K.L.N. COLLEGE OF ENGINEERING

Pottapalayam – 630 612, Sivagangai District

(An Autonomous Institution, Affiliated to Anna University, Chennai)

Estd: 1994

FINAL YEAR CURRICULUM AND SYLLABUS

REGULATIONS 2020

For Under Graduate Program

B.E. ELECTRICAL AND ELECTRONICS ENGINEERING

CHOICE BASED CREDIT SYSTEM

(For the students admitted in the academic year 2020-2021)

K.L.N. COLLEGE OF ENGINEERING, POTTAPALAYAM
(An Autonomous Institution, Affiliated to Anna University, Chennai)

VISION OF THE INSTITUTION

To become a Centre of Excellence in Technical Education and Research in producing Competent and Ethical professionals to the society.

MISSION OF THE INSTITUTION

To impart Value and Need based curriculum to the students with enriched skill development in the field of Engineering, Technology, Management and Entrepreneurshipand to nurture their character with social concern and to pursue their career in the areas of Research and Industry**.**

VISION OF THE DEPARTMENT

To become a high standard of excellence in Education, Training and Research in the field of Electrical & Electronics Engineering and allied applications.

MISSION OF THE DEPARTMENT

To produce excellent, innovative and Nationalistic Engineers with Ethical Values and to advance in the field of Electrical & Electronics Engineering and allied areas.

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PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO 1 To excel in industrial or graduate work in Electrical and Electronics Engineering and allied fields.

PEO 2 To practice their Professions conforming to Ethical Values and Environmentally friendly policies

PEO 3 To work in international and multi-disciplinary Environments.

PEO 4 To successfully adapt to evolving Technologies and stay current with their Professions.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO 1 Apply the fundamentals of Mathematics, Science and Engineering knowledge to identify, formulate, design and investigate complex engineering problems of Electric Circuits, Analog and Digital Electronic Circuits, Electrical Machines and Power Systems.

PSO 2 Apply appropriate techniques and modern Engineering hardware and software tools in Power Systems to engage in life- long learning and to successfully adapt in multi disciplinary environments

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PROGRAM OUTCOMES (POs)

PO1: Engineering knowledge

Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis

Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions

Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems

Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to providevalid conclusions.

PO5: Modern tool usage

Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: The engineer and society

Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineeringpractice.

PO7: Environment and sustainability

Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics

Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work

Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication

Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance

Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projectsand in multidisciplinary environments.

PO12: Life-long learning

Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

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REGULATIONS 2020

For Under Graduate Program

B.E. ELECTRICAL AND ELECTRONICS ENGINEERING

CHOICE BASED CREDIT SYSTEM

CATEGORY OF COURSES

i. **Humanities and Social Sciences (HS) Courses** include Technical English, Environmental Science and Engineering, Engineering Ethics and human values, Communication Skills and Management courses.

ii. **Basic Sciences (BS) Courses** include Mathematics, Physics, and Chemistry.

iii. **Engineering Sciences (ES) Courses** include Engineering Practices, Engineering Graphics, Basics of Electrical / Electronics / Mechanical / Computer Engineering / Instrumentation etc.

iv. **Professional Core (PC) Courses** include the core courses relevant to the chosen programme of study.

v. **Professional Elective (PE) Courses** include the elective courses relevant to the chosen programme of study.

vi. **Open Elective (OE) Courses** include courses from other departments which a student can choose from the list specified in the curriculum of the students B.E. / B.Tech. Programmes.

vii. **Employability Enhancement Courses (EEC)** include Project Work and/or Internship, Seminar, Professional Practices, Case Study and Industrial/Practical Training.

viii. **Mandatory Courses (MC)** include Personality and Character development and the courses recommended by the regulatory bodies such as AICTE, UGC, etc

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REGULATIONS 2020

CHOICE BASED CREDIT SYSTEM

B.E. – ELECTRICAL AND ELECTRONICS ENGINEERING

CURRICULAM AND SYLLABUS - VII & VIII SEMESTERS

SEMESTER VII

S. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1.	20EE701	Protection and Switchgear	**PC**	3	3	0	0	3
2.	20EE702	Renewable Energy Systems	**PC**	3	3	0	0	3
3.		Open Elective - II	**OE**	3	3	0	0	3
4.		Professional Elective III	**PE**	3	3	0	0	3
5.		Professional Elective-IV	**PE**	3	3	0	0	3
PRACTICAL								
6.	20EE7L1	Power System Simulation Laboratory	**PC**	3	0	0	3	1.5
7.	20EE7L2	Renewable Energy Systems Laboratory	**PC**	3	0	0	3	1.5
TOTAL				**21**	**15**	**0**	**6**	**18**

SEMESTER VIII

S. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1.		Professional Elective –V	**PE**	3	3	0	0	3
2.		Professional Elective VI	**PE**	3	3	0	0	3
PRACTICAL								
3.	20EE8L1	Project Work	**EEC**	20	0	0	20	10
TOTAL				**26**	**6**	**0**	**20**	**16**

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B.E. ELECTRICAL AND ELECTRONICS ENGINEERING

PROFESSIONAL ELECTIVE – III (VII SEMESTER)

S. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1.	20HS601	Operations Research	PE	3	3	0	0	3
2.	20HS7A1	Human Rights	PE	3	3	0	0	3
3.	20HS7A2	Total Quality Management	PE	3	3	0	0	3
4.	20BS404	Probability and Statistics	PE	3	3	0	0	3
5.	20EE7A1	Fibre Optics and Laser Instrumentation	PE	3	3	0	0	3
6.	20EE7A2	Power Systems Transients	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE – IV (VII SEMESTER)

S. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1.	20EE7B1	System Identification and Adaptive Control	PE	3	3	0	0	3
2.	20EE7B2	Control of Electrical Drives	PE	3	3	0	0	3
3.	20EE7B3	VLSI Design	PE	3	3	0	0	3
4.	20CS302	Data Structures and Algorithms	PE	3	3	0	0	3
5.	20CS401	Computer Organization and Architecture	PE	3	3	0	0	3
6.	20CS8B4	Blockchain Technology	PE	3	3	0	0	3

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PROFESSIONAL ELECTIVE – V (VIII SEMESTER)

S. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
		THEORY						
1.	20HS602	Principles of Management	**PE**	3	3	0	0	3
2.	20EE8A1	Flexible AC Transmission Systems	**PE**	3	3	0	0	3
3.	20EE8A2	Electric Vehicles and Power Management	**PE**	3	3	0	0	3
4.	20EE8A3	SMPS and UPS	**PE**	3	3	0	0	3
5.	20EE8A4	Electric Energy Generation, Utilization and Conservation	**PE**	3	3	0	0	3
6.	20CS8A4	Soft Computing	**PE**	3	3	0	0	3

PROFESSIONAL ELECTIVE – VI (VIII SEMESTER)

S. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
		THEORY						
1.	20EE8B1	Energy Auditing and Management	**PE**	3	3	0	0	3
2.	20EE8B2	High Voltage Direct Current Transmission	**PE**	3	3	0	0	3
3.	20EE8B3	Microcontroller Based System Design	**PE**	3	3	0	0	3
4.	20EE8B4	Smart Grid	**PE**	3	3	0	0	3
5.	20EE8B5	Fundamentals of Nano Science	**PE**	3	3	0	0	3
6.	20EI602	Biomedical Instrumentation	**PE**	3	3	0	0	3

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OPEN ELECTIVE – II (VII SEMESTER)

S. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1.	20OE105	Solar Photovoltaic Fundamentals and Applications	**OE**	3	3	0	0	3
2.	20OE108	Industrial Safety Practices	**OE**					
3.	20OE306	Consumer Electronics	**OE**	3	3	0	0	3
4.	20OE405	Fundamentals of Machine Learning	**OE**	3	3	0	0	3
5.	20OE407	Computer Graphics	**OE**					
6.	20OE408	Essentials of Data Analytics	**OE**	3	3	0	0	3
7.	20OE505	Essentials of Information Security	**OE**	3	3	0	0	3
8.	20OE506	Principles of Cyber Physical System	**OE**	3	3	0	0	3
9.	20OE507	Concepts of Ethical Hacking	**OE**	3	3	0	0	3
10.	20OE605	Lean Manufacturing Practices	**OE**	3	3	0	0	3

OPEN ELECTIVE – II (VII SEMESTER) offered to other Departments

S. No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1.	20OE205	Industrial Energy Auditing and Management	**OE**	3	3	0	0	3
2.	20OE206	Fundamentals of Fibre Optics and Lasers	**OE**	3	3	0	0	3
3.	20OE207	Electric Power Quality	**OE**	3	3	0	0	3
4.	20OE208	Electrical Drives and Control for Automation	**OE**	3	3	0	0	3

20EE701	PROTECTION AND SWITCHGEAR	L	T	P	C
		3	0	0	3

OBJECTIVES: To impart knowledge on the following

- Causes of abnormal operating conditions (faults, lightning and switching surges) of the apparatus and system.
- Characteristics and functions of relays and protection schemes.
- Apparatus protection, static and numerical relays
- Functioning of circuit breaker

PRE-REQUISITE:

Course Code: 20EE501
Course Name: Power System Analysis

UNIT - I OVERVOLTAGE PROTECTION 9

Causes and Effects of Over Voltages - Switching and lightning over voltages – Lightning Mechanism – Lightning Arresters and surge diverters

UNIT - II ELECTROMAGNETIC RELAYS 9

Zones of protection and essential qualities of protection - Operating principles of relays - the Universal relay – Torque equation – R-X diagram – Electromagnetic Relays – Over current, Directional, Distance, Differential, Negative sequence and Under frequency relays.

UNIT - III APPARATUS PROTECTION 9

Current transformers and Potential transformers applications in protection schemes - Protection of transformer, generator, motor, bus bars and transmission line.

UNIT - IV NUMERICAL PROTECTION 9

Block diagram of Numerical relays – Over current protection, transformer differential protection, distance protection of transmission lines – Microcontroller Assembly language programming for over current, directional and distance protection.

UNIT - V CIRCUIT BREAKERS 9

Physics of arcing phenomenon and arc interruption - DC and AC circuit breaking – re-striking voltage and recovery voltage - rate of rise of recovery voltage - resistance switching - current chopping - interruption of capacitive current - Types of circuit breakers – air blast, air break, oil, SF6, MCBs, MCCBs and vacuum circuit breakers – comparison of different circuit breakers – Rating and selection of Circuit breakers.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Badri Ram, B.H. Vishwakarma, 'Power System Protection and Switchgear', New Age International (P) Ltd, 2nd Edition, 2017.
2. B.Rabindranath and N.Chander, 'Power System Protection and Switchgear', New Age International (P) Ltd., First Edition 2018.
3. Y.G.Paithankar and S.R.Bhide, 'Fundamentals of power system protection', Second Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2010.

REFERENCES:

1. Sunil S.Rao, 'Switchgear and Protection', Shree Hari Publications, New Delhi, 2021.
2. Arun Ingole, 'Switch Gear and Protection' Pearson Education, 2018.
3. Ravindra P.Singh, 'Switchgear and Power System Protection', PHI Learning Private Ltd., NewDelhi, 2009.
4. VK Metha, "Principles of Power Systems" S. Chand, 2005.
5. A. Chakrabarti, M.L. Soni, P.V. Gupta, U.S. Bhatnagar, "A textbook on Power system Engineering" Dhanpat Rai Publishing Company (P) Ltd.2008
6. C.L.Wadhwa, "Electrical Power Systems", New Age International Private Limited, 2022

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : PROTECTION AND SWITCHGEAR											**Course Code : 20EE701**			
CO	**Course Outcomes**										**Unit**	**K –CO**	**POs**	**PSOs**
C401.1	Explain the Over voltage Protection of Power Systems										1	K2	1,2	1,2
C401.2	Explain the characteristics and functions of Electromagnetic type protective relays										2	K2	1,2	1,2
C401.3	Describe the various abnormal conditions in power system apparatus and to select a suitable protection scheme										3	K2	1,2	1,2
C401.4	Develop assembly language programming for numerical over current, directional and distance protection										4	K3	1,2,3,5,8, 12	1,2
C401.5	Analyze the circuit interruption problems										5	K4	1,2,3,4	1,2
C401.6	Explain the operation of Air, Oil, SF6 and Vacuum Circuit Breakers										5	K2	1,2	1,2
CO-PO Mapping														
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
C401.1	2	1	-	-	-	-	-	-	-	-	-	-	2	2
C401.2	2	1	-	-	-	-	-	-	-	-	-	-	2	2
C401.3	2	1	-	-	-	-	-	-	-	-	-	-	2	2
C401.4	3	2	1	-	2	-	-	2	-	-	-	2	3	3
C401.5	3	3	2	1	-	-	-	-	-	-	-	-	3	3
C401.6	2	1	-	-	-	-	-	-	-	-	-	-	2	2

20EE702	RENEWABLE ENERGY SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES: To impart knowledge on the following Topics

- Awareness about renewable Energy Sources and technologies.
- Adequate inputs on a variety of issues in harnessing renewable Energy.
- Recognize current and possible future role of renewable energy sources.
- Provide adequate inputs on Hybrid Renewable Energy Systems
- Provide adequate inputs on Intelligent Controllers for Hybrid Systems.

PRE-REQUISITE:

Course Code: 20EE201, 20EE402

Course Name: Electric Circuit Analysis, Transmission and Distribution

UNIT - I RENEWABLE ENERGY (RE) SOURCES 9

Environmental consequences of fossil fuel use, Importance of renewable sources of energy, Sustainable Design and development, Types of RE sources, Limitations of RE sources, Present Indian and international energy scenario of conventional and RE sources.

UNIT - II SOLAR AND PV SYSTEMS 9

Solar Radiation, Radiation Measurement, Central Receiver Power Plants, Solar Ponds.- Solar Photovoltaic systems : Basic Principle of SPV conversion – Types of PV Systems - Types of Solar Cells, Photovoltaic cell concepts: Cell, module, array, PV Module I-V Characteristics, Efficiency & Quality of the Cell, series and parallel connections, maximum power point tracking, Applications.

UNIT - III WIND ENERGY 9

Power in the Wind -Basic principles of Wind Energy Conversion Systems (WECS), Types and Classification of WECS, Parts of WECS, Power, torque and speed characteristics, Stand alone and grid connected of WECS, Grid integration issues of WECS, Site selection criteria.

UNIT - IV BIOMASS AND HYDRO ENERGY SOURCES 9

Introduction-Bio mass resources –Energy from Bio mass: conversion processes-Biomass Cogeneration- Biomass Gasification, Biomass to Ethanol Production, Biogas production from waste biomass, Environmental Benefits. Mini/micro hydro power: Classification of hydropower schemes, Classification of water turbine, Turbine theory, Essential components of hydroelectric system.

UNIT - V GEOTHERMAL , OCEAN AND OTHER ENERGY SOURCES 9

Geothermal Energy: Basics, Direct Use, Geothermal Electricity. Tidal Energy: Energy from the tides, Barrage and Non Barrage Tidal power systems. Wave Energy: Energy from waves, wave power devices. Ocean Thermal Energy Conversion (OTEC). Hydrogen Production and Storage - Fuel cell: Principle of working - various types - construction and applications. Energy Storage System- Hybrid Energy Systems.

TOTAL: 45PERIODS

TEXT BOOKS:

1. Joshua Earnest, Tore Wizeliu, 'Wind Power Plants and Project Development', PHI Learning Pvt. Ltd, New Delhi, 2011
2. D.P.Kothari, K.C Singal, Rakesh Ranjan "Renewable Energy Sources and Emerging Technologies", PHI Learning Pvt. Ltd, New Delhi, 2013
3. Rai G.D. , Non-Conventional Energy Sources, Khanna Publishers, 2011

REFERENCES:

1. Chetan Singh Solanki, " Solar Photovoltaics : Fundamentals, Technologies and Applications", PHI Learning Private Limited, New Delhi, 2011
2. Godfrey Boyle, "Renewable energy", Open University, Oxford University Press in association with the Open University, 2004.
3. Shobh Nath Singh, 'Non-conventional Energy resources' Pearson Education, 2015

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : RENEWABLE ENERGY SYSTEMS												**Course Code : 20EE702**			
CO	**Course Outcomes**											**Unit**	**K –CO**	**POs**	**PSOs**
C402.1	Describe about renewable Energy Sources and technologies. Outline the Environmental consequences of fossil fuel use											I	K2	1,2,7,8,12	1,2
C402.2	Discuss the basic principle and types of solar PV system and thermal energy systems											II	K2	1,2,7,8,12	1,2
C402.3	Explain the basic principles, types and Grid integration issues of Wind Energy Conversion Systems											III	K2	1,2,7,8,12	1,2
C402.4	Summarize the electrical power from bio-mass energy and Hydro energy											IV	K2	1,2,7,8,12	1,2
C402.5	Describe the electrical power from geothermal energy, Ocean energy, Hydrogen energy and Fuel cell.											V	K2	1,2,7,8,12	1,2
C402.6	Explain the different types of Hybrid energy systems with their advantages and disadvantages											V	K2	1,2,7,8,12	1,2
CO-PO Mapping															
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	
C402.1	2	1	-	-	-	-	3	3	-	-	-	3	2	2	
C402.2	2	1	-	-	-	-	3	3	-	-	-	3	2	2	
C402.3	2	1	-	-	-	-	3	3	-	-	-	3	2	2	
C402.4	2	1	-	-	-	-	3	3	-	-	-	3	2	2	
C402.5	2	1	-	-	-	-	3	3	-	-	-	3	2	2	
C402.6	2	1	-	-	-	-	3	3	-	-	-	3	2	2	

20EE7L1	POWER SYSTEM SIMULATION LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- To provide better understanding of power system parameter and Power System Analysis using software languages and MATLAB/Simulink.

