DESIGN WITH PIC MICROCONTROLLER 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- introduce the architecture of PIC microcontroller.
- educate the use of interrupts and timers.
- instruct about the peripheral devices for data communication and transfer.
- introduce the functional blocks of ARM processor.
- train on the architecture of ARM processors and applications.

UNIT I PIC MICROCONTROLLER 9

Introduction to PIC microcontroller - PIC 16C6x and PIC16C7x architecture - program memory considerations - register file structure - instruction set - addressing modes - pipelining.

UNIT II INTERRUPTS AND TIMER 9

PIC micro controller interrupts - external interrupts - loop time subroutine - timers - timer programming - front panel I/O - soft keys - state machines and key switches - display of constant and variable strings.

UNIT III PERIPHERALS AND INTERFACING 9

I^2C bus for peripherals chip access - bus operation - bus subroutines - serial EEPROM - analog to digital converter - UART - baud rate selection - LCD and keyboard interfacing - ADC, DAC and sensor interfacing.

UNIT IV ARM PROCESSOR 9

ARM architecture - ARM programmer's model - ARM development tools - memory hierarchy -ARM assembly language programming - architectural support for operating systems.

UNIT V ARM ORGANIZATION 9

3-Stage pipeline ARM organization - 5-Stage pipeline ARM organization - ARM instruction execution - ARM implementation - ARM instruction set - ARM coprocessor interface - architectural support for high level languages - embedded ARM application.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- describe the architecture of PIC microcontroller.
- explain about the microcontroller interrupts.
- design various interfaces to the PIC.

- comprehend about the ARM architecture and development tools.
- elucidate the various application of ARM and organization.

TEXT BOOKS

1. Peatman,J.B., "Design with PIC Micro Controllers" Pearson Education, 3rd Edition, Reprint 2016.
2. Furber,S., "ARM System on Chip Architecture" Addison Wesley trade Computer Publication, Reprint 2017.

REFERENCES

1. Rollin Mckinlay, Danny causey Mazidi, M.A., "PIC Microcontroller" Printice Hall of India, Reprint 2017.
2. Balamurugan C.R, "Microcontroller Based System Design", Magnus Publications, 2016.

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PROGRAMME ELECTIVE IV

EE16451 **TESTING AND COMMISSIONING OF ELECTRICAL EQUIPMENTS** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- know the fundamentals of certain guidelines and broad principles regarding the safety.
- learn the Installation of electrical equipment.
- provide a comprehensive understanding of testing of transformer, plant and equipment.
- understand the installation and commissioning of rotating electrical machines.
- study the commissioning of transmission line.

UNIT I SAFETY OBJECTIVES **6**

Objectives, safety management during operation and maintenance, clearance and creepages - electric shock - need of earthing - different methods of earthing - factors affecting the earth resistance - methods of measuring the earth resistance - equipment earthing and system grounding, earthing procedure - building installation - domestic appliances - industrial premises - earthing of substation - generating station and overhead line.

UNIT II INSTALLATION OF ELECTRICAL EQUIPMENTS **6**

Inspection of electrical equipment at site - storage electrical equipment at site - foundation of electrical equipment at site - alignment of electrical machines - tools/instruments necessary for installation - technical report - inspection, storage and handling of transformer - switchgear and motors.

UNIT III TESTING OF TRANSFORMER **13**

General requirements for type - routine and special tests - measurement of winding resistance - measurement of voltage ratio and check of voltage vector relationship - measurement of impedance voltage/short-circuit impedance and load loss - measurement of no-load loss and current - measurement of insulation resistance - dielectric tests - temperature-rise - insulation and HV test - dielectric absorption - switching impulse test.

UNIT IV INSTALLATION AND COMMISSIONING OF ROTATING ELECTRICAL MACHINES **12**

Degree of protection - cooling system - degree of cooling with IP - IC code (brief discussion), enclosures - rating of industrial rotating electric machine - installation, commissioning and protection of Induction motor and rotating electric machine - drying out of electric rotating machine - insulation resistance measurement - site testing and checking, care, services and maintenance of motors, commissioning of synchronous generator - protection and automation of synchronous generator,

synchronous motor , D.C. generator and motor with reference to Indian Standard (IS).

UNIT V TRANSMISSION LINE **8**

Commissioning of AC transmission line and HVDC transmission - galvanize steel structure, towers and insulator for transmission and distribution line - tower footing resistance - substation equipment - bus bar system - power cable - low power control cable – contactor - GIS (gas insulated substation).

