Academic Program: UG

Academic Year 2021-22 Syllabus

VII & VIII Semester B. E.

Electrical & Electronics Engineering

SHRI DHARMASTHALA MANJUNATHESHWARA COLLEGE OF ENGINEERING & TECHNOLOGY,
DHARWAD – 580 002

(An Autonomous Institution Approved by AICTE & Affiliated to VTU, Belagavi
Department Accredited by NBA under Tier-1 (July 2018-June 2022)**)**

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SDM College of Engineering & Technology, Dharwad

It is certified that the scheme and syllabus for VII & VIII semester B.E. in Electrical & Electronics Engineering is recommended by the Board of Studies of Electrical and Electronics Engineering Department and approved by the Academic Council, SDM College of Engineering &Technology, Dharwad. This scheme and syllabus will be in force from the academic year 2021-22 till further revision.

Principal   Chairman BoS & HoD

SDM College of Engineering & Technology, Dharwad
Department of Electrical & Electronics Engineering
*(**Our motto:** Professional **C**ompetence with **P**ositive **A**ttitude)*

College Vision and Mission

Vision

To develop competent professionals with human values

Mission

- To have contextually relevant Curricula.
- To promote effective Teaching Learning Practices supported by Modern Educational Tools and Techniques.
- To enhance Research Culture
- To involve Industrial Expertise for connecting classroom content to real life situations.
- To inculcate Ethics and impart soft-skill leading to overall Personality Development.

QUALITY POLICY:

In its quest to be a role model institution, committed to meet or exceed the utmost interest of all the stake holders.

CORE VALUES:

Competency

Commitment

Equity

Team work and Trust

DEPARTMENT VISION AND MISSION

Vision:

To develop globally acceptable Electrical and Electronics Engineering professionals with human values.

Mission:

- Adopting the state of the art curricula
- Practicing effective and innovative teaching-learning methodologies
- Initiating complementary learning activities to enhance competence
- Inculcating positive attitude and commitment to society.

Program Educational Objectives (PEOs)

I. To impart the domain knowledge and soft skills to secure employment or become entrepreneur or pursue higher studies.

II. To provide training for teamwork, leadership qualities, lifelong learning and adaptability to achieve professional growth.

III. To develop sense of positive attitude and practice ethics to contribute positively to the society as a responsible citizen.

POs and PSOs

PO 1.**Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

PO 2.**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.

PO 3.**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.

PO 4.**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 provide valid conclusions.

PO 5.**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.

PO 6.**The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO 7.**Environment and Sustainability**: Understand the impact of professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO 8.**Ethics:** Apply ethical principles and commit to professional ethics responsibilities and norms of the engineering practice.

PO 9.**Individual and Team work:** Function effectively as an individual and as a member or leader in diverse teams and individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO 10.**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, and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO 11.**Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and 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 projects and in multidisciplinary environments.

PO 12.**Life-long Learning:** long learning: Recognize the need for and have the Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

PSO-1 Enhancement of professional competence in cutting edge domain through value addition activities.

PSO-2 Ability to demonstrate the skill of carrying out operation and Maintenance of electrical distribution system effectively.

PSO-3 Design and implement the electronic circuits/programs for practical applications.

SDM College of Engineering and Technology, Dharwad
Dept. of Electrical & Electronics Engineering
VII Semester

Course Code	Course Category	Course Title	Teaching		Examination				
			L-T-P (Hrs/Week)	Credits	CIE	Theory (SEE)		Practical (SEE)	
					Max. Marks	*Max. Marks	Duration in Hrs.	Max. Marks	Duration In Hrs.
18UEEC700	PC	Computer Applications to Power Systems	3-0-0	3	50	100	3	-	-
18UEEC701	PC	Electrical Machine Design	3-0-0	3	50	100	3	-	-
18UEEE74X	PE	Elective –IV	4-0-0	4	50	100	3	-	-
18UEEO703	OE	Open Elective-II	3-0-0	3	50	100	3	-	-
18UEEL704	PC	Relay, High Voltage & Power System Simulation Lab	0-0-3	2	50	-	-	50	3
18UEEL705	PC	Major Project-Phase I	0-0-6	2	50	-	-	50	3
18UEEL706	PC	Internship	0-0-6	2	50	-	-	-	-
		Total	**13-0-15**	**19**	**350**	**400**		**100**	

PC- Program Core, **PE**-Professional Elective and **OE**- Open Elective
*SEE for theory courses is conducted for 100 marks and reduced to 50 marks.