PRE-REQUISITE: NIL

LIST OF EXPERIMENTS:

1. Modelling of Transmission line
2. Formation of bus admittance matrix.
3. Power flow analysis by Gauss-Seidel method.
4. Power flow analysis using Newton-Raphson method.
5. Short circuit analysis of Transmission line.
6. Stability analysis of Power system: Single Machine Infinite Bus System
7. Economic Dispatch in Power Systems.
8. Load – Frequency Dynamics of Single- Area and Two-Area Power Systems
9. Electromagnetic Transients in Power Systems: Transmission Line Energization
10. Transient Stability Analysis of Multi machine Power Systems

TOTAL: 45 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

S.No.	NAME OF THE EQUIPMENT	Qty.
1.	Personal computers (Intel i3, 80GB, 2GBRAM)	30 Nos.
2.	Printer laser	1 No.
3.	Dot matrix	1 No.
4.	Server (Intel i5, 80GB, 2GBRAM) (High Speed Processor)	1 No.
5.	Software: any power system simulation software with 5 user licenses	
6.	Compliers: C, C++, VB, VC++	30 Users.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

COURSE NAME : POWER SYSTEM SIMULATION LABORATORY												Course Code : 20EE7L1		
CO	**Course Outcomes**											**Exp**	**K –CO**	**POs**	**PSOs**
C406.1	Develop coding to determine the various line parameters of a transmission line.											1	K3	1,2,3,4,5,8, 9,10,12	1,2
C406.2	Develop coding to form bus admittance matrix for the given power system network.											2	K3	1,2,3,4,5,8, 9,10,12	1,2
C406.3	Develop program to determine the line losses of the given power system network.											3,4	K3	1,2,3,4,5,8, 9,10,12	1,2
C406.4	Develop simulink model for fault analysis in the transmission line using bus impedance matrix.											5	K4	1,2,3,4,5,8, 9,10,12	1,2
C406.5	Develop the coding to solve the economic dispatch problem in Power system.											7	K3	1,2,3,4,5,8, 9,10,12	1,2
C406.6	Analyze the steady state and Transient stability of the given power system using simulation											6,8,9,10	K4	1,2,3,4,5,8, 9,10,12	1,2
CO-PO Mapping															
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	
C406.1	3	2	1	-	2	-	-	1	1	1	-	1	3	3	
C406.2	3	2	1	-	2	-	-	1	1	1	-	1	3	3	
C406.3	3	2	1	-	2	-	-	1	1	1	-	1	3	3	
C406.4	3	3	2	1	2	-	-	1	1	1	-	1	3	3	
C406.5	3	2	1	-	2	-	-	1	1	1	-	1	3	3	
C406.6	3	3	2	1	2	-	-	1	1	1	-	1	3	3	

20EE7L2	RENEWABLE ENERGY SYSTEMS LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

- To train the students in Renewable Energy Sources and technologies.
- To provide adequate inputs on a variety of issues in harnessing Renewable Energy.
- To recognize current and possible future role of Renewable energy sources.
- To provide adequate inputs on Hybrid Renewable Energy Systems
- To provide adequate inputs on Intelligent Controllers for Hybrid Systems.

PRE-REQUISITE:

Course Code: 20EE3L1, 20EE6L1
Course Name: Electronics Laboratory, Power Electronics and Drives Laboratory

LIST OF EXPERIMENTS:

1. Simulation study on Solar PV Energy System.
2. Experiment on “VI-Characteristics and Efficiency of 1kWp Solar PV System”
3. Experiment on “Shadowing effect & diode based solution in 1kWp Solar PV System”.
4. Experiment on Performance assessment of Grid connected and Standalone 1kWp Solar Power System
5. Simulation study on Wind Energy Generator
6. Experiment on Performance assessment of micro Wind Energy Generator
7. Simulation study on Hybrid (Solar-Wind) Power System.
8. Experiment on Performance Assessment of Hybrid (Solar-Wind) Power System.
9. Simulation study on Hydel Power.
10. Experiment on Performance Assessment of 100W Fuel Cell.
11. Simulation study on Intelligent Controllers for Hybrid Systems.

TOTAL: 45 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

S.No.	NAME OF THE EQUIPMENT	Qty.
1.	Personal computers (Intel i3, 80GB, 2GBRAM)	15 Nos.
2.	CRO(30MHz)	9 Nos.
3.	Digital Multi-meter	10 Nos.
4.	PV panels - 100W, 24V	1 No.
5.	Battery storage system with charge and discharge control 40Ah	1 No.
6.	PV Emulator	1 No.
7.	Micro Wind Energy Generator module	1 No.
Consumabilitys (Minimum of 5 Nos. each)		
8.	Potentiometer	5 Nos.
9.	Step-down transformer (230V/12-0-12V)	5 Nos.
10.	Component data sheets to be provided	

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : RENEWABLE ENERGY SYSTEMS LABORATORY												Course Code : 20EE7L2		
CO	**Course Outcomes**											**Exp**	**K –CO**	**POs**	**PSOs**
C407.1	Analyze VI-Characteristics and Efficiency of 1kWp Solar PV System											2	K4	1,2,3,4 ,5,9,12	1,2
C407.2	Analyze the Shadowing effect & diode based solution in 1kWp Solar PV System											3	K4	1,2,3,4 ,5,9,12	1,2
C407.3	Analyze the Performance of Grid connected and Standalone 1kWp Solar Power System.											4	K4	1,2,3,4 ,5,9,12	1,2
C407.4	Simulate the various Renewable energy sources											1,5,7,9,11	K3	1,2,3,4 ,5,9,12	1,2
C407.5	Analyze the performance characteristics of micro Wind Energy Generator											6	K4	1,2,3,4 ,5,9,12	1,2
C407.6	Analyze the performance characteristics of Hybrid (Solar-Wind) Power System.											8	K4	1,2,3,4 ,5,9,12	1,2
CO-PO Mapping															
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	
C407.1	3	3	2	1	1	-	-	-	1	-	-	1	3	3	
C407.2	3	3	2	1	1	-	-	-	1	-	-	1	3	3	
C407.3	3	3	2	1	1	-	-	-	1	-	-	1	3	3	
C407.4	3	2	1	-	1	-	-	-	1	-	-	1	3	3	
C407.5	3	3	2	1	1	-	-	-	1	-	-	1	3	3	
C407.6	3	3	2	1	1	-	-	-	1	-	-	1	3	3	

20EE8L1	PROJECT WORK	L	T	P	C
		0	0	20	10

OBJECTIVES:

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

OUTCOMES:

• On Completion of the project work students will be in a position to take up any challenging practical problems and find solution by formulating proper methodology.

PRE-REQUISITE:

Course Code: All core courses & Laboratories
Course Name: All core courses & Laboratories

TOTAL: 300 PERIODS

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : PROJECT WORK												Course Code : 20EE8P1			
CO	**Course Outcomes**											**Exp**	**K –CO**	**POs**	**PSOs**
C410.1	Identify and apply the real world and societal importance problems in the Electrical and its allied area.											-	K4	1-12	1,2
C410.2	Identify, analyze, design, implement and handle prototype projects with a complete and organized solution methodologies											-	K4	1-12	1,2
C410.3	Apply modern engineering tools for solution											-	K4	1-12	1,2
C410.4	Contribute as an individual or in a team in development of technical projects											-	K4	1-12	1,2
C410.5	Develop effective communication skills for presentation of project related activities											-	K4	1-12	1,2
C410.6	Prepare reports and examination following professional ethics											-	K4	1-12	1,2
CO-PO Mapping															
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	
C410.1	3	3	2	1	-	3	3	-	-	-	-	3	3	3	
C410.2	3	3	2	1	-	-	-	-	-	-	-	-	3	3	
C410.3	3	2	1	-	3	-	-	-	-	-	-	-	3	3	
C410.4	3	2	1	-	-	-	-	-	3	-	-	-	3	3	
C410.5	3	2	1	-	-	-	-	-	-	3	-	-	3	3	
C410.6	3	2	1	-	-	-	-	3	-	-	3	-	3	3	

PROFESSIONAL ELECTIVE – III (VII SEMESTER)

		L	T	P	C
20HS601	**OPERATIONS RESEARCH**	3	0	0	3

OBJECTIVES

- To provide knowledge about optimization techniques and approaches.
- To formulate a real time problem as a mathematical programming model.
- To gain mathematical, computational and communication skills for solving problems.
- To gain knowledge to solve networking and inventory problems.
- To gain knowledge on solving different waiting line models

PREREQUISITE: NIL

UNIT - I LINEAR PROGRAMMING 9

Introduction to Operations Research, Linear programming (LP) – assumptions, properties of LP solutions, Formulations of linear programming problem – Graphical method. Solutions to LPP – simplex, Big M method.

UNIT – II TRANSPORTATION AND ASSIGNMENT MODELS 9

Transportation Problem - Mathematical Model, Types – Balanced and Unbalanced, Solution to Transportation Problem - Finding the initial basic solution, Optimizing the basic feasible solution applying U–V Method (Modi method)

Assignment problem –Hungarian method, Travelling salesman problem - Branch and Bound technique.

UNIT - III NETWORK MODELS 9

Network problem: shortest path – Systematic method, Dijkstra's algorithm, Floyd's algorithm, Minimal spanning tree – PRIM and Kruskal's algorithm, Maximum flow models – linear programming models, maximal flow problem algorithm

Project network representation, Critical Path Method computations, construction of time schedule, linear programming formulation of CPM, PERT networks.

UNIT – IV INVENTORY MODELS 9

Inventory models, Quantity Discount, Purchase Inventory Model - Q System, P System, Multiple-item Model - Shortage Limitation, Inventory Carrying Cost Constraint, EOQ Model - Multi-item Joint Replenishment with and without Shortages, Space Constraint.

UNIT - V QUEUEING MODELS 9

Queuing models - Queuing systems and structures – Notation parameter – Single server and multi server models – Poisson input – Exponential service – Constant rate service – Infinite population.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Hamdy A.Taha "Operations Research – An Introduction", MacMillan India Ltd., 10th Edition, 2017.
2. Panneerselvam R, "Operations Research", Prentice Hall India, 2016.
3. Hira.D Gupta.P.K, "Operations Research", S.Chand Publications, 1st Edition, Reprint 2016

REFERENCES:

1. G.Srinivasan, "Operations Research: Principles and Applications", PHI Ltd., 2016.
2. Kanti swarup Gupta.P.K, Man Muhan", Operations Research: Sultan Chand & Sons India Ltd., 12th Edition, New Delhi 2016.
3. Philips, Ravindran and Solberg, "Operations Research principle and practise", John Wiley, 2016.
4. Hiller and Liberman, Introduction to Operations Research, McGraw Hill, 2015.
5. Ramamurthy P, "Operations Research", New age International Publishers, 2nd edition, 2007.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : OPERATIONS RESEARCH												**Course Code : 20HS601**			
CO	**Course Outcomes**											**Unit**	**K –CO**	**POs**	**PSOs**
C404A1.1	Solve Linear Programming Problems by appropriate technique.											I	K3	1,2,3, 8,10	1,2,3
C404A1.2	Determine the performance characteristics such as time and cost in solving shortest route, transportation problems with an appropriate model.											II	K3	1,2,3, 9,10	1,2,3
C404A1.3	Solve the given assignment problem with an appropriate method.											II	K3	1,2,3, 8,10	1,2,3
C404A1.4	Determine the optimal solution for a project scheduling problem.											III	K3	1,2,3	1,2,3
C404A1.5	Determine the order quantity of goods under different constraints.											IV	K3	1,2,3, 8	1,2,3
C404A1.6	Determine the solutions to single and multi channel queuing problems.											V	K3	1,2,3, 8,9,10	1,2,3
CO-PO Mapping															
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	
C404A1.1	3	2	1	-	-	-	-	2	-	2	-	2	3	2	
C404A1.2	3	2	1	-	-	-	-	-	2	2	-	2	3	2	
C404A1.3	3	2	1	-	-	-	-	2	-	2	-	2	3	2	
C404A1.4	3	2	1	-	-	-	-	-	-	-	-	2	3	2	
C404A1.5	3	2	1	-	-	-	-	2	-	-	-	2	3	2	
C404A1.6	3	2	1	-	-	-	-	1	2	2	-	2	3	2	

20HS7A1	HUMAN RIGHTS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To sensitize the Engineering students to various aspects of Human Rights.

PRE-REQUISITE: Nil

UNIT - I INTRODUCTION 9

Human Rights – Meaning, origin and Development. Notion and classification of Rights – Natural, Moral and Legal Rights. Civil and Political Rights, Economic, Social and Cultural Rights; collective / Solidarity Rights.

UNIT - II EVOLUTION OF THE CONCEPT OF HUMAN RIGHTS 9

Evolution of the concept of Human Rights Magana carta – Geneva convention of 1864. Universal Declaration of Human Rights, 1948. Theories of Human Rights.

UNIT - III THE UNITED NATION AND HUMAN RIGHTS 9

United Nation charter based institution –Universal declaration of human rights-international Covenants on economic, social and cultural rights-international covenant on civil and political rights.

UNIT - IV HUMAN RIGHTS IN INDIA 9

Constitutional perceptive right to life, Liberty and securities of person- right to vote- freedom of association –right to education –right to health, equal pay for equal work ,enforcement of human right, human right act 1993- national human rights commission – state human rights commission.

UNIT - V HUMAN RIGHTS OF VULNERABLE GROUPS 9

Rights of Women, Right of children against exploitations – rights of disabled person aged person –rights of minorities.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Raphael D.D. "Human Rights"- McMillian Publishers- (old and new)
2. Paras Diwan- "Human Rights and Law" - Universal Publications

REFERENCES:

1. Kapoor S.K., “Human Rights under International law and Indian Laws”, Central Law Agency, Allahabad,2014.
2. Chandra U., “Human Rights”, Allahabad Law Agency, Allahabad,2014
3. Protection of Human Rights Act, 1993.
4. Constitutional Law of India (3 Volumes) by Seervai H.M 2015
5. The Human Rights Watch Global Report On Women’s Human Rights 2000 Oxford Publication.
6. RS Sharma Perspectives In Human Rights Development
7. Julies Stone Human Law And Human Justice 2000 Universal Publication.
8. Research Handbook On International Human Rights Law, Edited By Sarah Joseph & Edited By Sarah Joseph, Edward Elgar Publishing Limited USA

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : HUMAN RIGHTS											**Course Code : 20HS7A1**			
CO	**Course Outcomes**										**Unit**	**K –CO**	**POs**	**PSOs**
C404A2.1	Describe the nature of human rights its origin, the theories, the movements in the march of human rights and the facets of future of human rights.										I	K2	1,2,8	-
C404A2.2	Explain the classification of Human Rights										I	K2	1,2,8	-
C404A2.3	Discuss the international dimension of human rights, the role of UN and the global effort in formulating conventions and declarations.										II	K2	1,2,8	-
C404A2.4	Explain the regional developments of human rights in Europe, Africa and Asia and the enforceable value of human rights in international arena.										III	K2	1,2,8	-
C404A2.5	Discuss the human rights perspectives in India, more developed by its constitution and special legislations										IV	K2	1,2,8	-
C404A2.6	Explain the Redressal mechanism made available in case of human rights violation confined to India.										V	K2	1,2,8	-
CO-PO Mapping														
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
C404A2.1	2	1	-	-	-	-	-	3	-	-	-	-	-	-
C404A2.2	2	1	-	-	-	-	-	3	-	-	-	-	-	-
C404A2.3	2	1	-	-	-	-	-	3	-	-	-	-	-	-
C404A2.4	2	1	-	-	-	-	-	3	-	-	-	-	-	-
C404A2.5	2	1	-	-	-	-	-	3	-	-	-	-	-	-
C404A2.6	2	1	-	-	-	-	-	3	-	-	-	-	-	-

20HS7A2	TOTAL QUALITY MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand TQM concepts.
- To know about TQM principles.
- To understand Six Sigma, Traditional tools, New tools, Benchmarking and FMEA.
- To understand Taguchi's Quality Loss Function, Performance Measures and apply QFD, TPM, COQ and BPR.
- To apply QMS and EMS in any organization.

PRE-REQUISITE: NIL

UNIT - I INTRODUCTION 9

Quality – Need, Evolution, Definitions, Dimensions of product and service quality. TQM - Basic concepts, Framework, Contributions of Deming, Juran and Crosby, Barriers. Quality statements, Customer satisfaction, Customer complaints, Customer retention, Costs of quality.

UNIT – II TQM PRINCIPLES 9

Strategic quality planning, Quality Councils, Employee involvement, Motivation, Empowerment, Teamwork, Quality circles, Recognition and Reward, Performance appraisal, Continuous process improvement - PDCA cycle, 5S, Kaizen, Supplier partnership, Supplier selection, Supplier Rating.