TOTAL PERIODS 45

COURSE OUTCOMES

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

- undertake installation, commissioning and maintenance of various electrical equipment.
- prepare maintenance schedule of different equipment and machines.
- produce trouble shooting chart for various electrical equipment, machines and domestic appliances.
- describe different types of earthing for different types of electrical installations.
- familiar about electrical safety regulations and rules during maintenance.

TEXT BOOKS

1. Rao, S., “Testing, commissioning, operation and maintenance of electrical equipment”, 6/E., Khanna Publishers, New Delhi, Reprint 2017.
2. Paul Gill, “Electrical power equipment maintenance and testing”, CRC Press, Reprint 2018

REFERENCES

1. Singh Tarlok, "Installation, commissioning and maintenance of Electrical equipment", S.K. Kataria and Sons, New Delhi, Reprint 2017
2. Philip Kiameh, “Electrical Equipment Handbook: Troubleshooting and Maintenance”, McGrawHill, Reprint 2015.

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

EE16452 POWER QUALITY 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- know the concept of power quality problem.
- educate on production of voltages sags, over voltages and harmonics and methods of control.
- study overvoltage problems.
- study the sources and effect of harmonics in power system.
- impart knowledge on various methods of power quality monitoring.

UNIT I INTRODUCTION TO POWER QUALITY 9

Terms and definitions: overloading - under voltage - over voltage - concepts of transients - short duration variations such as interruption - long duration variation such as sustained interruption -sags and swells - voltage sag - voltage Swell - voltage imbalance - voltage fluctuation - power factor - power frequency variations - international standards of computer business equipment manufacturers associations (CBEMA) curve.

UNIT II VOLTAGE SAGS AND INTERRUPTIONS 9

Sources of sags and interruptions - estimating voltage sag performance - Thevenin's equivalent source - analysis and calculation of various faulted condition. Voltage sags due to induction motor starting - estimation of the sag severity - mitigation of voltage sags, active series compensators - static transfer switches and fast transfer switches.

UNIT III OVERVOLTAGES 9

Sources of over voltages - capacitor switching - lightning - ferro-resonance - mitigation of voltage swells - surge arresters - low pass filters - power conditioners. lightning protection - shielding- line arresters - protection of transformers and cables - introduction to computer analysis tools for transients, PSCAD and EMTP

UNIT IV HARMONICS 9

Harmonic sources from commercial and industrial loads, locating harmonic sources - power system response characteristics - harmonics vs transients - effect of harmonics - harmonic distortion – voltage and current distortion - harmonic indices - inter harmonics – resonance - harmonic distortion evaluation - devices for controlling harmonic distortion - passive and active filters. IEEE and IEC standards.

UNIT V POWER QUALITY MONITORING 9

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

TOTAL PERIODS 45

COURSE OUTCOMES

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

- analyze power quality problem.
- determine the voltage sags and interruptions in various concepts.
- evaluate the Over voltages in various concepts.
- obtain the knowledge in harmonics method and IEEE and IEC standards.
- design the power quality monitoring equipment's.

TEXT BOOKS

1. Roger. C. Dugan, Mark. F. McGranagham, Surya Santoso, H.WayneBeaty, 'Electrical Power Systems Quality' McGrawHill, Reprint 2018.
2. Eswald.F.Fudis and M.A.S.Masoum, "Power Quality in Power System and Electrical Machines," Elseviar Academic Press, Reprint 2017.
3. J. Arrillaga, N.R. Watson, S. Chen, "Power System Quality Assessment", Wiley, Reprint 2017.

REFERENCES

1. G.J.Wakileh, "Power Systems Harmonics – Fundamentals, Analysis and Filter Design," Springer 2017
2. Wayne Wolf, "Modern VLSI Design ", 2nd Edition, Prentice Hall, 2017.
3. E.Aeha and M.Madrigal, "Power System Harmonics, Computer Modelling and Analysis", WileyIndia, 2017.
4. R.S.Vedam, M.S.Sarma, "Power Quality – VAR Compensation in Power Systems," CRC Press Reprint 2018
4. C. Sankaran, "Power Quality", CRC press, Taylor and Francis group, 2017.

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EE16453 VIRTUAL INSTRUMENTATION 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand what is virtual instrumentation and to realize the architecture of VI.
- familiarize with the VI software and learn programming in VI.
- study various instrument interfacing and data acquisition methods.
- understand various analysis tools and develop programs for process control applications.
- use VI for different applications.