Electric Vehicles (**Open Elective-II)**	18UEEO703
Elective-IV	
AI Applications to Power System	18UEEE741
Modern Trends in Transmission System	18UEEE742
Modern Power System Protection	18UEEE743
Modern Power System Operation and Control	18UEEE744
Digital Image Processing	18UEEE745
Arm Processors	18UEEE746
Embedded Systems	18UEEE747

SDM College of Engineering and Technology, Dharwad
Department of Electrical & Electronics Engineering
VIII Semester

Course Code	Course Category	Course Title	Teaching		Examination				
			L-T-P (Hrs/Week)	Credits	CIE	Theory (SEE)		Practical (SEE)	
					Max. Marks	*Max. Marks	Duration in Hrs.	Max. Marks	Duration In Hrs.
18UEEC800	PC	Industrial Utilization of Electric Power	4-0-0	4	50	100	3	-	-
18UEEE85X	PE	Elective-V	3-0-0	3	50	100	3	-	-
18UEEO802	OE	Open Elective–III	3-0-0	3	50	100	3	-	-
18UEEL803	PC	Technical Seminar	0-0-3	1	50	-	-	-	-
18UEEL804	PC	Major Project-Phase-II	0-0-14	7	50	-	-	50	3
		Total	**10-0-17**	**18**	**250**	**300**		**50**	

PC- Program Core, PE-Professional Elective and OE- Open Elective
*SEE for theory courses is conducted for 100 marks and reduced to 50 marks.

Micro Electro Mechanical Systems **(Open Elective-III)** 18UEEO802	
Elective-V	
Modern Trends in Grid Integration	18UEEE851
Power System Dynamics and Stability	18UEEE852
Power System Restructuring and Power Quality	18UEEE853
Reliability Engineering	18UEEE854
Analog and Digital Communication	18UEEE855

Total credits offered during 2nd, 3rd and 4th year = 135

VII Semester

18UEEC700	**Computer Techniques in Power systems**	**(3 - 0 - 0) 3**

Contact Hours: 39

Course learning objectives (CLOs):

The students are expected to learn about the formation of different matrices to represent the power system network and load frequency control techniques. It is required to understand the load flow studies and use of various numerical techniques for the same. The student should get exposure to optimal distribution of load and economic operation. Further, must know to carry out steady and transient states analysis using different techniques.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to PO's (1 to12)/ PSO's (1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Describe importance of computer techniques in power system, form bus impedance and admittances matrices.	1, 2		
CO-2	Model single area and two area systems and analyse steady state and dynamic response of load frequency control,	1, 2		
CO-3	Analyse load flow using different techniques	1, 2		
CO-4	Determine Optimal distribution of load between the units with and without transmission line loss	1, 2		
CO-5	Analyse Transient stability studies using different methods.	1, 2		

PO's	**PO-1**	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**	**PSO-1**	**PSO-2**	**PSO-3**
Mapping Level	3.0	3.0													

Prerequisites:1. Electrical Power generation 2. Electrical Power Distribution and

Utilization 3. Power System Analysis and Stability 4. Switchgear and Protection

Contents:

Unit-I

Bus incidence matrix: Primitive admittance matrix, Y-Bus by singular transformation. Algorithm for formation bus impedance matrix of single-phase system and numerical examples. **08 Hrs.**

Unit-II

Power System Control: Load frequency control, turbine speed governing system modelling. Block diagram representation of single area, steady state and dynamic response and Two-area load frequency control. **07 Hrs.**

Unit-III

Load flow studies: static load flow equations, types of buses, Gauss – Siedel iterative method using Y bus including PV bus, acceleration of convergence. Newton Raphson method in polar co-ordinates. Fast Decoupled load flow method. Representation of transformer fixed tap setting transformer, tap changing under load transformer. **08 Hrs.**

Unit-IV

Economic operation of power system: Optimal distribution of loads between units within a plant, Transmission loss as a function of plant generation, determination of loss coefficient and economic load dispatch with and without transmission line loss and numerical problems. **08 Hrs.**

Unit-V

Transient stability studies: Swing equation, Numerical solutions of differential equations: modified Euler's method, Runge Kutta IV order method Representation of synchronous machine for transient stability studies, load representation, Network performance equation and. Solution techniques with flowcharts. **08 Hrs.**

Reference Books:

1) Stag and El-Abiad, "Computer Methods in Power System Analysis", 1/e, McGraw Hill International, 1965
2) Uma Rao, "Computer Techniques and Models in Power Systems", I.K. International Publishing House Pvt. Ltd, 2007
3) Nagrath & Kothari, "Modern Power system Analysis", Tata McGraw Hill, 3/e, 2003
4) M. A. Pai, "Computer Techniques in Power System', Tata McGraw Hill, 2/e, 2014.