UNIT – III TQM TOOLS AND TECHNIQUES I 9

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, 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: 45 PERIODS

TEXT BOOKS:

1. Dale H. Besterfiled, et at., "Total quality Management", Pearson Education Asia, 5th Edition, 2018.
2. James R. Evans and William M. Lindsay, "The Management and Control of Quality", Cengage Learning, 8th Edition, 2012.
3. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2nd Edition, 2006.

REFERENCES:

1. Joel.E. Ross, “Total Quality Management – Text and Cases”, CRC Press, 5th Edition, 2017.
2. Kiran.D.R, “Total Quality Management: Key concepts and case studies, Butterworth – Heinemann Ltd, 1st Edition, 2016.
3. Oakland, J.S. “TQM – Text with Cases”, Butterworth – Heinemann Ltd., Oxford, 3rd Edition, 2012.
4. Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 1st Edition, 2006.
5. Brue G, "Six Sigma for Managers”, Tata-McGraw Hill, 2nd Edition, 2002.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : TOTAL QUALITY MANAGEMENT											**Course Code : 20HS7A2**			
CO	**Course Outcomes**										**Unit**	**K –CO**	**POs**	**PSOs**
C404A3.1	Explain basic concepts, TQM framework, Barriers and Benefits of TQM.										I	K3	1,2,11	-
C404A3.2	Explain the TQM Principles for application.										II	K3	1,2,8,11	-
C404A3.3	Discuss the basics of Six Sigma and Traditional tools, New tools, Benchmarking and FMEA.										III	K2	1,2,4,11,12	-
C404A3.4	Describe Taguchi's Quality Loss Function, Performance Measures and apply Techniques like QFD, TPM, COQ and BPR.										IV	K3	1,2,3,4,7,11	-
C404A3.5	Illustrate and apply QMS and EMS in any organization.										V	K3	1,2,11,12	-
C404A3.6	Explain the process of implementation of ISO 9000/9001-2008/14000 for given manufacturing, service sector.										V	K3	1,2,11,12	-
CO-PO Mapping														
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
C404A3.1	2	1	-	-	-	-	-	-	-	-	2	-	-	-
C404A3.2	2	1	-	-	-	-	-	1	-	-	2	-	-	-
C404A3.3	2	1	-	1	-	-	-	-	-	-	2	1	-	-
C404A3.4	2	1	-	2	-	-	1	-	-	-	2	-	-	-
C404A3.5	2	1	-	-	-	-	-	-	-	-	2	1	-	-
C404A3.6	2	1	-	-	-	-	-	-	-	-	2	1	-	-

20BS404	PROBABILITY AND STATISTICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- This course aims at providing the required skill to apply the statistical tools in engineering problems.
- To introduce the basic concepts of probability and random variables of one and two dimensions
- To acquaint the knowledge of testing of hypothesis for small and large samples and to introduce the basic concepts of classifications of design of experiments which plays very important roles in the field of agriculture and statistical quality control.

PRE-REQUISITE: NIL

UNIT - I PROBABILITY AND RANDOM VARIABLES 9

Probability–Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Uniform, Exponential and Normal distributions.

UNIT - II TWO-DIMENSIONAL RANDOM VARIABLES 9

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression –Transformation of random variables–Central limit theorem (for independent and identically distributed random variables).

UNIT - III TESTING OF HYPOTHESIS 9

Sampling distributions - Estimation of parameters - Statistical hypothesis - Large sample tests based on Normal distribution for single mean and difference of means-Tests based on t, Chi-square and F distributions for mean, variance and proportion-Contingency table (test for independent)-Goodness of fit

UNIT - IV DESIGN OF EXPERIMENTS 9

One way and Two way classifications – Completely randomized design–Randomized block design – Latinsquare design - 2^2 factorial design.

UNIT - V STATISTICAL QUALITY CONTROL 9

Control charts for measurements (X and R charts) – Control charts for attributes (p,c and np charts)–Tolerance limits - Acceptance sampling

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Johnson. R.A., Miller, I and Freund J., "Miller and Freund‘s Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015
2. Veerarajan.T., "Probability, Statistics and Random Processes", Tata McGraw Hill, New Delhi , 2006.

REFERENCES:

1. Papoulis.A. and Unnikrishnapillai.S., "Probability, Random Variables and Stochastic Processes", McGraw Hill Education India, New Delhi, 4thEdition, 2002.
2. Spiegel.M.R., Schiller.J and Srinivasan.R.A., "Schaum's Outline of Theory and Problems of Probability and Statistics", Tata McGraw Hill, 3rd Edition, 2004.
3. Walpole.R.E., Myers.R.H., Myers.S.L. and Ye.K., "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia, 8th Edition, 2011.
4. Gupta.S.C., Kapoor.V.K,, "Fundamental of Mathematical Statistics", Sultan chand & Sons Educational Publishers, New Delhi, Reprint 2013.
5. Kandasamy.P., Thilagvathi.K., Gunavathi.K., "Probability Random Variables & Random Processes", S.Chand & Co.Ltd., Reprint 2008.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : PROBABILITY AND STATISTICS											**Course Code : 20BS404**			
CO	**Course Outcomes**										**Unit**	**K –CO**	**POs**	**PSOs**
C404A4.1	Build the parameters of statistical distributions using basic probability theory concepts.										1	K3	1,2,3,8,9	-
C404A4.2	Calculate the statistical measures for two dimensional random variables.										2	K3	1,2,3,8,9	-
C404A4.3	Apply the concepts of testing of hypothesis for large samples.										3	K3	1,2,3,8,9	-
C404A4.4	Apply t-test, chi-square and F- Test for small samples.										3	K3	1,2,3,8,9	-
C404A4.5	Apply the basic concepts of design of experiments in the field of agriculture.										4	K3	1,2,3,8,9	-
C404A4.6	Use control charts for quality control problems.										5	K3	1,2,3,8,9	-
CO-PO Mapping														
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
C404A4.1	3	2	1	-	-	-	-	1	**1**	-	-	-	-	-
C404A4.2	3	2	1	-	-	-	-	1	1	-	-	-	-	-
C404A4.3	3	2	1	-	-	-	-	1	1	-	-	-	-	-
C404A4.4	3	2	1	-	-	-	-	1	1	-	-	-	-	-
C404A4.5	3	2	1	-	-	-	-	1	1	-	-	-	-	-
C404A4.6	3	2	1	-	-	-	-	1	1	-	-	-	-	-

20EE7A1	FIBRE OPTICS AND LASER INSTRUMENTS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To expose the students to the basic concepts of optical fibres and their properties.
- To provide adequate knowledge about the Industrial applications of optical fibres.
- To expose the students to the Laser fundamentals.
- To provide adequate knowledge about Industrial application of lasers.
- To provide adequate knowledge about holography and Medical applications of Lasers.

PRE-REQUISITE: NIL

UNIT - I OPTICAL FIBRES AND THEIR PROPERTIES 9

Construction of optical fiber cable: Guiding mechanism in optical fiber and Basic component of optical fiber communication, –Principles of light propagation through a fibre: Total internal reflection, Acceptance angle (θa), Numerical aperture and Skew mode – Different types of fibres and their properties: Single and multimode fibers and Step index and graded index fibers – fibre characteristics: Mechanical characteristics and Transmission characteristics, – Absorption losses – Scattering losses– Dispersion – Connectors and splicers – Fibre termination – Optical sources: Light Emitting Diode(LED) – Optical detectors: PIN Diode.

UNIT - II INDUSTRIAL APPLICATION OF OPTICAL FIBRES 9

Fibre optic sensors: Types of fiber optics sensor, Intrinsic sensor- Temperature/ Pressure sensor, Extrinsic sensors, Phase Modulated Fibre Optic Sensor and Displacement sensor (Extrinsic Sensor) – Fibre optic instrumentation system: Measurement of attenuation (by cut back method), Optical domain reflectometers, Fiber Scattering loss Measurement, Fiber Absorption Measurement, Fiber dispersion measurements, End reflection method and Near field scanning techniques – Different types of modulators: Electro-optic modulator (EOM) – Interferometric method of measurement of length –Moire fringes – Measurement of pressure, temperature, current, voltage, liquid level and strain.

UNIT - III LASER FUNDAMENTALS 9

Fundamental characteristics of lasers – Level Lasers: Two-Level Laser, Three Level Laser, Quasi Three and four level lasers – Properties of laser: Monochromaticity, Coherence, Divergence and Directionality and Brightness – Laser modes – Resonator configuration – Q-switching and mode locking – Cavity damping – Types of lasers – Gas lasers, solid lasers, liquid lasers and semiconductor lasers.

UNIT - IV INDUSTRIAL APPLICATION OF LASERS 9

Laser for measurement of distance, Laser for measurement of length, Laser for measurement of velocity, Laser for measurement of acceleration, Laser for measurement of current, voltage and Laser for measurement of Atmospheric Effect: Types of LIDAR, Construction And Working, and LIDAR Applications – Material processing: Laser instrumentation for material processing, Powder Feeder, Laser Heating, Laser Welding, Laser Melting, Conduction Limited Melting and Key Hole Melting –Laser trimming of material: Process Of Laser Trimming, Types Of Trim, Construction And Working Advantages

– Material Removal and vaporization: Process Of Material Removal.

UNIT - V HOLOGRAM AND MEDICAL APPLICATIONS 9

Holography: Basic Principle, Holography vs. photography, Principle Of Hologram Recording, Condition For Recording A Hologram, Reconstructing and viewing the holographic image– Holography for non-destructive testing – Holographic components – Medical applications of lasers, laser-Tissue Interactions Photochemical reactions, Thermalisation, collisional relaxation, Types of Interactions and Selecting an Interaction Mechanism – Laser instruments for surgery, removal of tumors of vocal cards, brain surgery, plastic surgery, gynaecology and oncology.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. J.M. Senior, 'Optical Fibre Communication – Principles and Practice', Prentice Hall of India, January 2014.
2. Eric Udd, William B., and Spillman, Jr., "Fiber Optic Sensors: An Introduction for Engineers and Scientists ", John Wiley & Sons, 2011.
3. J. Wilson and J.F.B. Hawkes, 'Introduction to Opto Electronics', Prentice Hall of India, 2001.

REFERENCES:

1. G. Keiser, 'Optical Fibre Communication', McGraw Hill, 1995.
2. M. Arumugam, 'Optical Fibre Communication and Sensors', Anuradha Agencies, 2002.
3. John F. Ready, "Industrial Applications of Lasers", Academic Press, Digitized in 2008.
4. Monte Ross, 'Laser Applications', McGraw Hill, 1968.
5. John and Harry, "Industrial lasers and their application", McGraw-Hill, 2002.
6. Keiser, G., "Optical Fiber Communication", McGraw-Hill, 3rd Edition, 2000.
   http://nptel.ac.in/courses/117101002

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : FIBRE OPTICS AND LASER INSTRUMENTS											Course Code : 20EE7A1			
CO	**Course Outcomes**										**Unit**	**K –CO**	**POs**	**PSOs**
C404A5.1	Explain the principle, transmission, dispersion and attenuation characteristics of optical fibers										I	K2	1,2	1
C404A5.2	Explain the principle of Fibre Optical sources and Optical detectors.										I	K2	1,2	1
C404A5.3	Illustrate the optical fibers for its use as communication medium and as sensor as well which have important applications in production, manufacturing industrial and biomedical applications.										II	K2	1,2	1
C404A5.4	Describe the Fiber Scattering loss Measurement, Fiber Absorption Measurement and Fiber dispersion measurements										II	K2	1,2	1
C404A5.5	Discuss the laser theory and laser generation system.										IV	K2	1,2	1
C404A5.6	Explain the laser theory for the selection of lasers for a specific Industrial and medical application.										V	K2	1,2	1
CO-PO Mapping														
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
C404A5.1	2	1	-	-	-	-	-	-	-	-	-	-	1	-
C404A5.2	2	1	-	-	-	-	-	-	-	-	-	-	1	-
C404A5.3	2	1		-	-	-	-	-	-	-	-	-	1	-
C404A5.4	2	1	-	-	-	-	-	-	-	-	-	-	1	-
C404A5.5	2	1	-	-	-	-	-	-	-	-	-	-	1	-
C404A5.6	2	1	-	-	-	-	-	-	-	-	-	-	1	-

20EE7A2	POWER SYSTEM TRANSIENTS	L	T	P	C
		3	0	0	3

OBJECTIVES: To impart knowledge about the following topics:

- Generation of switching transients and their control using circuit – theoretical concept.
- Mechanism of lighting strokes and the production of lighting surges.
- Propagation, reflection and refraction of travelling waves.
- Voltage transients caused by faults, circuit breaker action, load rejection on integrated power system.

PRE-REQUISITE:

Course Code: 20EE402, 20EE501

Course Name: Transmission and Distribution, Power System Analysis

UNIT - I INTRODUCTION AND SURVEY 9

Review and importance of the study of transients - causes for transients. RL circuit transient with sine wave excitation - double frequency transients - basic transforms of the RLC circuit transients. Different types of power system transients - effect of transients on power systems – role of the study of transients in system planning.

UNIT - II SWITCHING TRANSIENTS 9

Over voltages due to switching transients - resistance switching and the equivalent circuit for interrupting the resistor current - load switching and equivalent circuit - waveforms for transient voltage across the load and the switch - normal and abnormal switching transients. Current suppression - current chopping - effective equivalent circuit. Capacitance switching - effect of source regulation - capacitance switching with a restrike, with multiple restrikes. Illustration for multiple restriking transients - ferro resonance.

UNIT - III LIGHTNING TRANSIENTS 9

Review of the theories in the formation of clouds and charge formation - rate of charging of thunder clouds – mechanism of lightning discharges and characteristics of lightning strokes – model for lightning stroke - factors contributing to good line design - protection using ground wires - tower footing resistance - Interaction between lightning and power system.

UNIT - IV TRAVELING WAVES ON TRANSMISSION LINE COMPUTATION OF TRANSIENTS 9

Computation of transients - transient response of systems with series and shunt lumped parameters and distributed lines. Traveling wave concept - step response - Bewely's lattice diagram - standing waves and natural frequencies - reflection and refraction of travelling waves.

UNIT - V TRANSIENTS IN INTEGRATED POWER SYSTEM 12

The short line and kilometric fault - distribution of voltages in a power system - Line dropping and load rejection - voltage transients on closing and reclosing lines – over voltage induced by faults -switching surges on integrated system Qualitative application of EMTP for transient computation.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Allan Greenwood, 'Electrical Transients in Power Systems', Wiley Inter Science, New York, 2ndEdition, 1991.
2. Pritindra Chowdhari, "Electromagnetic transients in Power System", John Wiley and Sons Inc., Second Edition, 2009.
3. C.S. Indulkar, D.P.Kothari, K. Ramalingam, 'Power System Transients – A statistical approach', PHI Learning Private Limited, Second Edition, 2010.

REFERENCES:

1. M.S.Naidu and V.Kamaraju, 'High Voltage Engineering', McGraw Hill, Fifth Edition, 2013.
2. R.D. Begamudre, 'Extra High Voltage AC Transmission Engineering', Wiley Eastern Limited, 1986.
3. Y.Hase, Handbook of Power System Engineering," Wiley India, 2012.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : POWER SYSTEMS TRANSIENTS											**Course Code : 20EE7A2**			
CO	**Course Outcomes**										**Unit**	**K –CO**	**POs**	**PSOs**
C404A6.1	Explain the switching and lightning transients.										I	K2	1,2	1
C404A6.2	Describe the generation of switching transients and their control.										II	K2	1,2	1
C404A6.3	Explain the mechanism of lighting strokes.										III	K2	1,2	1
C404A6.4	Explain the importance of propagation, reflection and refraction of travelling waves.										IV	K2	1,2	1
C404A6.5	Find the voltage transients caused by faults.										V	K2	1,2	1
C404A6.6	Explain the concept of circuit breaker action, load rejection on integrated power system.										V	K2	1,2	1
CO-PO Mapping														
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
C404A6.1	2	1	-	-	-	-	-	-	-	-	-	-	1	-
C404A6.2	2	1	-	-	-	-	-	-	-	-	-	-	1	-
C404A6.3	2	1	-	-	-	-	-	-	-	-	-	-	1	-
C404A6.4	2	1	-	-	-	-	-	-	-	-	-	-	1	-
C404A6.5	2	1	-	-	-	-	-	-	-	-	-	-	1	-
C404A6.6	2	1	-	-	-	-	-	-	-	-	-	-	1	-

PROFESSIONAL ELECTIVE – IV (VII SEMESTER)

20EE7B1	SYSTEM IDENTIFICATION AND ADAPTIVE CONTROL	L	T	P	C
		3	0	0	3

OBJECTIVES: To impart knowledge about the following topics:

- The concept of system identification and adaptive control
- Black-box approach based system identification
- Batch and recursive identification
- Computer Controlled Systems
- Design concept for adaptive control schemes

PRE-REQUISITE:

Course Code: 20EE504
Course Name: Control Systems

UNIT - I NON-PARAMETRIC METHODS 9

Non-parametric methods - Transient analysis - frequency analysis - Correlation analysis - Spectral analysis - Input signal design for identification.

UNIT - II PARAMETRIC METHODS 9

Least squares estimation – Analysis of the least squares estimate - Best linear unbiased estimate – Model parameterizations - Prediction error methods.