UNIT I INTRODUCTION 9

Virtual Instrumentation: historical perspective - advantages - block diagram and architecture of a virtual instrument - conventional instruments versus traditional instruments - data - flow techniques, graphical programming in data flow, comparison with conventional programming.

UNIT II VI PROGRAMMING TECHNIQUES 9

VIs and sub - VIs, loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, state machine, string and file I/O, instrument drivers, publishing measurement data in the web.

UNIT III DATA ACQUISITION 9

Signals, signal conditioning, DAQ hardware configuration, ADCs, DACs, digital I/O, counters and timers, DAQ architecture, software and hardware installation, data acquisition interface requirements - issues involved in selection of data acquisition cards - data acquisition cards with serial communication and industrial applications.

UNIT IV TOOLSETS 9

Use of analysis tools, fourier transforms, power spectrum, correlation methods, windowing and filtering - application of VI in process control designing of equipments like oscilloscope, design of digital voltmeters with transducer input virtual laboratory, web based laboratory, creating, editing and debugging.

UNIT V APPLICATIONS 9

Pressure control system - flow control system - level control system - temperature data acquisition system - motion control employing stepper motor - PID controller tool box and pendulum.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- explain the architecture of VI.
- handle VI software and programming in VI.
- interfacing the instrument with help of data acquisition methods.
- develop programs for process control applications.
- gain adequate knowledge about various application of VI.

TEXT BOOKS

1. Dr. Sumathi. S and Prof. Surekha. P, "LabVIEW Based Advanced Instrumentation Systems", 2nd edition, Reprint 2017
2. Jovitha Jerome, "Virtual Instrumentation Using LabVIEW", PHI learning Pvt. Ltd. Reprint 2016.
3. Gary Johnson, "LabVIEW Graphical Programming", McGraw Hill, Reprint 2016.

REFERENCES

1. Lisa K. wells and Jeffrey Travis, "Lab VIEW for everyone", Prentice Hall, New Jersey, Reprint 2016.
2. Kevin James, "PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control", Newnes, 2017.
3. Ronald W. Larsen, "LabVIEW for Engineers", Prentice Hall Ltd, USA Reprint 2016.
4. Sanjay Gupta and Joseph John, " Virtual Instrumentation using LabVIEW", Tata McGraw-Hill Publishing Company Limited, New Delhi, 1st Edition, Reprint 2015.

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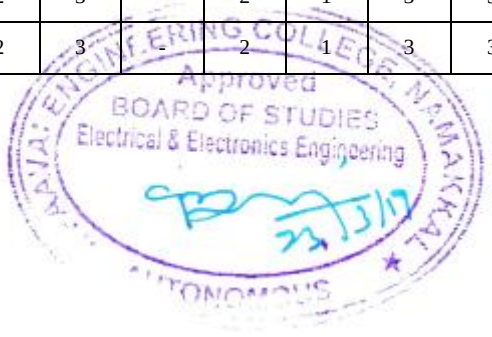


EE16454 COMPUTER AIDED DESIGN OF ELECTRICAL MACHINES 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- know the basics of computer aided design..
- understand the design of DC machines.
- familiarize with optimal design of transformers..
- learn the algorithm for design of alternators.
- gain knowledge on design of induction motors.

UNIT I CONCEPT OF COMPUTER -AIDED DESIGN AND OPTIMIZATION 9

Introduction - computer aided design; explanation of details of flow chart - input data to be fed into the program - applicable constraints maximum or minimum permissible limits - output data to be printed after execution of program - various objective parameters for optimization in an electrical machine - selection of optimal design.

UNIT II COMPUTER AIDED DESIGN OF DC MACHINES 9

Optimal design of DC machine: design of armature, windings and field systems - selection of variables for optimal design - formulation of design equations, objective function, constraint functions - algorithms for optimal design.

UNIT III COMPUTER AIDED DESIGN OF TRANSFORMERS 9

Optimal design of power transformer: design of magnetic circuit - design of windings - selection of variables for optimal design - Formulation of design equations - objective function - constraint functions - algorithms for optimal design.

UNIT IV COMPUTER AIDED DESIGN OF ALTERNATOR 9

Optimal design for 3-phase alternator: design of stator, windings - design of field systems for salient pole and non-salient pole machines -selection of variables for optimal design - formulation of design equations - objective function, constraint functions - algorithms for optimal design.