18UEEC701	Electrical Machine Design	(3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

The students are expected to learn the Principles of Electrical Machine Design including magnetic and insulating materials, magnetic circuit calculations, heating and cooling aspects. Further, they are expected to independently design single phase and three phase transformers, DC machines, three phase induction motors and 3 phase synchronous machines.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to PO's (1 to12)/ PSO's (1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Discuss the fundamentals of Electrical machine design and analyse the thermal aspects.	1, 2		
CO-2	Discuss design aspects of electromagnet and determine magnetic circuit parameters of electric machines.	2, 3		
CO-3	Design single phase and three phase transformers.	2, 3		
CO-4	Design DC machines and discuss basics of three phase Induction motor design	2,3		
CO-5	Design three phase induction motor and three phase synchronous machine.	2,3		

PO's	**PO-1**	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**	**PSO-1**	**PSO-2**	**PSO-3**
Mapping Level	3	3	3												

Prerequisites: Electrical machines.

Contents:

Unit-I

Principles of Electrical Machine Design: Introduction, specifications of different machines, Limitations, Conducting, magnetic and insulating materials used. Classification of solid insulating materials.

Heating and Cooling: Modes of heat dissipation in electric machines. Expression for temperature rise.Heating and cooling curves, related problems. **07 Hrs.**

Unit-II

Design of Electromagnets: Expression for magnetic pull, calculation flux density in the air gap, AT for airgap and iron parts calculation of coil current.

Magnetic circuit calculations: Magnetic circuit of rotating machines and transformers, Calculation of total mmf in case of dc machines. **08 Hrs.**

Unit-III

Design of single phase and three phase transformers: Output equations, expression for volt/turn, determination of main dimensions of the core, yoke and window, design of windings and arrangement of turns, estimation of no-load current, expression for leakage reactance, determination of no. of cooling tubes. **08 Hrs.**

Unit-IV

Design of DC machines: Output equation, selection of specific loadings, choice of no. of poles, design of main dimensions, slot design of poles, design of shunt and series field windings.

Design of three phase induction motors: Output equation, choice of specific loadings, design of main dimensions, stator winding design. **08 Hrs.**

Unit-V

Design of three phase induction motors: calculation of air gap length, selection of no. of slots of cage rotors, design of rotor bars and end rings, estimation of no-load current, design of slip ring induction motors.

Design of 3 phase synchronous machines: Output equation, choice of specific loadings, short circuit ratio, design of main dimensions, design of stator slots and windings, design of rotor of salient pole and cylindrical rotor machines. **08 Hrs.**

Reference Books:

1) A.K.Sawhney, “A course in Electrical Machine Design”, 6/e edition, Dhanpatrai & Co, 2006.
2) V. N. Mittle, “Design of Electrical Machines”, 4/e edition, standard publishers, and distributors, 2002.
3) R. K. Aggarwal, “Principles of Electrical Machine Design”, S. K.Kataria & Sons, 4/e, 2000.

4) Shanmugasundaram, Gangadharan and Palani, “Electrical Machine Design data book”1/e, Willey Eastern Ltd.1979.

18UEEO703	Electric Vehicles	(3 – 0 – 0) 3

Contact Hours:39

Course Learning Objectives (CLOs):

The students are expected to learn the working of Electric Vehicles and recent trends. To analyse different power converter topology used for electric vehicle application. To develop the electric propulsion unit and its control for application of electric vehicles. To design converters for battery charging and explain transformer less topology.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to PO's (1 to12)/ PSO's (1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Explain the roadway fundamentals, laws of motion, vehicle mechanics and propulsion system design.	1,2		
CO-2	Explain the working of electric vehicles and hybrid electric vehicles in recent trends.	1,2		
CO-3	Energy storage for EV and charging from renewable and grid sources.	1,2		
CO-4	Develop the electric propulsion unit and its control for application of electric vehicles and	1,2		
CO-5	Basic Design of Electric Vehicles	1,2	3	

POs	**PO-1**	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**	**PSO-1**	**PSO-2**	**PSO-3**
Mapping Level	3.0	3.0	2.0												

Prerequisites: Power Electronics

Contents:

Unit-I

Vehicle Mechanics: Roadway Fundamentals, Laws of Motion, Vehicle Kinetics, Dynamics of Vehicle Motion, Propulsion Power, Force-Velocity Characteristics, Maximum Gradability, Velocity and Acceleration, Constant FTR, Level Road, Velocity Profile, Distance Traversed, Tractive Power, Energy Required, Non-constant FTR, General Acceleration, Propulsion System Design. **07 Hrs**.