UNIT - III RECURSIVE IDENTIFICATION METHODS 9

The recursive least square method - Model validation –Model structure determination - Introduction to closed loop system identification.

UNIT - IV ADAPTIVE CONTROL SCHEMES 9

Introduction – Auto-tuning of PID controller using relay feedback approach – Types of adaptive control, Gain scheduling, Model reference adaptive control, Self–tuning controller – Design of gain scheduled adaptive controller – Applications of gain scheduling.

UNIT - V MODEL-REFERENCE ADAPTIVE SYSTEM (MRAS) and SELF-TUNING REGULATOR (STR) 9

STR – Pole placement design – Indirect STR and direct STR – MRAC - MIT rule – Lyapunov theory – Relationship between MRAC and STR.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. T. Soderstrom and PetreStoica, System Identification, Prentice Hall International (UK) Ltd. 1989
2. Karl J. Astrom and Bjorn Witten mark, Adaptive Control, Pearson Education, Second edition, Fifth impression, 2009.

REFERENCES:

1. L. Ljung, System Identification - Theory for the User, 2nd edition, PTR Prentice Hall, Upper Saddle River, N.J., 1999.
2. K. S. Narendra and A. M. Annaswamy, Stability Adaptive Systems, Prentice-Hall,1989.
3. H. K. Khalil, Nonlinear Systems, Prentice Hall, 3rd edition, 2002.
4. William S.Levine, "Control Systems Advanced Methods, the Control Handbook, CRC Press 2011.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : SYSTEM IDENTIFICATION AND ADAPTIVE CONTROL											**Course Code : 20EE7B1**			
CO	**Course Outcomes**										**Unit**	**K –CO**	**POs**	**PSOs**
C405B1.1	Explain the various system identification techniques and features of adaptive control.										I	K2	1,2	-
C405B1.2	Explain the concept of system identification and adaptive control										II	K2	1,2	-
C405B1.3	Explain about Black-box approach based system identification										III	K2	1,2	-
C405B1.4	Discuss the batch and recursive identification.										IV	K2	1,2	-
C405B1.5	Explain about the computer controlled systems.										V	K2	1,2	-
C405B1.6	Explain the concept for adaptive control schemes										V	K2	1,2	-
CO-PO Mapping														
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
C405B1.1	2	1	-	-	-	-	-	-	-	-	-	-	-	-
C405B1.2	2	1	-	-	-	-	-	-	-	-	-	-	-	-
C405B1.3	2	1	-	-	-	-	-	-	-	-	-	-	-	-
C405B1.4	2	1	-	-	-	-	-	-	-	-	-	-	-	-
C405B1.5	2	1	-	-	-	-	-	-	-	-	-	-	-	-
C405B1.6	2	1	-	-	-	-	-	-	-	-	-	-	-	-

20EE7B2	CONTROL OF ELECTRICAL DRIVES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the DC drive control.
- To study and analyze the Induction motor drive control.
- To study and understand the Synchronous motor drive control.
- To study and analyze the SRM and BLDC motor drive control.
- To analyze and design the Digital control for drives.

PRE-REQUISITE:

Course Code: 20EE502, 20EE601, 20EE6B2
Course Name: Power Electronics, Solid State Drives, Special Electrical Machines

UNIT - I CONTROL OF DC DRIVES 9

Losses in electrical drive system, Energy efficient operation of drives, block diagram /transfer function of self, separately excited DC motors --closed loop control-speed control current control - constant torque/power operation - P, PI and PID controllers–response Comparison.

UNIT - II CONTROL OF INDUCTION MOTOR DRIVE 9

VSI and CSI fed induction motor drives-principles of V/f control-closed loop variable frequency PWM inverter with dynamic braking- static Scherbius drives- power factor considerations– modified Kramer drives-principle of vector control- implementation-block diagram, Design of closed loop operation of V/f control of Induction motor drive systems.

UNIT - III CONTROL OF SYNCHRONOUS MOTOR DRIVES 9

Open loop VSI fed drive and its characteristics–Self-control–Torque control –Torque angle Control –Power factor control–Brushless excitation systems—Field oriented control –Design of closed loop operation of Self-control of Synchronous motor drive systems.

UNIT - IV CONTROL OF SRM AND BLDC MOTOR DRIVES 9

SRM construction - Principle of operation - SRM drive design factors-Torque controlled SRM- Block diagram of Instantaneous Torque control using current controllers and flux Controllers. Construction and Principle of operation of BLDC Machine -Sensing and logic switching scheme,-Sinusoidal and trapezoidal type of Brushless dc motors – Block diagram of current controlled Brushless dc motor drive.

UNIT - V DIGITAL CONTROL OF DC DRIVE 9

Phase Locked Loop and micro-computer control of DC drives–Program flow chart for constant constant torque and constant horse power operations Speed detection and current sensing circuits and feedback elements.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Gopal K.Dubey, Fundamentals of Electrical Drives, Narosa Publishing House, Second Edition, 2015.
2. Krishnan R., " Electric Motor & Drives: Modelling, Analysis and Control", Pearson Education, 2015

REFERENCES:

1. Bin Wu, High-Power Converters and AC Drives, Wiley-IEEE Press
2. Bimal K Bose, "Modern Power Electronics and AC Drives" Pearson Education, 2016.
3. R. Krishnan, Switched Reluctance Motor Drives: Modeling, Simulation, Analysis, Design, and Applications, CRC press, 2001.
4. Werner Leonhard, Control of Electrical Drives, 3rd Edition, Springer, Sept., 2001.
5. R. Krishnan, Permanent Magnet Synchronous and Brushless DC Motor Drives, CRC press, 2001.
6. Murphy, J.M.D, Turnbull F.G, Thyristor control of AC motors,., Pergamon press, Oxford, 1988

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : CONTROL OF ELECTRICAL DRIVES												**Course Code : 20EE7B2**			
CO	**Course Outcomes**											**Unit**	**K –CO**	**POs**	**PSOs**
C405B2.1	Explain the various control strategies and controllers for DC Motor Drive systems.											I	K2	1,2	1
C405B2.2	Discuss the various control strategies and controllers for Induction Motor Drive systems and develop the closed loop operation of V/f control of Induction motor drive systems.											II	K3	1,2,3	1
C405B2.3	Describe the various control strategies and controllers for Synchronous Motor Drive systems.											III	K2	1,2	1
C405B2.4	Explain the various control strategies and controllers for SRM Motor Drive systems.											IV	K2	1,2	1
C405B2.5	Discuss the various control strategies and controllers for BLDC Motor Drive systems.											IV	K2	1,2	1
C405B2.6	Explain the various Digital control for DC Motor Drive systems.											V	K2	1,2	1
CO-PO Mapping															
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	
C405B2.1	2	1	-	-	-	-	-	-	-	-	-	-	1	-	
C405B2.2	3	2	1	-	-	-	-	-	-	-	-	-	2	-	
C405B2.3	2	1	-	-	-	-	-	-	-	-	-	-	1	-	
C405B2.4	2	1	-	-	-	-	-	-	-	-	-	-	1	-	
C405B2.5	2	1	-	-		-	-	-	-	-	-	-	1	-	
C405B2.6	2	1	-	-	-	-	-	-	-	-	-	-	1	-	

20EE7B3	VLSI DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the fundamentals of CMOS circuits and its characteristics.
- To learn the design and realization of combinational Circuits
- To gain knowledge about Sequential logic circuits.
- To educate on Architectural choices and performance tradeoffs involved in designing and realizing the circuits in CMOS technology
- To learn the different FPGA architectures and testability of VLSI circuits

PRE-REQUISITE:

Course Code: 20EE505
Course Name: Microprocessors, Microcontrollers and Applications

UNIT - I MOS TRANSISTOR PRINCIPLE 9

NMOS and PMOS transistors, Process parameters for MOS and CMOS, Electrical properties of CMOS circuits and device modeling, Scaling principles and fundamental limits, CMOS inverter scaling, propagation delays, Stick diagram, Layout diagrams.

UNIT - II COMBINATIONAL LOGIC CIRCUITS 9

Combinational Logic Design, Elmore's constant, Pass transistor Logic, Transmission gates, static and dynamic CMOS design, Power dissipation – Low power design principles.

UNIT - III SEQUENTIAL LOGIC CIRCUITS 9

Static and Dynamic Latches and Registers, Timing issues, pipelines, clock strategies, Memory architecture and memory control circuits, Low power memory circuits, Synchronous and Asynchronous design.

UNIT - IV DESIGNING ARITHMETIC BUILDING BLOCKS 9

Data path circuits, Architectures for ripple carry adders, carry look ahead adders, High speed adders, accumulators, Multipliers, dividers, Barrel shifters, speed and area tradeoff.

UNIT - V IMPLEMENTATION STRATEGIES 9

Full custom and Semi custom design, Standard cell design and cell libraries, FPGA building block architectures, FPGA interconnect routing procedures

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Jan Rabaey, Anantha Chandrakasan, B.Nikolic, "Digital Integrated Circuits: A Design Perspective", Second Edition, Prentice Hall of India, 2016.
2. N.Weste, K.Eshraghian, "Principles of CMOS VLSI Design", Second Edition, Addision Wesley 2017.

REFERENCES:

1. A.Pucknell, Kamran Eshraghian, “BASIC VLSI Design”, Fourth Edition, Prentice Hall of India,2017.
2. Jacob Baker “CMOS: Circuit Design, Layout, and Simulation, Third Edition”, Wiley IEEE Press 2010.
3. Sung-Mo kang, Yusuf leblebici, Chulwoo Kim “CMOS Digital Integrated Circuits:Analysis & Design”,4th edition, McGraw Hill Education,2013.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : VLSI DESIGN											**Course Code : 20EE7B3**			
CO	**Course Outcomes**										**Unit**	**K –CO**	**POs**	**PSOs**
C405B3.1	Explain the concepts of digital building blocks using MOS transistor.										I	K2	1,2	-
C405B3.2	Describe combinational MOS circuits and power strategies										II	K2	1,2	-
C405B3.3	Illustrate the concept of Sequential Circuits and low power memory circuits.										III	K2	1,2	-
C405B3.4	Explain the arithmetic building blocks and memory subsystems										IV	K2	1,2	-
C405B3.5	Discuss the concept of full custom and semi custom design										V	K2	1,2	-
C405B3.6	Explain the FPGA interconnect routing procedures										V	K2	1,2	-
CO-PO Mapping														
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
C405B3.1	2	1	-	-	-	-	-	-	-	-	-	-	-	-
C405B3.2	2	1	-	-	-	-	-	-	-	-	-	-	-	-
C405B3.3	2	1	-	-	-	-	-	-	-	-	-	-	-	-
C405B3.4	2	1	-	-	-	-	-	-	-	-	-	-	-	-
C405B3.5	2	1	-	-	-	-	-	-	-	-	-	-	-	-
C405B3.6	2	1	-	-	-	-	-	-	-	-	-	-	-	-

20CS302	DATA STRUCTURES AND ALGORITHMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the concepts of ADTs
- To understand the basics of algorithm analysis
- To Learn linear data structures – lists, stacks, and queues
- To apply Tree and Graph structures
- To understand sorting, searching and hashing algorithms and their analysis.

PRE-REQUISITE:

Course Code: 20CS201
Course Name: Programming in C

UNIT - I INTRODUCTION TO DATA STRUCTURES AND ALGORITHM ANALYSIS 10

Introduction: Data Structures, Notion of an algorithm, Algorithm Efficiency and Analysis Framework, Asymptotic Notations and their properties. Linear Data Structures: Abstract Data Types (ADTs) – List ADT – Array-based implementation – Linked list implementation –– Singly Linked Lists- Circularly Linked Lists- Doubly-Linked Lists – Applications of Lists – Polynomial Manipulation – All operations (Insertion, Deletion, Merge, Traversal). Implementation of algorithmic problems.

UNIT - II LINEAR DATA STRUCTURES – STACKS, QUEUES 8

Stack ADT – Operations – Applications– Evaluating arithmetic expressions- Conversion of Infix to postfix expression – Queue ADT – Operations – Circular Queue – Priority Queue – deQueue – Applications of Queues.

UNIT - III NON LINEAR DATA STRUCTURES – TREES 9

Tree ADT – Tree Traversals – Binary Tree ADT – Expression Trees – Applications of Trees – Binary Search Tree ADT –Threaded Binary Trees- AVL Trees – B-Tree – B+ Tree – Heap – Applications of heap.

UNIT - IV NON LINEAR DATA STRUCTURES – GRAPHS 9

Definition – Representation of Graph – Types of graph – Breadth-first traversal – Depth-first traversal – Topological Sort – Bi-connectivity – Cut vertex – Euler circuits – Applications of graphs.

UNIT - V SEARCHING, SORTING AND HASHING TECHNIQUES 9

Divide and Conquer Methodology: Comparison of Searching Techniques: Linear Search – Binary Search, Mathematical analysis of Binary Search. Sorting – Merge Sort, Quick Sort, Bubble sort – Selection sort – Insertion sort – Shell sort – Radix sort. Hashing- Hash Functions – Separate Chaining – Open Addressing – Rehashing – Extendible Hashing.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Mark Allen Weiss, — Data Structures and Algorithm Analysis in C, 2nd Edition Reprint, Pearson Education, 2002.
2. Reema Thareja, — Data Structures Using C, Second Edition, Oxford University Press, 2011.
3. Thomas H. Cormen, Charles E. Leiserson, Ronald L.Rivest, Clifford Stein – Introduction to Algorithms, MIT Press, Third Edition, 2009.

REFERENCES:

1. Stephen G. Kochan, —Programming in C, 3rd edition, Pearson Education, 2005.
2. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, — Fundamentals of Data Structures in C, Second Edition, University Press, 2008.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : DATA STRUCTURES AND ALGORITHMS												**Course Code : 20CS302**			
CO	**Course Outcomes**											**Unit**	**K –CO**	**POs**	**PSOs**
C405B4.1	Explain the concept of asymptotic notations and algorithmic efficiency with properties.											I	K2	1,2,8,9, 12	1
C405B4.2	Describe abstract data types and implement various algorithmic problems using arrays and linked list.											I	K2	1,2,8,9, 12	1
C405B4.3	Apply the different linear data structures like stack and queue to various computing problems.											II	K3	1,2,3,8, 9,12	1
C405B4.4	Build different types of trees and graphs and apply various operations and their applications.											III, IV	K3	1,2,3,8, 9,10,12	1
C405B4.5	Analyze different sorting and searching techniques based on time and space complexity of the algorithms designed using divide and conquer methods.											V	K4	1-4,8-10,12	1
C405B4.6	Develop suitable hashing algorithm for indexing data items into specific locations in a hash table considering collision resolution techniques.											V	K3	1-3,8-10,12	1
CO-PO Mapping															
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	
C405B4.1	2	1	-	-	-	-	-	1	1	-	-	2	2	-	
C405B4.2	2	1	-	-	-	-	-	1	1	-	-	2	3	-	
C405B4.3	3	2	1	-	-	-	-	1	1	-	-	2	3	-	
C405B4.4	3	2	1	-	-	-	-	1	1	1	-	2	3	-	
C405B4.5	3	3	2	1	-	-	-	1	1	1	-	2	3	-	
C405B4.6	3	2	1	-	-	-	-	1	1	1	-	2	3	-	

20CS401	COMPUTER ORGANIZATION AND ARCHITECTURE	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the fundamentals of a computer system and operations.
- To learn the arithmetic and logic unit and implementation of fixed-point and floating point arithmetic unit.
- To learn the basics of pipelined execution.
- To understand parallelism and multi-core processors
- To understand the memory hierarchies and different ways of communication with I/O devices

PRE-REQUISITE: NIL

UNIT - I FUNDAMENTALS OF A COMPUTER SYSTEM 9

Functional Units – Basic Operational Concepts- Bus structures – Performance Metrics – Instructions: Language of the Computer – Operations, Operands – Instruction Set Architecture- Instruction representation- RISC and CISC Architectures – Amdahl's Law – Logical operations – decision making – MIPS Addressing.

UNIT - II ARITHMETIC FOR COMPUTERS 9

ALU design -Addition and Subtraction – Multiplication – Division – Floating Point Representation – Floating Point Operations – Subword Parallelism.

UNIT - III PROCESSOR AND CONTROL UNIT 9

Components of the Processor - Hardwired control – Micro programmed control – Nano programming-A Basic MIPS implementation – Building a Datapath – Control Implementation Scheme – Pipelining – Pipelined data path and control – Hazards – Structural, Data and Control Hazards –Exception handling. Building blocks of Raspberry-pi.

UNIT - IV PARALLELISIM 9

Parallel processing challenges – Instruction Level Parallelism - Exploitation of more ILP – Hardware and Software Approaches – Dynamic Scheduling – Speculation – Compiler Approaches – Multiple Issue Processors - ILP and Thread Level Parallelism-Flynn's classification – SISD, MIMD, SIMD, SPMD, and Vector Architectures - Hardware multithreading – Multi-core processors and other Shared Memory Multiprocessors - Introduction to Graphics Processing Units, Clusters, Warehouse Scale Computers and other Message-Passing Multiprocessors.