UNIT V COMPUTER AIDED DESIGN OF INDUCTION MOTOR 9

Optimal design of 3-phase induction motor: design of stator, windings - design of squirrel cage rotor - design of slip ring rotor - selection of variables for optimal design - formulation of design equations - objective functions - constraint functions - algorithms for optimal design.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- apply concepts related to computer aided design of electrical equipments.
- choose optimal parameters for design of electrical machines.
- formulate design equations for design of electrical machines.
- develop algorithm for design of electrical machines.
- design electrical machines with optimal solutions.

TEXT BOOKS

1. K M Vishnu Murthy, "Computer aided design of electrical machines" S Publications, 2018.
2. Dr. M. Ramamoorthy, "Computer- Aided Design of Electrical Equipment" Affiliated East-West press Pvt. Ltd. New Delhi, 2017.

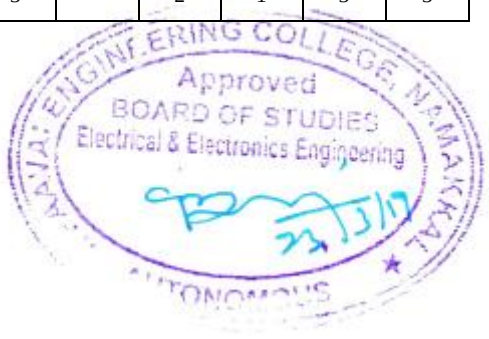
REFERENCES

1. A.K. Sawhney, Dhanpat Rai and Sons, "Electrical Machine Design".
2. S.K. Sen, "Principles of Electrical Machine Design with Computer Programmes", Oxford and IBH Publishing Co,2016
3. M.G. Say, "Performance and Design of A.C. Machines" Affiliated East West Press Pvt. Ltd., New Delhi.
4. Clayton and Hancock "Performance and Design of D.C. Machines".

CO-PO MAPPING:

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

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



BA16253 TOTAL QUALITY MANAGEMENT 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the basic concepts in quality management, customer orientation and retention.
- facilitate the understanding of quality management principles and process.
- get the techniques in six sigma, bench marking and FMEA.
- know the basic concepts in quality function development and TPM.
- familiar with quality system, quality auditing and HR practices.

UNIT I INTRODUCTION 9

Introduction - need for quality - evolution of quality - definitions of quality - dimensions of product and service quality - basic concepts of TQM - TQM framework - contributions of deming, juran and crosby - Barriers to TQM - quality statements - customer focus - customer orientation, customer satisfaction, customer complaints, customer retention - costs of quality.

UNIT II TQM PRINCIPLES 9

Leadership - strategic quality planning, quality councils - employee involvement - motivation, empowerment, team and teamwork, quality circles recognition and reward, performance appraisal - continuous process improvement - PDCA cycle, 5S, kaizen - supplier partnership - partnering, supplier selection, supplier rating.

UNIT III TQM TOOLS AND TECHNIQUES I 9

The seven traditional tools of quality - new management tools - six sigma: concepts, methodology, applications to manufacturing, service sector including IT - bench marking - reason to bench mark, bench marking process - FMEA - stages, types.

UNIT IV TQM TOOLS AND TECHNIQUES II 9

Control charts - process capability - concepts of six sigma - quality function development (QFD) - Taguchi quality loss function - TPM - concepts, improvement needs - performance measures.

UNIT V QUALITY SYSTEMS 9

Need for ISO 9000 - ISO 9001-2008 quality system - elements, documentation, quality auditing - QS 9000 - ISO 14000 - concepts, requirements and benefits - TQM implementation in manufacturing and service sectors.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- discuss the basic concepts in quality management, customer orientation and retention.
- describe the principles and process of quality management.
- implement the quality control techniques in six sigma, bench marking and FMEA.
- explain the basic concepts in quality function development and TPM.
- deliver the elements in quality system, quality auditing and HR practices.

TEXT BOOKS

1. Dale H. Besterfiled, et at., "Total quality Management", Third Edition, Pearson Education Asia, Indian Reprint, 2016
2. D.R Kiran, "Total quality Management", Butterworth-Heinemann, 2016.

REFERENCES

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First Indian Edition, Cengage Learning, 2015.
2. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2016.
3. Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2016.
4. Dennis AuBuchon, Understanding the Concept of Quality, Pronoun, 2017.
5. Donna C. S. Summers, Quality, Pearson, 5th edition, 2016.

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