Unit-II

Electric and Hybrid Electric Vehicles: Configuration of Electric Vehicles, Performance of Electric Vehicles, Traction motor characteristics, Tractive effort and Transmission requirement, Vehicle performance, Tractive effort in normal driving, Energy consumption Concept of Hybrid Electric Drive Trains, Architecture of Hybrid Electric Drive Trains, Series Hybrid Electric Drive Trains, Parallel hybrid electric drive trains. **08 Hrs.**

Unit-III

Energy storage for EV: Energy storage requirements, Battery parameters, Types of Batteries, Modelling of Battery, Super capacitors. Power Electronic Converter for Battery Charging: Charging methods for battery, Termination methods, charging from grid, charging from Renewable Energy Sources. **08 Hrs.**

Unit-IV

Electric Propulsion: EV consideration, DC motor drives, Induction motor drives, Permanent Magnet Motor Drives, Switch Reluctance Motor Drive for Electric Vehicles, Configuration, and control of Drives. **08 Hrs.**

Unit-V

Design of Electric and Hybrid Electric Vehicles: Series Hybrid Electric Drive Train Design: Operating patterns, Sizing of major components, power rating of traction motor, power rating of engine/generator, design of Parallel Hybrid Electric Drive Train Design: design of engine power capacity, design of electric motor drive capacity, transmission design. **08 Hrs.**

Reference Books:

1) Iqbal Husain - Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.
2) M. Ehsani, Y. Gao, S.Gay and Ali Emadi- Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design, CRC Press, 2003.
3) Sheldon S. Williamson - Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles, Springer, 2013.

4) C.C. Chan and K.T. Chau - Modern Electric Vehicle Technology, OXFORD University, 2001.
5) Chris Mi, M. AbulMasrur, David WenzhongGao - Hybrid Electric VehiclesPrinciples and Applications with Practical Perspectives, Wiley Publication, 2011.

18UEEE741 AI Applications to Power System (4 - 0 - 0) 4

Contact Hrs: 52

Course Learning Objectives (CLOs):

The students are expected to learn basic concepts of AI, soft and hard computing. They study about artificial intelligence and relevance of fuzzy logic, fuzzification and defuzzification. Further, they are expected to learn genetic algorithms and apply AI techniques to power system applications.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to PO's (1 to12)/ PSO's (1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Discuss soft, hard computing techniques, expert systems, fuzzy systems, and genetic algorithm	1		2
CO-2	Illustrate the concepts of feed forward neural networks, learning and understanding of feedback neural networks.	3	1	2
CO-3	Design and develop fuzzy logic for simple systems.	3	1	2
CO-4	Design and develop genetic algorithms for simple systems.	3	1	2
CO-5	Assess Fuzzy logic, Expert System and Genetic Algorithm application in power systems operation and control.	3,5		

PO's	**PO-1**	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**	**PSO-1**	**PSO-2**	**PSO-3**
Mapping Level	2.0	1.33	2.33		3.0										

Prerequisites: 1. A course higher level language 2. Mathematics

Contents:

Unit-I

Introduction: Introduction, definition of AI, difference between soft computing techniques and hard computing systems, Expert Systems, brief history of ANN, Fuzzy Logic and Genetic Algorithm. **09 Hrs.**

Unit-II

Artificial neural networks: Introduction, human brain, model of artificial neuron, neural network architectures, characteristics of neural network, learning methods, architecture of back propagation network, back propagation learning. **11 Hrs.**

Unit-III

Fuzzy logic: Introduction, Fuzzy versus crisp, fuzzy sets - membership function – basic fuzzy set operations – properties of fuzzy sets, crisp relations- fuzzy Cartesian product, operations on fuzzy relations, fuzzy logic - fuzzy quantifiers-fuzzy inference, fuzzy rule-basedsystem, defuzzification methods. **12 Hrs.**

Unit-IV

Genetic algorithms: Working principles, difference between genetic algorithm and traditional methods, different types of coding methods, fitness function, reproduction, different types of cross over methods in genetic algorithm, mutation. **11 Hrs**.

Unit-V

Applications of AI techniques in electrical systems: Applications of ANN, Fuzzy logic, Expert System and Genetic Algorithm in power systems operation and control.
09 Hrs.