UNIT - V MEMORY & I/O SYSTEMS 9

Memory Hierarchy - memory technologies – cache memory – measuring and improving cache performance – virtual memory- Memory management techniques – Associative memories - TLB's – Accessing I/O Devices – Interrupts – Direct Memory Access – Bus structure – Bus operation – Arbitration – Interface circuits - USB. Case Study: Design of Memory Systems using Raspberry Pi.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. David A. Patterson and John L. Hennessy, Computer Organization and Design: The Hardware/Software Interface, 5th Edition, Morgan Kaufmann / Elsevier, 2014.
2. Carl Hamacher, Zvonko Vranesic, Safwat Zaky and Naraig Manjikian, Computer Organization and Embedded Systems, 6th Edition, Tata McGraw Hill, 2012.

REFERENCES:

1. John L. Hennessey and David A. Patterson, Computer Architecture – A Quantitative Approach, Morgan Kaufmann / Elsevier Publishers, 5th Edition, 2012.
2. John P. Hayes, Computer Architecture and Organization, 3rd Edition, Tata McGraw Hill, 2012.
3. William Stallings, Computer Organization and Architecture – Designing for Performance, Eighth Edition, Pearson Education, 2010.
4. Learning Computer Architecture using Raspberry pi – EbenUpton, Jeffrey Duntemann 2016 (1st Edition).

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : COMPUTER ORGANIZATION AND ARCHITECTURE												**Course Code : 20CS401**			
CO	**Course Outcomes**											**Unit**	**K –CO**	**POs**	**PSOs**
C405B5.1	Explain the computer organization components, instructions and addressing modes.											I	K2	1,2	1
C405B5.2	Compute the arithmetic operations such as Addition, Subtraction, Multiplication and Division.											II	K3	1-3,8,9	1
C405B5.3	Discuss the basics of MIPS implementation and pipelining.											III	K2	1,2,8-10,12	1
C405B5.4	Illustrate the basic concepts of parallelism, multi-core processor, GPU & Clusters.											IV	K2	1,2,8,9,12	1
C405B5.5	Describe the memory technologies & I/O systems.											V	K2	1,2,8-10,12	1
C405B5.6	Utilize Raspberry-pi for demonstrating memory systems.											V	K3	1-3,5,8,9,12	1,2
CO-PO Mapping															
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	
C405B5.1	2	1	-	-	-	-	-		-	-	-	-	2	-	
C405B5.2	3	2	1	-	-	-	-	1	1	-	-	-	3	-	
C405B5.3	2	1	-	-	-	-	-	1	1	1	-	1	2	-	
C405B5.4	2	1	-	-	-	-	-	1	1	-	-	1	2	-	
C405B5.5	2	1	-	-	-	-	-	1	1	1	-	1	2	-	
C405B5.6	3	2	1	-	1	-	-	1	1	-	-	1	2	1	

20CS8B4	BLOCKCHAIN TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Comprehend the structure of a Blockchain networks.
- Evaluate security issues relating to Blockchain and cryptocurrency.
- Design and analyze the applications based on Blockchain technology

PRE-REQUISITE: NIL

UNIT - I INTRODUCTION TO BLOCKCHAIN 10

History, Digital Money to Distributed Ledgers, Design Primitives, Protocols, Security, Consensus, Permissions, Privacy

UNIT - II BLOCKCHAIN ARCHITECTURE, DESIGN AND CONSENSUS 8

Basic crypto primitives: Hash, Signature, Hash chain to Blockchain, Basic consensus mechanisms, Requirements for the consensus protocols, PoW and PoS, Scalability aspects of Blockchain consensus protocols

UNIT - III PERMISSIONED AND PUBLIC BLOCKCHAINS 9

Design goals, Consensus protocols for Permissioned Blockchains, Hyperledger Fabric, Decomposing the consensus process, Hyperledger fabric components, Smart Contracts, Chain code design, Hybrid models (PoS and PoW)

UNIT - IV BLOCKCHAIN CRYPTOGRAPHY 9

Different techniques for Blockchain cryptography, privacy and security of Blockchain, multi-sig concept

UNIT - V RECENT TRENDS AND RESEARCH ISSUES IN BLOCKCHAIN 9

Scalability, secure cryptographic protocols on Blockchain, multiparty communication, FinTech and Blockchain applicability

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Andreas Antonopoulos,-Mastering Bitcoin, Programming the Open Blockchain,2017
2. Melanie Swan,-Blockchain, Blueprint for a new Economy, 1st edition, 2015

REFERENCES:

1. Jonathan B Morley- That Book on Blockchain: A One-Hour Intro, 2017.
2. Daniel Drescher-Blockchain Basics: A Non-Technical Introduction in 25 Steps 1st Edition, 2017.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : BLOCK CHAIN TECHNOLOGY											Course Code : 20CS8B4			
CO	**Course Outcomes**										**Unit**	**K –CO**	**POs**	**PSOs**
C405B6.1	Discuss the basic of block chain in terms of protocols and security and privacy										1	K2	1,2,8,9	-
C405B6.2	Explain the crypto primitives of block chain architecture										2	K2	1,2,8,9	-
C405B6.3	Illustrate the appropriate Consensus design for application protocol										2	K2	1,2,8,9	-
C405B6.4	Apply Hyper ledger Fabric to implement the Block chain										3	K3	1,2,3,8 ,9,12	-
C405B6.5	Apply various cryptographic techniques in Block chain cryptography, privacy and security										4	K3	1,2,3,8 ,9,12	-
C405B6.6	Discuss the research issues of Block chain										5	K2	1,2,8,9	-
CO-PO Mapping														
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
C405B6.1	2	1	-	-	-	-	-	1	**1**	-	-	-	-	-
C405B6.2	2	1	-	-	-	-	-	1	1	-	-	-	-	-
C405B6.3	2	1	-	-	-	-	-	1	1	-	-	-	-	-
C405B6.4	3	2	1	-	-	-	-	1	1	-	-	1	-	-
C405B6.5	3	2	1	-	1	1	-	1	1	-	-	1	-	-
C405B6.6	2	1	-	-	-	-	-	1	1	-	-	-	-	-

PROFESSIONAL ELECTIVE – V (VIII SEMESTER)

20HS602	PRINCIPLES OF MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Study the evolution of Management And organization types
- Learn the concepts involved in Planning process
- Explain how organizing is done by manager
- Detail on Human Resource Management and , Career planning
- Learn the importance of Motivation and leadership
- Detail on directing and controlling in Management

PRE-REQUISITE: NIL

UNIT - I INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS **9**

Definition of Management – Science or Art – Managerial roles and skills – Theories of Management- F.W.Taylor, Elton Mayo - Principles of Henry Fayol – Types of Business organization – Sole proprietorship, partnership, company- Types -public and private sector enterprises – Current trends and issues in Management.

UNIT - II PLANNING **9**

Nature and purpose of planning – process – types – objectives – MBO- Policies – Planning premises- Tools and Techniques ; Strategic planning - Types – Decision making steps and process. Rational Decision Making Process - Decision Making under different conditions.

UNIT - III ORGANISING AND STAFFING **9**

Nature and purpose – Formal and informal organization – organization chart – organization structure – types – Line and staff authority – departmentalization – delegation of authority – centralization and decentralization – Man Power planning- Recruitment & selection process, Training and Development, Performance Management , Career planning and management. Career Development - Career stages – Training - Performance Appraisal.

UNIT - IV DIRECTING **9**

Foundations of individual and group behavior – motivation – motivation theories – Motivational techniques – job satisfaction – job enrichment – leadership – types and theories of leadership – communication – process of communication – barrier in communication – effective communication – communication and role of information technology.

UNIT - V CONTROLLING **9**

System and process of controlling – budgetary and non-budgetary control techniques – use of computers and IT in Management control – Productivity problems and management – Cost Control - Purchase Control - Maintenance Control - Quality Control.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Stephen P. Robbins & Mary Coulter, —Managementǁ, Prentice Hall (India) Pvt. Ltd., 10th Edition, 2020.
2. JAF Stoner, Freeman R.E and Daniel R Gilbert —Managementǁ, Pearson Education, 6th Edition, 2018.

REFERENCES:

1. Stephen A. Robbins & David A. Decenzo & Mary Coulter, —Fundamentals of Managementǁ Pearson Education, 7th Edition, 2019.
2. Robert Kreitner & Mamata Mohapatra, — Managementǁ, Biztantra, 2008.
3. Harold Koontz & Heinz Weihrich —Essentials of managementǁ Tata McGraw Hill,2018.
4. Tripathy PC & Reddy PN, —Principles of Managementǁ, Tata McGraw Hill, 2016

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : PRINCIPLES OF MANAGEMENT											**Course Code : 20HS602**			
CO	**Course Outcomes**										**Unit**	**K –CO**	**POs**	**PSOs**
C408A1.1	Explain the evolution of Management and organization types										1	K2	1,2,8,9,10, 11	-
C408A1.2	Demonstrate the concepts involved in Planning process										2	K2	1,2,8,9,10, 11,12	-
C408A1.3	Describe the organizing concept and its types.										3	K2	1,2,8,9,10, 11	-
C408A1.4	Explain the human resource management and, career planning process.										3	K2	1,2,8,9,10, 11	-
C408A1.5	Illustrate the importance of Motivation and leadership.										4	K2	1,2,8,9,10, 11,12	-
C408A1.6	Explain the directing and controlling in Management process.										5	K2	1,2,8,9,10, 11	-
CO-PO Mapping														
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
C408A1.1	2	1	-	-	-	-	-	2	2	2	1	-	-	-
C408A1.2	2	1	-	-	-	-	-	2	2	2	1	1	-	-
C408A1.3	2	1	-	-	-	-	-	2	2	2	1	-	-	-
C408A1.4	2	1	-	-	-	-	-	2	2	2	1	-	-	-
C408A1.5	2	1	-	-	-	-	-	2	2	2	1	1	-	-
C408A1.6	2	1	-	-	-	-	-	2	2	2	1	-	-	-

20EE8A1	FLEXIBLE AC TRANSMISSION SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES: To impart knowledge about the following topics:

- The start-of-art of the power system
- Performance of power systems with FACTS controllers.
- FACTS controllers for load flow and dynamic analysis

PRE-REQUISITE:
Course Code: 20EE402
Course Name: Transmission and Distribution

UNIT - I INTRODUCTION 9

Real and reactive power control in electrical power transmission lines–loads & system compensation-Uncompensated transmission line–shunt and series compensation.

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–TCR-FC-TCR-Modeling of SVC for power flow and fast transient stability– Applications: Enhancement of transient stability –Steady state power transfer –Enhancement of power system damping.

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

Operation of the TCSC–Different modes of operation–Modelling of TCSC, Variability reactance model– Modelling for Power Flow and stability studies. Applications: Improvement of the system stability limit–Enhancement of system damping.

UNIT - IV VOLTAGE SOURCE CONVERTER BASED 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. SSSC-operation of SSSC and the control of power flow–modelling of SSSC in load flow and transient stability studies- Dynamic voltage restorer(DVR).

UNIT - V ADVANCED FACTS CONTROLLERS 12

Interline DVR(IDVR) - Unified Power flow controller (UPFC) - Interline power flow controller (IPFC) - Unified Power quality conditioner (UPQC).

TOTAL: 45 PERIODS

TEXT BOOKS:

1. R.Mohan Mathur, Rajiv K.Varma,“Thyristor–Based Facts Controllers for Electrical Transmission Systems”, IEEE press andJohnWiley&Sons,Inc,2002.
2. NarainG. Hingorani, “Understanding FACTS-Concepts and Technology of Flexible AC Transmission Systems”, Standard Publishers Distributors,Delhi-110006,2011.
3. T.J.E Miller, Power Electronics in power systems, John Wiley and sons.

REFERENCES:

1. K.R. Padiyar, ”FACTS Controllers in Power Transmission and Distribution”, New Age International (P) Limited, Publishers, New Delhi, 2008
2. A.T.John, “Flexible A.C. Transmission Systems”, Institution of Electrical and Electronic Engineers (IEEE), 1999.
3. V.K.Sood, HVDC and FACTS controllers–Applications of Static Converters in Power System, APRIL2004, Kluwer Academic Publishers, 2004.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : FLEXIBLE AC TRANSMISSION SYSTEMS											**Course Code : 20EE8A1**			
CO	**Course Outcomes**										**Unit**	**K –CO**	**POs**	**PSOs**
C408A2.1	Describe the analytical model of FACTS controller for power system application.										I	K2	1,2	1,2
C408A2.2	Explain the concepts about load compensation techniques.										I	K2	1,2	1,2
C408A2.3	Explain about facts devices.										II	K2	1,2	1,2
C408A2.4	Discuss the start-of-art of the power system										III	K2	1,2	1,2
C408A2.5	Describe the performance of steady state and transients of facts controllers.										IV	K2	1,2	1,2
C408A2.6	Discuss about advanced FACTS controllers.										V	K2	1,2	1,2
CO-PO Mapping														
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
C408A2.1	2	1	-	-	-	-	-	-	-	-	-	-	1	1
C408A2.2	2	1	-	-	-	-	-	-	-	-	-	-	1	1
C408A2.3	2	1	-	-	-	-	-	-	-	-	-	-	1	1
C408A2.4	2	1	-	-	-	-	-	-	-	-	-	-	1	1
C408A2.5	2	1	-	-	-	-	-	-	-	-	-	-	1	1
C408A2.6	2	1	-	-	-	-	-	-	-	-	-	-	1	1

20EE8A2	ELECTRIC VEHICLES AND POWER MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES: To impart knowledge about the following topics:

- To understand the concept of electrical vehicles and its operations
- To compare the concept of EV with hybrid and conventional Electric vehicles
- To understand the need of power electronics converters control in DC and AC drives.
- To provide knowledge about various possible energy storage technologies that can be used in electric vehicles
- To discuss alternative energy storage systems

PRE-REQUISITE:

Course Code: 20EE401, 20EE502, 20EE601

Course Name: Electrical Machines – II, Power Electronics, Solid State Drives

UNIT - I ELECTRIC VEHICLES AND VEHICLE MECHANICS 9

Electric Vehicles (EV), Hybrid Electric Vehicles (HEV), Engine ratings, Comparisons of EV with internal combustion Engine vehicles, Fundamentals of vehicle mechanics

UNIT - II ARCHITECTURE OF EV's AND POWERTRAINCOMPONENTS 9

Architecture of EV's and HEV's – Plug-in Hybrid Electric Vehicles (PHEV)- Power train components and sizing, Gears, Clutches, Transmission and Brakes

UNIT - III CONTROL OF DC AND AC DRIVES 9

DC/DC chopper based four quadrant operations of DC drives – Inverter based V/f Operation (motoring and braking) of induction motor drive system – Induction motor and permanent motor based vector control operation – Switched reluctance motor (SRM) drives

UNIT - IV BATTERY ENERGYSTORAGE SYSTEM 9

Battery Basics, Different types, Battery Parameters, Mathematical modeling of lead acid Batteries, Traction Batteries

UNIT - V ALTERNATIVE ENERGYSTORAGE SYSTEMS 9

Fuel cell – Characteristics- Types – hydrogen Storage Systems and Fuel cell EV – Ultra capacitors

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Iqbal Hussain, "Electric and Hybrid Vehicles: Design Fundamentals" CRC Press, Taylor & Francis Group, Second Edition, 2016
2. Mehrdad Ehsani, Yimin Gao, Stefano Longo, Kambiz Ebrahimi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles", CRC Press, Third Edition, 2019

REFERENCES:

1. Ali Emadi, Mehrdad Ehsani, John M.Miller, “Vehicular Electric Power Systems”, Special Indian Edition, Marcel dekker, Inc 2010
2. Simona Onori, Lorenzo Serrao, “Hybrid Electric Vehicles Energy Management Strategies”, Springer, 2015
3. Xiong, Rui, “Battery Management Algorithm for Electric Vehicles”, Springer, 2020

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : ELECTRIC VEHICLES AND POWER MANAGEMENT													**Course Code : 20EE8A3**	
CO	**Course Outcomes**										**Unit**	**K –CO**	**POs**	**PSOs**
C408A3.1	Explain the operation of Electric vehicles and various energy storage technologies for electrical vehicles										1	K2	1,2	1
C408A3.2	Explain the Architecture of EV’s and Power Train Components										2	K2	1,2	1
C408A3.3	Discuss the Control of DC drives										3	K2	1,2	1
C408A3.4	Describe the Control of AC drives										3	K2	1,2	1
C408A3.5	Explain about various types of Battery energy storage system										4	K2	1,2	1
C408A3.6	Generalize the Alternative energy storage system										5	K2	1,2	1
CO-PO Mapping														
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
C408A3.1	2	1	-	-	-	-	-	-	-	-	-	-	1	-
C408A3.2	2	1	-	-	-	-	-	-	-	-	-	-	1	-
C408A3.3	2	1	-	-	-	-	-	-	-	-	-	-	1	-
C408A3.4	2	1	-	-	-	-	-	-	-	-	-	-	1	-
C408A3.5	2	1	-	-	-	-	-	-	-	-	-	-	1	-
C408A3.6	2	1	-	-	-	-	-	-	-	-	-	-	1	-

20EE8A3	SMPS AND UPS	L	T	P	C
		3	0	0	3

OBJECTIVES:

To impart knowledge about the following topics:

- Modern power electronic converters and its applications in electric power utility.
- Resonant converters and UPS

PRE-REQUISITE: NIL

UNIT - I DC-DC CONVERTERS 9

Principles of step down and step up converters – Analysis and state space modeling of Buck, Boost, Buck- Boost and Cuk converters.