Reference Books:

1) S.Rajasekaran,G.A.V.Pai, “Neural Networks, Fuzzy Logic & Genetic Algorithms” PHI,1/e,New Delhi, 2003.
2) Abe Springer, “Neural Networks and Fuzzy Systems Theory and Applications”, Science&Business Media, 2012.
3) D.E.Goldberg,” Genetic Algorithms” Pearson Education India,1/e, Dec -2006.
4**)** Weerakorn Ongsakul, “Artificial Intelligence in Power System Optimization” CRC Press, May-2013

18UEEE742 Modern Trends in Transmission System (4 - 0 - 0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

The students are expected to learn FACTS concept, transmission interconnection, FACTs controllers, shunt, series, combined shunt and series connected controllers. The students are required to get exposure to power semiconductor devices like MOSFET, MOS turn OFF thyristor, emitter turn OFF thyristor, integrated gate commuted thyristor (GCT & IGCT). They are also required to learn Static shunt compensator SVC and STATCOM, general aspects of DC transmission and comparison of it with AC transmission and control of HVDC converters and systems.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to PO's (1 to12)/ PSO's (1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Discuss the basic concepts of FACTS.	1, 2		
CO-2	Select power semiconductor devices and converter configuration for FACTS application.	1, 2		
CO-3	Analyse performance of shunt FACTS devices.	1, 2	3, 5	
CO-4	Analyse performance of series FACTS devices.	1, 2	3, 5	
CO-5	Discuss the configuration and performance of HVDC power transmission.	1, 2	5	
CO-6	Carry out a self-study in FACTS and HVDC in the form of Case study.	12		

POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
Mapping Level	3.0	3.0	2.0		2.0							3.0			

Prerequisites: 1. Electrical Power Generation and Transmission 2. Electrical Power Distribution and Utilization 3. Power System Analysis and Stability 4. Switchgear and Protection 5. Power Electronics

Contents:

Unit-I

FACTS: Concepts and general system configuration: Transmission, interconnection, flow of power in AC system, power flow and dynamic stability consideration, relative importance of controllable parameters, basic types of FACTS controllers, shunt, series, combined shunt, and series connected controllers. Significance of power semiconductor devices in FACTS application. **10 Hrs.**

Unit-II

Power semiconductor devices and converters for FACTS: Types of high-power devices, principle of high-power device characteristics and requirements, power device material, diode, MOSFET, MOS turn OFF thyristor, emitter turn OFF thyristor, integrated gate commuted thyristor (GCT & IGCT). Voltage sourced converters: basic concepts, single phase full wave bridge converter operation, square wave voltage harmonics for a single-phase bridge 3 phase full wave bridge converter. Self and line commutated current source converter: basic concepts, 3 phase full wave diode rectifier, thyristor-based converter, current sourced converter with turnoff devices, current sourced versus voltage source converter. **10 Hrs.**

Unit-III

Static shunt compensator SVC and STATCOM: Objective of shunt compensation, methods of controllable Var generation, static Var compensator, SVC and STATCOM, comparison between, SVC and STATCOM. **10 Hrs.**

Unit-IV

Static series compensators: Objectives of series compensation GCSC, TSSC, TCSC and SSSC, variable impedance type of series compensation, switching converter type series compensation, external control for series reactive compensators. **09 Hrs.**

Unit-V

HVDC transmission: Historical sketch, Comparison of HVAC and HVDC Transmission. Earlier practices, Present Trends-Thyristor valves, Self commutated valves, Active filters, Tunable ac filters, ac-dc measurements, DSP controllers, Compact station design.

Case study: Students have to carry out a self-study in FACTS or HVDC**.** **13 Hrs.**

Reference Books:

1) Narian Hingorani, L Gyugyi,” Understanding FACTS: concepts and technology offlexible AC transmission systems” IEEE Press ISBN 0-7803- 3455-8
2) K.R.Padiyar,” HVDC Power Transmission Systems” 2/e, New Academic Science, 2011.
3) E.W. Kimbark, “Direct current Transmission”1/e, Wiley-Interscience,1971.
4) PrabhaKundur, “Power system stability and control” 9th reprint, TMH, 2007.
5) S. Rao, “EHV AC, HVDC Transmission & Distribution Engineering” 3/e, Khanna publishers, 2003.
6) HVDC and FACTS Controller- Application of static converters in Power System; Vijay K Sood Kluwer Academic Publishers 2004.

18UEEE743 Modern Power System Protection (4 – 0 – 0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

The students are expected to learn Basic construction, classification, basic circuits, smoothing circuits, and output devices used in static relays. Further, the students must have exposure to digital/ numerical relays &numerical protection system, relaying algorithms.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to PO’s (1 to12)/ PSO’s (1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Illustrate the knowledge of microprocessor based static relay and Microprocessor based digital protection	1,2		
CO-2	Apply the knowledge of Over current protection schemes for transmission lines	1,2	3	
CO-3	Illustrate DSP based relay algorithms.	1,2		
CO-4	Apply the knowledge of distance protection schemes	1,2		

	for transmission lines and			
CO-5	Understand protection of Induction motor.	1,2		

POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
Mapping Level	3.0	3.0	2.0												

Prerequisites: 1.Digital Signal Processing 2.Switchgear and Protection

Contents:

Unit-I

Solid State Relays: Introduction, Microprocessor-based static relay, types of electronic circuits in a static protection system, Advantages and limitations of static relays, Comparators, Instantaneous over current relay, definite time over current relay, inverse-time over current relay, directional over current relay, Basic radial feeder, methods of discrimination, Rules for setting the IDMT relays. **12 Hrs**.

Unit-II

Microprocessor-Based Digital Protection: Advantages of numerical relaying, Numerical relay hardware, Data Acquisition system, Sample and Hold Circuit, Sampling theorem, Anti-Aliasing Filter, Estimation of Phasors. **10 Hrs.**

Unit-III

Relaying Algorithms: Mann and Morrison Algorithm, Three Sample technique, First and second derivative algorithm, Two sample technique, differential equation algorithm, Application of Differential Equation algorithm to three-phase line, LSQ Algorithm by Sachdev**.** **12 Hrs.**

Unit-IV

Protection of Transmission Lines by Distance Relay: Types of Distance relays, Stepped distance characteristics of a distance relay, Problems in distance measurement, Limitations of distance protection for transmission lines. **09 Hrs.**

Unit-V

Induction Motor Protection: Starting of Induction motor, Faults in induction motors, Abnormalities of induction motors, Protection of small induction motors, Protection of large induction motors. **09 Hrs.**

Reference Books:

1) Badriram & Vishwa Karma – "Power System Protection & Switch Gear"1/e, TMH, 1995.
2) Bhuvanesh A Oza, Nirmal Kumar C Nair, Rashesh P Mehta &Vijay H Makwana – "Power System Protection and Switchgear", 1/e, McGraw Hill Education India, 2016.
3) Ravindranath & Chander - Power System Protection & Switch Gear, New Age Publications, 2005.
4) S. R. Bhide – "Digital Power System Protection", 1/e, PHI Learning, 2014.

18UEEE744 Modern Power System Operation and Control (4 - 0 - 0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

The students are expected to learn SCADA, control canter, digital computer configuration, automatic generation control, area control error, operation without central computers, expression for tie-line flow and frequency deviation, parallel operation of generators, generation control loops, Load frequency control (LFC) modelling, steady state frequency deviation, AGC in single area system and multi area system and tie line bias control. Further, they are required to get exposure to reactive power & voltage control, optimal dispatch of generation and Unit Commitment.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to PO's (1 to12)/ PSO's (1 to 3)		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Describe the concepts of SCADA, AGC, Tie-lines and analyse the process of frequency deviation in power system.	1,2		
CO-2	Develop LFC block diagram and analyse it using MATLAB.	1,2		5
CO-3	Develop AVR block diagram and analyse it using MATLAB and describe the	1,2		5

	secondary voltage control methods.			
CO-4	Exhibit the knowledge of economic dispatch of thermal units using optimization techniques.	1,2		PSO-1
CO-5	Exhibit the knowledge of Unit commitment and explore its methods	1,2		

PO's	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
Mapping Level	3	3			1								1		

Prerequisites: 1. Power System Analysis and Stability 2. Control Systems

Contents:

Unit-I

Control center operation of power systems: Introduction to SCADA, control center, digital computer configuration, automatic generation control, area control error, operation without central computers, expression for tie-line flow and frequency deviation, parallel operation of generators, area lumped dynamic model. **10 Hrs.**

Unit-II

Power system Control: Basic generation control loops, Load frequency control (LFC) modeling, steady state frequency deviation, AGC in single area system and multi area system, tie line bias control. examples to be solved with MATLAB & Simulink. **10 Hrs.**

Unit-III

Reactive Power and voltage control: Automatic voltage control (AVR)modeling, steady state voltage response, excitation system stabilizer-rate feedback, and PID controller, power flow through transmission line, relation between voltage, real power and reactive power, supplementary methods of voltage control, sub synchronous resonance, voltage stability, voltage collapse. Examples to be solved using MATLAB and Simulink. **10 Hrs.**

Unit-IV

Optimal dispatch of generation: Introduction, equality and inequality constraints, operating cost of thermal plant, economic dispatch neglecting losses and no generator limits, economic dispatch neglecting losses and including generator limits, economic dispatch including losses. Examples. **10 Hrs.**

Unit-V

Unit Commitment: Statement of the problem, need and importance of unit commitment, example with shut down rule, constraints, Spinning reserve, thermal unit constraints and other constraints, Unit commitment solution methods-priority lists method, dynamic programming method.