UNIT - II SWITCHED MODE POWER CONVERTERS 9

Analysis and state space modeling of fly back, Forward, Push pull, Luo, Half bridge and full bridge converters- control circuits and PWM techniques.

UNIT - III RESONANT CONVERTERS 9

Introduction- classification- basic concepts- Resonant switch- Load Resonant converters- ZVS , Clamped voltage topologies- DC link inverters with Zero Voltage Switching- Series and parallel Resonant inverters- Voltage control.

UNIT - IV DC-AC CONVERTERS 9

Single phase and three phase inverters, control using various (sine PWM, SVPWM and PSPWM) techniques, various harmonic elimination techniques- Multilevel inverters- Concepts - Types: Diode clamped- Flying capacitor- Cascaded types- Applications.

UNIT - V V POWER CONDITIONERS, UPS & FILTERS 9

Introduction- Power line disturbances- Power conditioners –UPS: offline UPS, Online UPS, Applications – Filters: Voltage filters, Series-parallel resonant filters, filter without series capacitors, filter for PWM VSI, current filter, DC filters – Design of inductor and transformer for PE applications – Selection of capacitors.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Simon Ang, Alejandro Oliva," Power-Switching Converters", Third Edition, CRC Press, 2010.
2. KjeldThorborg, "Power Electronics – In theory and Practice", Overseas Press, First Indian Edition 2005.
3. M.H. Rashid – Power Electronics handbook, Elsevier Publication, 2001

REFERENCES:

1. Philip T Krein, " Elements of Power Electronics", Oxford University Press
2. Ned Mohan, Tore.M.Undeland, William.P.Robbins, Power Electronics converters, Applications and design- Third Edition- John Wiley and Sons- 2006
3. M.H. Rashid – Power Electronics circuits, devices and applications-third edition Prentice Hall of India New Delhi, 2007.
4. Erickson, Robert W, "Fundamentals of Power Electronics", Springer, second edition, 2010.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : SMPS AND UPS											**Course Code : 20EE8A4**			
CO	**Course Outcomes**										**Unit**	**K –CO**	**POs**	**PSOs**
C408A4.1	Explain the operation and state space modeling of DC-DC converters										1	K2	1,2	1
C408A4.2	Describe the operation and state space modeling of switched mode power converters										2	K2	1,2	1
C408A4.3	Discuss the basic concept and operation of resonant converters										3	K2	1,2	1
C408A4.4	Summarize the PWM techniques for DC-AC converters										4	K2	1,2	1
C408A4.5	Explain the operation of Power conditioners, UPS and its applications in electric power utility.										5	K2	1,2	1
C408A4.6	Describe the operation of various types of filters										5	K2	1,2	1
CO-PO Mapping														
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
C408A4.1	2	1	-	-	-	-	-	-	-	-	-	-	1	-
C408A4.2	2	1	-	-	-	-	-	-	-	-	-	-	1	-
C408A4.3	2	1	-	-	-	-	-	-	-	-	-	-	1	-
C408A4.4	2	1	-	-	-	-	-	-	-	-	-	-	1	-
C408A4.5	2	1	-	-	-	-	-	-	-	-	-	-	1	-
C408A4.6	2	1	-	-	-	-	-	-	-	-	-	-	1	-

20EE8A4	ELECTRIC ENERGY GENERATION, UTILIZATION AND CONSERVATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To discuss the various sources of power generation.
- To understand the principle, design of illumination systems and energy efficiency lamps.
- To explain the various methods of industrial heating and welding.
- To Analyze the behavior & control of electric traction system.
- To understand the principle of Refrigerator and Air Conditioner

PRE-REQUISITE: NIL

UNIT - I POWER GENERATION 9

Review of conventional methods – thermal, hydro and nuclear based power generation. Non-conventional methods of power generation – fuel cells - tidal waves – wind – geothermal – solar -bio-mass - municipal waste. Cogeneration. Effect of distributed generation on power system operation.

UNIT- II ILLUMINATION ENGINEERING 9

Nature of radiation – definition – laws of illumination – lighting calculations – design of illumination systems – residential, industrial, commercial, flood lighting and street lighting – types of lamps – energy efficient lamps

UNIT-III HEATING AND WELDING 9

Role electric heating for industrial applications – Requirement of heating material – Design of heating element – Methods of heating: Resistance heating – Induction heating – Dielectric heating – Methods of welding: Resistance welding – Arc welding – welding generator, welding transformer and the characteristics.

UNIT- IV ELECTRIC DRIVES AND TRACTION 9

Fundamentals of electric drive - choice of an electric motor - application of motors for particular services - traction motors - characteristic features of traction motor - systems of railway electrification - electric braking - train movement and energy consumption - traction motor control - track equipment and collection gear.

UNIT-V REFRIGERATION AND AIR CONDITIONING 9

Refrigeration-Domestic refrigerator and water coolers - Air-Conditioning-Various types of air-conditioning system and their applications, smart air conditioning units – Energy Efficient motors: Standard motor efficiency, need for efficient motors

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Wadhwa, C.L., Generation, Distribution and Utilization of Electrical Energy, New Academic Science, 2011
2. Gupta, B.R., Generation of Electrical Energy, Eurasia Publishing House (P) Ltd, New Delhi, 2003.
3. S. Sivanagaraju, M. Balasubba Reddy, D. Srilatha,' Generation and Utilization of Electrical Energy', Pearson Education, 2010.

REFERENCES:

1. Dr. Uppal S.L. and Prof. S. Rao, 'Electrical Power Systems', Khanna Publishers, New Delhi, 15th Edition, 2014.
2. H.Partab, Art and Science of Utilisation of Electrical Energy", Dhanpat Rai and Co., New Delhi, 2004.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Electric Energy Generation, Utilization And Conservation											**Course Code : 20EE8A5**			
CO	**Course Outcomes**										**Unit**	**K –CO**	**POs**	**PSOs**
C408A5.1	Describe the basic principles & technologies of various renewable and nonrenewable energy resource-based power generation										I	K2	1,2	1,2
C408A5.2	Categorize different light sources and design various illumination systems for the indoor lighting schemes, factory lighting, halls, outdoor lighting schemes, flood lighting, street lighting										II	K4	1,2,3, 4	1,2
C408A5.3	Classify different methods of electric heating and electric welding in industries.										III	K3	1,2,3	1,2
C408A5.4	Compute the tractive effort for the propulsion of train, name the traction motors, list the traction motor control, track equipment and collection gear.										IV	K3	1,2,3	1,2
C408A5.5	Describe the selection of electrical drives based on the industrial applications.										IV	K2	1,2	1,2
C408A5.6	Explain the concept of Air conditioner and refrigerator.										V	K2	1,2	1,2
CO-PO Mapping														
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
C408A5.1	2	1	-	-	-	-	-	-	-	-	-	-	1	1
C408A5.2	3	3	2	1	-	-	-	-	-	-	-	-	3	1
C408A5.3	3	2	1	-	-	-	-	-	-	-	-	-	2	1
C408A5.4	3	2	1	-	-	-	-	-	-	-	-	-	2	1
C408A5.5	2	1	-	-	-	-	-	-	-	-	-	-	1	1
C408A5.6	2	1	-	-	-	-	-	-	-	-	-	-	1	1

20CS8A4	SOFT COMPUTING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the basic concepts of Soft Computing
- To become familiar with various techniques like neural networks, genetic algorithms and fuzzy systems.
- To integrate various soft computing techniques for complex problems

PRE-REQUISITE: NIL

UNIT - I INTRODUCTION TO SOFT COMPUTING 9

Introduction-Artificial Intelligence-Artificial Neural Networks-Fuzzy Systems-Genetic Algorithm and Evolutionary Programming-Swarm Intelligent Systems-Classification of ANNs-McCulloch and Pitts Neuron Model-Learning Rules: Hebbian and Delta- Perceptron Network-Adaline Network-Madaline Network.

UNIT - II ARTIFICIAL NEURAL NETWORKS 9

Back propagation Neural Networks - Kohonen Neural Network -Learning Vector Quantization -Hamming Neural Network - Hopfield Neural Network- Bi-directional Associative Memory -Adaptive Resonance Theory Neural Networks- Support Vector Machines - Spike Neuron Models.

UNIT - III FUZZY SYSTEMS 9

Introduction to Fuzzy Logic, Classical Sets and Fuzzy Sets - Classical Relations and Fuzzy Relations -Membership Functions -Defuzzification - Fuzzy Arithmetic and Fuzzy Measures - Fuzzy Rule Base and Approximate Reasoning - Introduction to Fuzzy Decision Making.

UNIT - IV GENETIC ALGORITHMS 9

Basic Concepts- Working Principles -Encoding- Fitness Function - Reproduction - Inheritance Operators - Cross Over - Inversion and Deletion -Mutation Operator - Bit-wise Operators -Convergence of Genetic Algorithm.

UNIT - V HYBRID SYSTEMS 9

Hybrid Systems -Neural Networks, Fuzzy Logic and Genetic -GA Based Weight Determination - LR-Type Fuzzy Numbers - Fuzzy Neuron - Fuzzy BP Architecture - Learning in Fuzzy BP- Inference by Fuzzy BP - Fuzzy ArtMap: A Brief Introduction – Soft Computing Tools - GA in Fuzzy Logic Controller Design - Fuzzy Logic Controller.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. N.P.Padhy, S.P.Simon, "Soft Computing with MATLAB Programming", Oxford University Press, 2015
2. S.N.Sivanandam , S.N.Deepa, "Principles of Soft Computing", Wiley India Pvt. Ltd., 2nd Edition, 2011
3. S.Rajasekaran, G.A.Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithm, Synthesis and Applications ", PHI Learning Pvt. Ltd., 2017

REFERENCES:

1. Jyh-Shing Roger Jang, Chuen-Tsai Sun, EijiMizutani, “Neuro-Fuzzy and Soft Computing”, Prentice-Hall of India, 2002
2. Kwang H.Lee, “First course on Fuzzy Theory and Applications”, Springer, 2005
3. George J. Klir and Bo Yuan, “Fuzzy Sets and Fuzzy Logic-Theory and Applications”, Prentice Hall, 1996
4. James A. Freeman and David M. Skapura, “Neural Networks Algorithms, Applications, and Programming Techniques”, Addison Wesley, 2003

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : SOFT COMPUTING													Course Code : 20CS8A4	
CO	**Course Outcomes**												**Unit**	**K –CO**	**POs**	**PSOs**
C408A6.1	Explain the different categories of soft computing techniques												1	K2	1,2,8, 9	-
C408A6.2	Illustrate neural networks modeling for different applications												2	K3	1,2,3, 8,9,12	-
C408A6.3	Apply fuzzy design principles for solving various fuzzy problems												3	K3	1,2,3, 8,9,12	-
C408A6.4	Explain the different operators and phases of genetic algorithm												4	K2	1,2, 8,9,10	-
C408A6.5	Illustrate the techniques for developing hybrid fuzzy based systems												5	K3	1,2,3,5,6 8,9,12	-
C408A6.6	Apply different soft computing tools to solve engineering problems												5	K3	1,2,3,5,6 8,9,12	-
CO-PO Mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**		
C408A6.1	2	1	-	-	-	-	-	2	2	-	-	-	-	-		
C408A6.2	3	2	1	-	-	-	-	2	2	-	-	1	-	-		
C408A6.3	3	2	1	-	-	-	-	2	2	-	-	1	-	-		
C408A6.4	2	1	-	-	-	-	-	2	2	1	-		-	-		
C408A6.5	3	2	1	-	1	1	-	2	2	-	-	1	-	-		
C408A6.6	3	2	1	-	1	1	-	2	2	-	-	1	-	-		

PROFESSIONAL ELECTIVE – VI (VIII SEMESTER)

		L	T	P	C
20EE8B1	**ENERGY AUDITING AND MANAGEMENT**	**3**	**0**	**0**	**3**

OBJECTIVES: To impart knowledge on the following Topics

- Awareness about importance of energy management and auditing..
- Understanding the Energy management on various electrical motors.
- Understanding the Energy management on electric lighting systems.
- Apply the different types of metering methods of energy management and auditing
- Provide the economic models for energy and load management.

PRE-REQUISITE:

Course Code: 20EE304,20EE401, 20EE402,
Course Name: Electrical Machines, Transmission and Distribution

UNIT - I INTRODUCTION **9**

Basics of Energy – Need for energy management – Energy accounting – Energy monitoring, targeting and reporting – Energy audit process.

UNIT - II ENERGY MANAGEMENT FOR MOTORS AND COGENERATION **9**

Energy management for electric motors – Transformer and reactors – Capacitors and synchronous machines, energy management by cogeneration – Forms of cogeneration – Feasibility of cogeneration – Electrical interconnection.

UNIT - III LIGHTING SYSTEMS **9**

Energy management in lighting systems – Task and the working space – Light sources – Ballasts – Lighting controls – Optimizing lighting energy – Power factor and effect of harmonics, lighting and energy standards..

UNIT - IV METERING FOR ENERGY MANAGEMENT **9**

Metering for energy management – Units of measure – Utility meters – Demand meters – Paralleling of current transformers – Instrument transformer burdens – Multi tasking solid state meters, metering location vs requirements, metering techniques and practical examples.

UNIT - V ECONOMIC ANALYSIS AND MODELS **9**

Economic analysis – Economic models – Time value of money – Utility rate structures – Cost of electricity – Loss evaluation, load management – Demand control techniques – Utility monitoring and control system – HVAC and energy management – Economic justification.

TOTAL: 45PERIODS

TEXT BOOKS:

1. Barney L. Capehart, Wayne C. Turner, and William J. Kennedy, Guide to Energy Management, Fifth Edition, The Fairmont Press, Inc., 2006
2. Eastop T. D & Croft D. R, Energy Efficiency for Engineers and Technologists, Logman Scientific & Technical, ISBN-0-582-03184, 1990.

REFERENCES:

1. Reay D.A, Industrial Energy Conservation, 1stedition, Pergamon Press, 1977.
2. IEEE Recommended Practice for Energy Management in Industrial and Commercial Facilities, IEEE, 1996.
3. Amit K. Tyagi, Handbook on Energy Audits and Management, TERI, 2003.
4. Electricity in buildings good practice guide, McGraw-Hill Education, 2016.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : ENERGY AUDITING AND MANAGEMENT											**Course Code : 20EE8B1**			
CO	**Course Outcomes**										**Unit**	**K –CO**	**POs**	**PSOs**
C409B1.1	Explain the importance of energy management and auditing.										I	K2	1,2,6, 7	1
C409B1.2	Describe energy management on different types of electrical equipment.										II	K3	1,2,6, 7	1
C409B1.3	Explain the Forms and feasibility of cogeneration										II	K3	1,2,6, 7	1
C409B1.4	Discuss the energy management on different types of lighting system and light sources.										III	K3	1,2,6, 7	1
C409B1.5	Describe the different types of metering methods of energy management and auditing.										IV	K4	1,2,6,7, 12	1
C409B1.6	Explain the economic models for energy and load management.										V	K2	1,2,6, 7	1
CO-PO Mapping														
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
C409B1.1	2	1	-	-	-	1	1	-	-	-	-	-	1	-
C409B1.2	2	1	-	-	-	1	1	-	-	-	-	-	1	-
C409B1.3	2	1	-	-	-	1	1	-	-	-	-	-	1	-
C409B1.4	2	1	-	-	-	1	1	-	-	-	-	-	1	-
C409B1.5	2	1	-	-	-	1	1	-	-	-	-	1	1	-
C409B1.6	2	1	-	-	-	1	1	-	-	-	-	-	1	-

20EE8B2	HIGH VOLTAGE DIRECT CURRENT TRANSMISSION	L	T	P	C
		3	0	0	3

OBJECTIVES: To impart knowledge about the following topics:

- Planning of DC power transmission and comparison with AC power transmission.
- HVDC converters.
- HVDC system control.
- Harmonics and design of filters.
- Power flow in HVDC system under steady state

PRE-REQUISITE:

Course Code: 20EE402

Course Name: Transmission and Distribution

UNIT - I INTRODUCTION 9

DC Power transmission technology–Comparison of AC and DC transmission–Application of DC transmission–Description of DC transmission system–Planning for HVDC transmission–Modern trends in HVDC technology–DC breakers–Operating problems– HVDC transmission based on VSC –Types and applications of MTDC systems.

UNIT - II ANALYSIS OF HVDC CONVERTERS 9

Line commutated converter -Analysis of Graetz circuit with and without overlap -Pulse number– Choice of converter configuration – Converter bridge characteristics– Analysis of a 12 pulse converters– Analysis of VSC topologies and firing schemes.

UNIT - III CONVERTER AND HVDC SYSTEM CONTROL 9

Principles of DC link control–Converter control characteristics–System control hierarchy–Firing angle control– Current and extinction angle control–Starting and stopping of DC link –Power control –Higher level controllers –Control of VSC based HVDC link

UNIT - IV REACTIVE POWER AND HARMONICS CONTROL 9

Reactive power requirements in steady state–Sources of reactive power–SVC and STATCOM– Generation of harmonics –Design of AC and DC filters– Active filters.