Power system security: Introduction, factors affecting security, contingency analysis, detection of network problems, calculation of network sensitivity factors. **12 Hrs.**

Reference Books:

1) G. L. Kusic, "Computer Aided Power System Analysis", 2/e, Taylor & Francis, 2008.
2) Hadi Saadat, "Power System Engineering", 2/e TMH, 2002.
3) Kotrhari, Nagrath "Power System Analysis", 2/e, TMH, 2008.
4) A. J. Wood & B. F. Woolemberg, "Power Generation, Operation and Control", 1/e, JohnWiley, and Sons,1984.

18UEEE745	Digital Image Processing	(4 – 0 – 0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

The students are required to learn fundamentals of image processing such as image sampling, quantization, various image enhancement techniques in spatial and frequency domain, colour image processing, and concepts of detection of discontinuities, edge linking and boundary detection.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to		**Mapping to PO's (1 to12)/ PSO's (1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Recite fundamentals of image processing	1		
CO-2	Describe image enhancement in spatial and frequency domains and use suitable image enhancement technique based on application.	1		
CO-3	Explain and compare various image restoration techniques	1	5	PSO-2

CO-4	Explain and Compare various image segmentation techniques	1	5	
CO-5	Explain the fundamentals of colour image processing	1		

PO's	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
Mapping Level	3.0				2.0									1	

Prerequisites: 1. A course on Analog Electronic circuits
2. A course on Digital Electronics

Contents:

Unit-I

Introduction: Fundamental steps in digital image processing, Components of digital image processing systems.

Digital Image Fundamentals: Elements of visual perception, Image sensing and acquisition, Image sampling and quantization, Basic relationship between pixels, Linear and nonlinear operations. **10 Hrs.**

Unit –II

Image Enhancement in Spatial Domain: Basic Gray level transformation, Histogram processing, Enhancement using arithmetic and logic operations, Spatial filtering, Smoothing, and sharpening spatial filters.

Image Enhancement in Frequency Domain: Smoothing frequency domain filters, Sharpening frequency domain filters, Homomorphic filtering. **11 Hrs.**

Unit - III

Image Restoration: Noise models, Restoration in the presence of noise, Spatial filtering, Periodic noise reduction by frequency domain filtering, Linear position invariant degradation, estimating degradation function, Inverse filtering, Minimum mean square error filtering, Constrained least squares filtering, Geometric mean filter, Geometric transformations. **11 Hrs.**

Unit -IV

Image Segmentation: Detection of discontinuities, Edge linking and boundary detection, Thresholding, Region-based segmentation. **10 Hrs.**

Unit -V

Colour Image Processing: Colour fundamentals, Colour models, Pseudo colour image processing, Basics of full colour image processing, Colour transformations, Smoothing and sharpening concept. **10 Hrs.**

Reference Book:

1) C Gonzalez and Richard E Woods, Rafael, "Digital Image Processing", 2/e,Pearson Education, 2005.
2) Anil K Jain, "Fundamentals of Digital Image Processing", Pearson Education,PHI,2001
3) B Chanda and D DuttaMajumdar, "Digital Image Processing and Analysis", PHI, 2003.
4) Milan Sonka, Vaclav Hlavac&Roger Boyle, "Image Processing, Analysis and Machine Vision", 2nd Edition, Thomoson Learning, 2001.

18UEEE746	ARM Processor	(4- 0 - 0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

To learn fundamentals of ARM architecture and ARM embedded systems. To acquire and develop logical and Assembly Programming skills. To understand about the interrupt structure in ARM and Embedded Operating system.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to PO's (1 to12)/ PSO's (1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Recite the fundamentals of ARM architecture and embedded system.	1		
CO-2	Illustrate ARM instruction set.	1, 2	5	
CO-3	Demonstrate ARM and Thumb instructions usage and synthesize simple programs using Arm/Thumb instructions.	5	1, 2	
CO-4	Describe interrupt structure & handling, and discuss fundamentals of embedded operating system	1, 2		
CO-5	Analyse C programs to compile on ARM architecture.	3, 5		

PO's	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
Mapping Level	2.75	2.67	3.0		2.67										

Prerequisites: Microcontrollers

Contents:

Unit-I

ARM Embedded System: The RISC Design Philosophy, ARM Design Philosophy, Embedded System Hardware and Software.