UNIT - V POWER FLOW ANALYSIS IN AC/DC SYSTEMS 12

Per unit system for DC quantities–DC system model –Inclusion of constraints –Power flow analysis –case study

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Padiyar,K.R.,“HVDC power transmission system”, New Age International(P)Ltd. New Delhi, Second Edition,2010.
2. Arrillaga,J.,“High Voltage Direct Current Transmission”, Peter Pregrinus, London,1983.

REFERENCES:

1. Kundur P.," Power System Stability and Control", McGraw-Hill,1993.
2. Colin Adamson and Hingorani NG," High Voltage Direct Current Power Transmission", Garraway Limited, London, 1960.
3. Edward Wilson Kimbark," Direct Current Transmission", Vol.I, Wiley inter science, New York, London, Sydney,1971.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : HIGH VOLTAGE DIRECT CURRENT TRANSMISSION											**Course Code : 20EE8B2**			
CO	**Course Outcomes**										**Unit**	**K –CO**	**POs**	**PSOs**
C409B2.1	Explain the principles and types of HVDC system.										I	K2	1,2	1
C409B2.2	Explain the concepts of HVDC converters.										II	K2	1,2	1
C409B2.3	Explain the significance of DC link control.										III	K2	1,2	1
C409B2.4	Explain the concepts of reactive power management, harmonics and power flow analysis.										IV	K2	1,2	1
C409B2.5	Compare the planning of DC power transmission with AC power transmission.										V	K2	1,2	1
C409B2.6	Explain the importance of power flow in HVDC system under steady state.										V	K2	1,2	1
CO-PO Mapping														
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
C409B2.1	2	1	-	-	-	-	-	-	-	-	-	-	1	-
C409B2.2	2	1	-	-	-	-	-	-	-	-	-	-	1	-
C409B2.3	2	1	-	-	-	-	-	-	-	-	-	-	1	-
C409B2.4	2	1	-	-	-	-	-	-	-	-	-	-	1	-
C409B2.5	2	1	-	-	-	-	-	-	-	-	-	-	1	-
C409B2.6	2	1	-	-	-	-	-	-	-	-	-	-	1	-

20EE8B3	MICRO CONTROLLER BASED SYSTEM DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Study about the PIC Microcontroller, its architecture and programming
- Gain knowledge about the interrupts and timer of PIC microcontroller
- Study and understand the peripherals and interfacing devices with microcontrollers
- Get introduced to the concept of ARM processor, its architecture and programming
- Learn the ARM processor organization, execution, implementation and applications

PRE-REQUISITE:

Course Code: 20EE505
Course Name: Microprocessors, Microcontrollers and Applications

UNIT – I INTRODUCTION 9

Introduction to PIC Microcontroller – PIC 16C6x and PIC 16C7x Architecture – PIC16Cxx– - Pipelining - Program Memory considerations – Register File Structure - Instruction Set - Addressing modes – Simple Operations.

UNIT – II INTERRUPTS AND TIMERS 9

PIC microcontroller Interrupts - External Interrupts - Interrupt Programming – 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 – Data handling circuit – Initialization - LCD and keyboard Interfacing - ADC, DAC, and Sensor Interfacing.

UNIT – IV ARM INTRODUCTION 9

ARM Architecture – ARM programmer's model - ARM Development tools- Memory Hierarchy – ARM Assembly Language Programming – Simple Examples – 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 ARMApplications.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Mazidi, “PIC Microcontroller and Embedded Systems “Pearson Education”, Second Edition 2021.
2. Steve Furber., “ARM System on Chip Architecture” blication, 2014.

REFERENCES:

1. Martin Bates, “Interfacing PIC Microcontrollers”, Newnes Publication, second Edition 2013.
2. Muhammed Tahir, ”ARM Microprocessor Systems”, Special Indian Edition, CRC Press, 2017.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Microcontroller Based System Design													**Course Code : 20EE8B3**	
CO	**Course Outcomes**										**Unit**	**K –CO**	**POs**	**PSOs**
C409B3.1	Explain the functional building block of PIC16cxx and formulate the instruction set for simple operations.										I	K2	1,2	1
C409B3.2	Describe the concept of interrupts in PIC micro controllers and Illustrate the interrupt programs										II	K2	1,2	1
C409B3.3	Illustrate the concept of PIC programming to interface I/O devices like LCD, Keyboard, and Sensors etc.,										III	K2	1,2	1
C409B3.4	Explain the programming concepts in ARM processor.										IV	K2	1,2	1
C409B3.5	Discuss embedded ARM applications and select an ARM Coprocessor										V	K2	1,2	1
C409B3.6	Describe the concept of Pipeline ARM Organization										V	K2	1,2	1
CO-PO Mapping														
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
C409B3.1	2	1	-	-	-	-	-	-	-	-	-	-	1	-
C409B3.2	2	1	-	-	-	-	-	-	-	-	-	-	1	-
C409B3.3	2	1	-	-	-	-	-	-	-	-	-	-	1	-
C409B3.4	2	1	-	-	-	-	-	-	-	-	-	-	1	-
C409B3.5	2	1	-	-	-	-	-	-	-	-	-	-	1	-
C409B3.6	2	1	-	-	-	-	-	-	-	-	-	-	1	-

20EE8B4	SMART GRID	L	T	P	C
		3	0	0	3

OBJECTIVES: To impart knowledge about the following topics:

- Introduction to smart grid and compare this with conventional grid
- Smart Grid technologies both in transmission and distribution side
- Different smart meters and advanced metering infrastructure
- Power quality management issues in Smart Grid.
- The high performance computing for Smart Grid applications

PRE-REQUISITE:
Course Code: 20EE402, 20EE6B3
Course Name: Transmission and Distribution, Power Quality

UNIT - I INTRODUCTION TO SMART GRID 9

Evolution of Electric Grid, Concept, Definitions and Need for Smart Grid, Smart grid drivers, functions, opportunities, challenges and benefits, Difference between conventional & Smart Grid, National and International Initiatives in Smart Grid.

UNIT - II SMART GRID TECHNOLOGIES (TRANSMISSION) 9

Technology Drivers, Smart energy resources, Smart substations, Substation Automation, Feeder Automation ,Transmission systems: EMS, FACTS and HVDC, Wide area monitoring, Protection and control.

UNIT - III SMART GRID TECHNOLOGIES (DISTRIBUTION) 9

DMS, Volt/VAR control, Fault Detection, Isolation and service restoration, Outage management, High-Efficiency Distribution Transformers, Phase Shifting Transformers, Plugin Hybrid Electric Vehicles (PHEV).

UNIT - IV SMART METERS AND ADVANCED METERING INFRASTRUCTURE 9

Introduction to Smart Meters, Advanced Metering infrastructure(AMI) drivers and benefits, AMI protocols, standards and initiatives, AMI needs in the smart grid, Phasor Measurement Unit(PMU), Intelligent Electronic Devices(IED)&their application for monitoring & protection.

UNIT - V POWER QUALITY MANAGEMENT IN SMART GRID AND SMART GRID APPLICATIONS 9

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

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Stuart Borlase “Smart Grid: Infrastructure, Technology and Solutions”, CRC Press 2012.
2. Janaka Ekanayake, NickJ enkins, Kithsiri Liyanage, JianzhongWu, AkihikoYokoyama, “Smart Grid: Technology and Applications”, Wiley 2012.

REFERENCES:

1. VehbiC. Gungor ,Dilan Sahin, Taskin Kocak, Salih Ergut, Concettina Buccella, Carlo Cecati, and Gerhard P. Hancke, “Smart Grid Technologies: Communication Technologies and Standards” IEEE Transactions On Industrial Informatics,Vol.7,No.4, November 2011.
2. Xi Fang, Satyajayant Misra, Guoliang Xue, and Dejun Yang“SmartGrid –The New and Improved Power Grid: A Survey” ,IEEE Transaction on Smart Grids,vol.14,2012.
3. James Momohe “Smart Grid: Fundamentals of Design and Analysis,”, Wiley-IEEE Press , 2012.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : SMART GRID												**Course Code : 20EE8B4**			
CO	**Course Outcomes**											**Unit**	**K –CO**	**POs**	**PSOs**
C409B4.1	Discuss the functions, opportunities, challenges and benefits of Smart Grid											I	K2	1,2	1
C409B4.2	Describe the Smart energy resources and Transmission systems											II	K2	1,2	1
C409B4.3	Explain the different Smart Grid distribution technologies											III	K2	1,2	1
C409B4.4	Discuss the function of different smart meters and advanced metering infrastructure.											IV	K2	1,2	1
C409B4.5	Summarize the power quality management in Smart Grids											V	K2	1,2	1
C409B4.6	Describe the basic service on LAN, WAN and Cloud Computing for Smart Grid applications.											V	K2	1,2	1
CO-PO Mapping															
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	
C409B4.1	2	1	-	-	-	-	-	-	-	-	-	-	1	-	
C409B4.2	2	1	-	-	-	-	-	-	-	-	-	-	1	-	
C409B4.3	2	1	-	-	-	-	-	-	-	-	-	-	1	-	
C409B4.4	2	1	-	-	-	-	-	-	-	-	-	-	1	-	
C409B4.5	2	1	-	-	-	-	-	-	-	-	-	-	1	-	
C409B4.6	2	1	-	-	-	-	-	-	-	-	-	-	1	-	

20EE8B5	FUNDAMENTALS OF NANO SCIENCE	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the concept and knowledge of Nano science and Nanotechnology.
- To create awareness of clean room environment & societal implications of Nanotechnology
- To know about preparation methods and nanofabrication techniques
- To know about the different characterization techniques used for Nano systems.
- To understand the significant applications of nanotechnology

PRE-REQUISITE: Nil

UNIT - I INTRODUCTION 9

Overview of Nano scale Science and Technology- Implications on Science, Engineering and society nano structured materials- Properties- Nanotoxicology-Clean room standards.

UNIT - II PREPARARTION ROUTES 9

Preparation of nanoscale materials: precipitation, mechanical milling, colloidal routes, self assembly; vapour phase deposition, CVDs, sputtering, evaporation, molecular beam epitaxy, atomic layer epitaxy.

UNIT - III LITHOGRAPHY FOR NANOSCALE DEVICES 9

Lithography process, optical/UV, electron beam, Ion Beam and x-ray lithography, Nano imprint technique- Scanning probe lithography.

UNIT - IV CHARECTERIZATION TECHNIQUES 9

X-ray and Neutron diffraction technique, Scanning Electron Microscopy plus environmental techniques, Transmission Electron Microscopy including high-resolution imaging, analytical electron microscopy, EDX and EELS, Surface Analysis techniques, XPS, SIMS, Auger.

UNIT - V EVOLVING INTERFACES OF NANO 9

Applications of nanotechnology: NEMS – Nanosensor – nanomedicines –Nano applications in electrical engineering –Nanoelectronics: quantum transport devices, molecular electronics devices, quantum computing ,memory, CNT and its applications, Nano motor, Nano robot, energy efficient battery technology, Nano dielectrics, lighting system, solar cell

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Chattopadhyay K.K and A.N Banerjee, Introduction to Nanoscience and nanotechnology, PHI, 2009
2. T. Pradeep, Nano the essentials, Tata-McGraw Hill Education, 2007

REFERENCES:

1. G Timp, “Nanotechnology”, AIP press/Springer, 1999.
2. Charles P. Poole & Frank, J.Owens, Introduction to nanotechnology, Wiley India, 2007
3. Jan Korwink and Andreas Greiner, Semiconductors for Micro and Nanotechnology: An Introduction for Engineers, Weinheim Cambridge: wiley-VCH,2001
4. N.John Dinardo, Nanoscale Characterization of Surfaces and Interfaces, Second edition, Weinheim Cambridge: wiley-VCH,2000
5. B S Murthy,P Shankar, Baldev Raj, BB Rath& James Murday. ’Text book of Nanoscience and Nano Technology’, Universities Press, 2011

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : FUNDAMENTALS OF NANO SCIENCE											**Course Code : 20EE8B5**			
CO	**Course Outcomes**										**Unit**	**K –CO**	**POs**	**PSOs**
C409B5.1	Explain the science of nano structured materials										I	K2	1,2	1
C409B5.2	Demonstrate the general methods of nanomaterials preparation										II	K2	1,2	1
C409B5.3	Discuss the types and properties of nanomaterials										III	K2	1,2	1
C409B5.4	Explain the characterization techniques of nanomaterials										IV	K2	1,2	1
C409B5.5	Describe the operation of NanoInfoTech and Nanobiotechlogy										V	K2	1,2	1
C409B5.6	Summarize the operation of Nanoparticles for sunbarrier products										V	K2	1,2	1
CO-PO Mapping														
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
C409B5.1	2	1	-	-	-	-	-	-	-	-	-	-	2	-
C409B5.2	2	1	-	-	-	-	-	-	-	-	-	-	2	-
C409B5.3	2	1	-	-	-	-	-	-	-	-	-	-	2	-
C409B5.4	2	1	-	-	-	-	-	-	-	-	-	-	2	-
C409B5.5	2	1	-	-	-	-	-	-	-	-	-	-	2	-
C409B5.6	2	1	-	-	-	-	-	-	-	-	-	-	2	-

20EI602	BIOMEDICAL INSTRUMENTATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To Introduce Fundamentals of Biomedical Engineering
- To understand the measurement of non-electrical parameters and diagnostic procedure.
- To study measurement of certain important electrical parameters and analysis.
- To understand the basic principles in imaging techniques.
- To understand the basic knowledge in life assisting and therapeutic devices.

PRE-REQUISITE: NIL

UNIT-I FUNDAMENTALS OF BIOMEDICAL ENGINEERING 9

Cell and its structure – Resting and Action Potential – Propagation of potential -Nervous system and its fundamentals - Cardiovascular systems- Respiratory systems –Kidney and blood flow -Basic components of a biomedical system- Physiological signals and transducers – selection criteria – Piezoelectric, ultrasonic transducers -Temperature measurements - Fibre optic temperature sensors.

UNIT-II NON ELECTRICAL PARAMETERS MEASUREMENT AND DIAGNOSTIC PROCEDURES 9

Measurement of blood pressure - Cardiac output - Heart rate - Heart sound - Pulmonary function measurements – spirometer – Photo Plethysmography, Body Plethysmography – Blood Gas analysers, pH of blood –measurement of blood pCO2, pO2, finger-tip oxymeter - ESR, GSR measurements.

UNIT – III ELECTRICAL PARAMETERS ACQUISITION AND ANALYSIS 9

Electrodes – Limb electrodes –floating electrodes – pregelled disposable electrodes - Micro, needle and surface electrodes – Amplifiers, Preamplifiers, differential amplifiers, chopper amplifiers – Isolation amplifier - ECG – EEG – EMG – ERG – Lead systems and recording methods – Typical waveforms - Electrical safety in medical environment, shock hazards – leakage current-Instruments for checking safety parameters of biomedical equipment.

UNIT – IV IMAGING MODALITIES AND ANALYSIS 9

Radio graphic and fluoroscopic techniques – Computer tomography – MRI – Ultrasonography –Endoscopy – Thermography –Different types of biotelemetry systems - Retinal Imaging – Imaging application in Biometric systems.

UNIT – V LIFE ASSISTING, THERAPEUTIC AND ROBOTIC DEVICES 9

Pacemakers – Defibrillators – Ventilators – Nerve and muscle stimulators – Diathermy – Heart –Lung machine – Audio meters – Dialysers – Lithotripsy – Laser therapeutic for eye - Robotic surgery –Orthopaedic prostheses fixation – Tele medicine

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Leslie Cromwell, “Biomedical Instrumentation and Measurement”, Prentice Hall of India, 2018.
2. Khandpur R.S, Handbook of Biomedical Instrumentation, Tata McGraw-Hill, 2nd edition, 2014.

REFERENCES:

1. John G. Webster, Medical Instrumentation Application and Design, John Wiley and sons, 5th Edition, 2020.
2. R.Anandanatarajan, Biomedical Instrumentation and Measurements, PHI Learning Private Limited, 2011.
3. Ed. Joseph D. Bronzino, The Biomedical Engineering Hand Book, 4th Edition, Boca Raton, CRC Press LLC, 2015.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : BIOMEDICAL INSTRUMENTATION													**Course Code : 20EI602**	
CO	**Course Outcomes**											**Unit**	**K-CO**	**POs**	**PSOs**
C409B6.1	Explain the philosophy of the heart, lung, blood circulation and respiration system.											1	K2	1,2	-
C409B6.2	Describe the concept of measurement of non-electrical parameters.											2	K2	1,2	-
C409B6.3	Explain the various sensing and measurement devices of electrical origin.											3	K2	1,2	-
C409B6.4	Describe the importance of electrical safety in various biomedical device.											3	K2	1,2	-
C409B6.5	Explain the construction and working of imaging device and their analysis.											4	K2	1,2	-
C409B6.6	Explain the working of medical assistance/techniques, robotic and therapeutic equipment's.											5	K2	1,2	-
CO-PO mapping															
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	
C409B6.1	2	1	-	-	-	-	-	-	-	-	-	-	-	-	
C409B6.2	2	1	-	-	-	-	-	-	-	-	-	-	-	-	
C409B6.3	2	1	-	-	-	-	-	-	-	-	-	-	-	-	
C409B6.4	2	1	-	-	-	-	-	-	-	-	-	-	-	-	
C409B6.5	2	1	-	-	-	-	-	-	-	-	-	-	-	-	
C409B6.6	2	1	-	-	-	-	-	-	-	-	-	-	-	-	

OPEN ELECTIVE – II (VII SEMESTER) - for other Departments

20OE205	INDUSTRIAL ENERGY AUDITING AND MANAGEMENT (Qualitative Treatment only)	L	T	P	C
		3	0	0	3

OBJECTIVES: To impart knowledge on the following Topics

- Awareness about importance of energy management and auditing..
- Understanding the Energy management on various electrical motors.
- Understanding the Energy management on electric lighting systems.
- Apply the different types of metering methods of energy management and auditing
- Provide the economic models for energy and load management.

PRE-REQUISITE: NIL

UNIT - I INTRODUCTION 9

Basics of Energy – Need for energy management – Energy accounting – Energy monitoring, targeting and reporting – Energy audit process.

UNIT - II ENERGY MANAGEMENT FOR MOTORS AND COGENERATION 9

Energy management for electric motors – Transformer and reactors – Capacitors and synchronous machines, energy management by cogeneration – Forms of cogeneration – Feasibility of cogeneration – Electrical interconnection.

UNIT - III LIGHTING SYSTEMS 9

Energy management in lighting systems – Task and the working space – Light sources – Ballasts – Lighting controls – Optimizing lighting energy – Power factor and effect of harmonics, lighting and energy standards..

UNIT - IV METERING FOR ENERGY MANAGEMENT 9

Metering for energy management – Units of measure – Utility meters – Demand meters – Paralleling of current transformers – Instrument transformer burdens – Multi tasking solid state meters, metering location vs requirements, metering techniques and practical examples.

UNIT - V ECONOMIC ANALYSIS AND MODELS 9

Economic analysis – Economic models – Time value of money – Utility rate structures – Cost of electricity – Loss evaluation, load management – Demand control techniques – Utility monitoring and control system – HVAC and energy management – Economic justification.

TOTAL: 45PERIODS

TEXT BOOKS:

1. Barney L. Capehart, Wayne C. Turner, and William J. Kennedy, Guide to Energy Management, Fifth Edition, The Fairmont Press, Inc., 2006
2. Eastop T. D & Croft D. R, Energy Efficiency for Engineers and Technologists, Logman Scientific & Technical, ISBN-0-582-03184, 1990.

REFERENCES:

1. Reay D.A, Industrial Energy Conservation, 1stedition, Pergamon Press, 1977.
2. IEEE Recommended Practice for Energy Management in Industrial and Commercial Facilities, IEEE, 1996.
3. Amit K. Tyagi, Handbook on Energy Audits and Management, TERI, 2003.
4. Electricity in buildings good practice guide, McGraw-Hill Education, 2016.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : INDUSTRIAL ENERGY AUDITING AND MANAGEMENT											**Course Code : 20OE205**			
CO	**Course Outcomes**										**Unit**	**K –CO**	**POs**	**PSOs**
CO.1	Explain the importance of energy management and auditing.										I	K2	1,2	-
CO.2	Describe energy management on different types of electrical equipment.										II	K2	1,2	-
CO.3	Explain the Forms and feasibility of cogeneration										II	K2	1,2	-
CO.4	Discuss the energy management on different types of lighting system and light sources.										III	K2	1,2	-
CO.5	Describe the different types of metering methods of energy management and auditing.										IV	K2	1,2	-
CO.6	Explain the economic models for energy and load management.										V	K2	1,2	-
CO-PO Mapping														
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO.1	2	1	-	-	-	-	-	-	-	-	-	-	1	-
CO.2	2	1	-	-	-	-	-	-	-	-	-	-	1	-
CO.3	2	1		-	-	-	-	-	-	-	-	-	1	-
CO.4	2	1	-	-	-	-	-	-	-	-	-	-	1	-
CO.5	2	1	-	-	-	-	-	-	-	-	-	-	1	-
CO.6	2	1	-	-	-	-	-	-	-	-	-	-	1	-

20OE206	FUNDAMENTALS OF FIBRE OPTICS AND LASERS (Qualitative Treatment only)	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To expose the students to the basic concepts of optical fibres and their properties.
- To provide adequate knowledge about the Industrial applications of optical fibres.
- To expose the students to the Laser fundamentals.
- To provide adequate knowledge about Industrial application of lasers.
- To provide adequate knowledge about holography and Medical applications of Lasers.

PRE-REQUISITE: NIL

UNIT - I OPTICAL FIBRES AND THEIR PROPERTIES 9

Construction of optical fiber cable: Guiding mechanism in optical fiber and Basic component of optical fiber communication, –Principles of light propagation through a fibre: Total internal reflection, Acceptance angle (θa), Numerical aperture and Skew mode – Different types of fibres and their properties: Single and multimode fibers and Step index and graded index fibers – fibre characteristics: Mechanical characteristics and Transmission characteristics, – Absorption losses – Scattering losses– Dispersion – Connectors and splicers – Fibre termination – Optical sources: Light Emitting Diode(LED) – Optical detectors: PIN Diode.

UNIT - II INDUSTRIAL APPLICATION OF OPTICAL FIBRES 9

Fibre optic sensors: Types of fiber optics sensor, Intrinsic sensor- Temperature/ Pressure sensor, Extrinsic sensors, Phase Modulated Fibre Optic Sensor and Displacement sensor (Extrinsic Sensor) – Fibre optic instrumentation system: Measurement of attenuation (by cut back method), Optical domain reflectometers, Fiber Scattering loss Measurement, Fiber Absorption Measurement, Fiber dispersion measurements, End reflection method and Near field scanning techniques – Different types of modulators: Electro-optic modulator (EOM) – Interferometric method of measurement of length –Moire fringes – Measurement of pressure, temperature, current, voltage, liquid level and strain.

UNIT - III LASER FUNDAMENTALS 9

Fundamental characteristics of lasers – Level Lasers: Two-Level Laser, Three Level Laser, Quasi Three and four level lasers – Properties of laser: Monochromaticity, Coherence, Divergence and Directionality and Brightness – Laser modes – Resonator configuration – Q-switching and mode locking – Cavity damping – Types of lasers – Gas lasers, solid lasers, liquid lasers and semiconductor lasers.

UNIT - IV INDUSTRIAL APPLICATION OF LASERS 9

Laser for measurement of distance, Laser for measurement of length, Laser for measurement of velocity, Laser for measurement of acceleration, Laser for measurement of current, voltage and Laser for measurement of Atmospheric Effect: Types of LIDAR, Construction And Working, and LIDAR Applications – Material processing: Laser instrumentation for material processing, Powder Feeder, Laser Heating, Laser Welding, Laser Melting, Conduction Limited Melting and Key Hole Melting –Laser trimming of material: Process Of Laser Trimming, Types Of Trim, Construction And Working Advantages – Material Removal and vaporization: Process Of Material Removal.

UNIT - V HOLOGRAM AND MEDICAL APPLICATIONS 9

Holography: Basic Principle, Holography vs. photography, Principle Of Hologram Recording, Condition For Recording A Hologram, Reconstructing and viewing the holographic image– Holography for non-destructive testing – Holographic components – Medical applications of lasers, laser-Tissue Interactions Photochemical reactions, Thermalisation, collisional relaxation, Types of Interactions and Selecting an Interaction Mechanism – Laser instruments for surgery, removal of tumors of vocal cards, brain surgery, plastic surgery, gynaecology and oncology.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. J.M. Senior, 'Optical Fibre Communication – Principles and Practice', Prentice Hall of India, January 2014.
2. Eric Udd, William B., and Spillman, Jr., "Fiber Optic Sensors: An Introduction for Engineers and Scientists ", John Wiley & Sons, 2011.
3. J. Wilson and J.F.B. Hawkes, 'Introduction to Opto Electronics', Prentice Hall of India, 2001.

REFERENCES:

1. G. Keiser, 'Optical Fibre Communication', McGraw Hill, 1995.
2. M. Arumugam, 'Optical Fibre Communication and Sensors', Anuradha Agencies, 2002.
3. John F. Ready, "Industrial Applications of Lasers", Academic Press, Digitized in 2008.
4. Monte Ross, 'Laser Applications', McGraw Hill, 1968.
5. John and Harry, "Industrial lasers and their application", McGraw-Hill, 2002.
6. Keiser, G., "Optical Fiber Communication", McGraw-Hill, 3rd Edition, 2000.
http://nptel.ac.in/courses/117101002

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : FUNDAMENTALS OF FIBRE OPTICS AND LASERS											**Course Code : 20OE206**			
CO	**Course Outcomes**										**Unit**	**K –CO**	**POs**	**PSOs**
CO.1	Explain the principle, transmission, dispersion and attenuation characteristics of optical fibers										I	K2	1,2	1
CO.2	Explain the principle of Fibre Optical sources and Optical detectors.										I	K2	1,2	1
CO.3	Describe the Fiber Scattering loss Measurement, Fiber Absorption Measurement and Fiber dispersion measurements										II	K2	1,2	1
CO.4	Summarize the Fundamental characteristics and types of lasers										III	K2	1,2	1
CO.5	Discuss the Construction and Working of industrial application of lasers										IV	K2	1,2	1
CO.6	Explain the Basic Principle of Hologram and medical applications of laser.										V	K2	1,2	1
CO-PO Mapping														
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO.1	2	1	-	-	-	-	-	-	-	-	-	-	1	-
CO.2	2	1	-	-	-	-	-	-	-	-	-	-	1	-
CO.3	2	1		-	-	-	-	-	-	-	-	-	1	-
CO.4	2	1	-	-	-	-	-	-	-	-	-	-	1	-
CO.5	2	1	-	-	-	-	-	-	-	-	-	-	1	-
CO.6	2	1	-	-	-	-	-	-	-	-	-	-	1	-

20OE207	ELECTRIC POWER QUALITY	L	T	P	C
		3	0	0	3

(Qualitative Treatment only)

OBJECTIVES:

- To understand the various power quality issues.
- To understand the causes, impacts and mitigation of Voltage sag and interruptions in power system.
- To understand the causes, impacts and mitigation of over voltages in power system with PSCAD and EMTP.
- To understand the concept of harmonics in power system with their causes, effects and control techniques.
- To understand the various types of conventional and modern power quality monitoring devices/methods.

PRE-REQUISITE: NIL

UNIT – I INTRODUCTION 9

Terms and definitions – Overloading – Under voltage – Sustained interruption - Sags and Swells – Waveform distortion – Total Harmonic Distortion (THD) – Computer Business Equipment Manufacturers Associations (CBEMA) curve.

UNIT – II VOLTAGE SAGS AND INTERRUPTIONS 9

Sources of sags and interruptions – Estimating voltage sag performance – Motor starting sags – Estimating 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 – Computer analysis tools for transients – PSCAD and EMTP.

UNIT – IV HARMONICS 9

Harmonic distortion – Voltage and current distortion – Harmonic indices – Harmonic sources from commercial and industrial loads – Locating harmonic sources – Power system response characteristics – Resonance – Harmonic distortion evaluation – Devices for controlling harmonic distortion – Passive filters – Active filters – IEEE and IEC standards.

UNIT – V POWER QUALITY MONITORING AND CUSTOM POWER DEVIES 9

Power line disturbance analyzer - Harmonic/Spectrum analyzer - Flicker meters - Rectifier supported DVR – DC Capacitor supported DVR – DVR Structure – voltage Restoration – Series Active Filter – Unified power quality conditioner.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. R.C. Duggan , “Power Quality”, McGraw-Hill Education, 2012.(2nd edition)
2. A.J. Arrillga, “Power system harmonics”, Wiley, 2003 (2nd edition)

REFERENCES:

1. G.T.Heydt, “Electric Power Quality”, Stars in a Circle Publications, 1994 (2nd edition)
2. Derek A. Paice, “Power Electronic Converter Harmonics”, Wiley-IEEE Press-Ist Edition-1999

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : ELECTRIC POWER QUALITY											Course Code : 20OE207			
CO	**Course Outcomes**										**Unit**	**K –CO**	**POs**	**PSOs**
CO.1	Explain power quality disturbances, their causes, detrimental effects and Power quality standard.										I	K2	1,2	1
CO.2	Describe the impact of voltage sag and interruptions in power systems.										II	K2	1,2	1
CO.3	Analyze the over voltage phenomena using PSCAD and EMTP.										III	K2	1,2	1
CO.4	Describe the impact of Harmonics in power systems.										IV	K2	1,2	1
CO.5	Explain the different types of monitoring devices/methods for power quality in power system.										IV	K2	1,2	1
CO.6	Discuss the different types of custom power devices for enhancement of power quality in power system.										V	K2	1,2	1
CO-PO Mapping														
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO.1	2	1	-	-	-	-	-	-	-	-	-	-	1	-
CO.2	2	1	-	-	-	-	-	-	-	-	-	-	1	-
CO.3	2	1	-	-	-	-	-	-	-	-	-	-	1	-
CO.4	2	1	-	-	-	-	-	-	-	-	-	-	1	-
CO.5	2	1	-	-		-	-	-	-	-	-	-	1	-
CO.6	2	1	-	-	-	-	-	-	-	-	-	-	1	-

20OE208	ELECTRICAL DRIVES AND CONTROL FOR AUTOMATION (Qualitative Treatment only)	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the DC drive control.
- To study and analyze the Induction motor drive control.
- To study and understand the Synchronous motor drive control.
- To study and analyze the SRM and BLDC motor drive control.
- To analyze and design the Digital control for drives.

PRE-REQUISITE: NIL

UNIT - I CONTROL OF DC DRIVES 9

Losses in electrical drive system, Energy efficient operation of drives, block diagram /transfer function of self, separately excited DC motors --closed loop control-speed control current control - constant torque/power operation - P, PI and PID controllers–response Comparison.

UNIT - II CONTROL OF INDUCTION MOTOR DRIVE 9

VSI and CSI fed induction motor drives-principles of V/f control-closed loop variable frequency PWM inverter with dynamic braking- static Scherbius drives- power factor considerations– modified Kramer drives-principle of vector control- implementation-block diagram, Design of closed loop operation of V/f control of Induction motor drive systems.

UNIT - III CONTROL OF SYNCHRONOUS MOTOR DRIVES 9

Open loop VSI fed drive and its characteristics–Self-control–Torque control –Torque angle Control –Power factor control–Brushless excitation systems—Field oriented control –Design of closed loop operation of Self-control of Synchronous motor drive systems.

UNIT - IV CONTROL OF SRM AND BLDC MOTOR DRIVES 9

SRM construction - Principle of operation - SRM drive design factors-Torque controlled SRM- Block diagram of Instantaneous Torque control using current controllers and flux Controllers. Construction and Principle of operation of BLDC Machine -Sensing and logic switching scheme,-Sinusoidal and trapezoidal type of Brushless dc motors – Block diagram of current controlled Brushless dc motor drive.

UNIT - V DIGITAL CONTROL OF DC DRIVE 9

Phase Locked Loop and micro-computer control of DC drives–Program flow chart for constant constant torque and constant horse power operations Speed detection and current sensing circuits and feedback elements.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Gopal K.Dubey, Fundamentals of Electrical Drives, Narosa Publishing House, Second Edition, 2015.
2. Krishnan R., " Electric Motor & Drives: Modelling, Analysis and Control", Pearson Education, 2015

REFERENCES:

1. Bin Wu, High-Power Converters and AC Drives, Wiley-IEEE Press
2. Bimal K Bose, “Modern Power Electronics and AC Drives” Pearson Education, 2016.
3. R. Krishnan, Switched Reluctance Motor Drives: Modeling, Simulation, Analysis, Design, and Applications, CRC press, 2001.
4. Werner Leonhard, Control of Electrical Drives, 3rd Edition, Springer, Sept., 2001.
5. R. Krishnan, Permanent Magnet Synchronous and Brushless DC Motor Drives, CRC press, 2001.
6. Murphy, J.M.D, Turnbull F.G, Thyristor control of AC motors, Pergamon press, Oxford, 1988

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : ELECTRICAL DRIVES AND CONTROL FOR AUTOMATION												**Course Code : 20OE208**			
CO	**Course Outcomes**											**Unit**	**K –CO**	**POs**	**PSOs**
CO.1	Explain the various control strategies and controllers for DC Motor Drive systems.											I	K2	1,2	1
CO.2	Discuss the various control strategies and controllers for Induction Motor Drive systems and develop the closed loop operation of V/f control of Induction motor drive systems.											II	K2	1,2	1
CO.3	Describe the various control strategies and controllers for Synchronous Motor Drive systems.											III	K2	1,2	1
CO.4	Explain the various control strategies and controllers for SRM Motor Drive systems.											IV	K2	1,2	1
CO.5	Discuss the various control strategies and controllers for BLDC Motor Drive systems.											IV	K2	1,2	1
CO.6	Explain the various Digital control for DC Motor Drive systems.											V	K2	1,2	1
CO-PO Mapping															
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	
CO.1	2	1	-	-	-	-	-	-	-	-	-	-	1	-	
CO.2	2	1	-	-	-	-	-	-	-	-	-	-	1	-	
CO.3	2	1	-	-	-	-	-	-	-	-	-	-	1	-	
CO.4	2	1	-	-	-	-	-	-	-	-	-	-	1	-	
CO.5	2	1	-	-		-	-	-	-	-	-	-	1	-	
CO.6	2	1	-	-	-	-	-	-	-	-	-	-	1	-	