ARM Processor Fundamentals: Registers, Current Program Status Register, Pipeline, Exceptions, Interrupts, and the Vector Table, Assembler directives viz AREA, DCB, DCW, DCD. EQU, ENTRY, ALIGN, END. **11 Hrs.**

Unit-II

Introduction to the ARM Instruction Set: Data Processing Instructions, Branch Instructions, Load-Store Instructions, Software Interrupt Instruction, Program Status Register Instructions,Single word and unsigned byte data transfer instructions, Half-word and signed byte data transfer instructions Loading constant, Conditional Execution. **10 Hrs.**

Unit-III

Introduction to the Thumb Instruction Set: Thumb programmer's model**,** Thumb Register Usage, ARM-Thumb Interworking, Thumb other Branch Instructions and SWI instruction, Data Processing Instructions, Single-Register Load-Store Instructions, Multiple-Register Load-Store Instructions, Stack Instructions, Software Interrupt Instruction.

Programming using ARM and Thumb Instructions: Programming examples using ARM and Thumb, SWI, Arithmetic and logical examples. **11 Hrs.**

Unit-IV

Exception and Interrupt Handling: Exception Handling Interrupts, Interrupt Handling Schemes Viz. Non-nested, Nested

Embedded Operating Systems: Fundamental Components, Example: Simple Little Operating System. **11 Hrs.**

Unit-V

Efficient C programming: Basic C data types, C looping structures, allocation, C function calls, Pointer aliasing, structure arrangement, Inline functions and assembly, Bit fields Portability issues. **10 Hrs.**

Reference Books:

1) Andrew Sloss, Dominic Symes, Chris Wright, "ARM System Developer's Guide: Designing Optimizing System Software",2/e, Morgan Kaufmann, 2004.
2) Steve Furber, "ARM System-on-Chip Architecture", 2/e, Pearson Education,2000.
3) ARM Assembly Language fundamentals and Techniques, Fourth Impression2013,by William Hohl, (CRC press).

18UEEE747	Embedded Systems	(4 - 0 - 0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

The students are expected to learn about Embedded Systems**.** Classification, Major Application Areas, Purpose of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems. They also know Sensors and Actuators, Communication Interface, Development Languages, RTOS Based Embedded System Design, Operating System Task Scheduling, memory management. Further they are exposed to Device Drivers, Integration and Testing of Embedded Hardware, Firmware and Advanced Microcontrollers.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to PO's (1 to12)/ PSO's (1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Outline the difference between embedded and desktop system.		1	
CO-2	Recognize the best technology suitable for embedded systems		1, 3	
CO-3	Explain real-time operating systems & basic kernel services of an OS and concept of task, processes & threads, basic of Multi-tasking and different scheduling algorithms,	1		
CO-4	Comprehend different types of message passing techniques &analyse inter process communication & the need for task synchronization in Multi-tasking environment	1	3	

CO-5	Demonstrate the knowledge of integration and testing of embedded systems including advanced microcontrollers.	4		1

PO's	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
Mapping Level	2.2		2.0	3.0											

Prerequisites: 1. Microcontrollers 2. C-programming language

Contents:

Unit-I

Introduction to Embedded Systems: Definition of Embedded System, Embedded Systems vs General Computing Systems, History of Embedded Systems, Classification, Major Application Areas, Purpose of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems. **09 Hrs.**

Unit-II

Typical Embedded System: Core of the Embedded System, Sensors and Actuators, Communication Interface, Embedded Firmware, Other System components, Embedded Firmware Design Approaches and Development Languages. **11 Hrs**.

Unit-III

RTOS Based Embedded System Design: Operating System Basics, Types of Operating Systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling. **10 Hrs**.

Unit-IV

Task Communication: Shared Memory, Message Passing, Remote Procedure Call and Sockets, Task Synchronization: Task Communication/Synchronization Issues, Task Synchronization Techniques, Device Drivers, How to Choose an RTOS. **10 Hrs.**

Unit-V

Integration and Testing of Embedded Hardware and Firmware & Advanced: Microcontrollers, Out of Circuit Programming, in system Programming, in application Programming, Use of Factory Programmed Chip, Overview of PIC and ATMEL Family of Microcontrollers. **12 Hrs**.

Reference Books:

1) Shibu K.V, "Introduction to Embedded Systems" 1/e,Tata McGraw Hill, 2013.
2) Jonathan W. Valvano, "Embedded Microcomputer Systems", 3/e, Cengage Learning, 2011.

3) Lyla B. Das, “Embedded Systems an Integrated Approach”, First Impression, Pearson, 2013.
4) Raj Kamal, “Introduction to Embedded Systems”, Tata McGraw Hill, 2/e, 2008.
5) Tammy Noergaard, “Embedded Systems Architecture: A Comprehensive Guidefor Engineers and Programmers”,Newnes,2/e, 2012.

18UEEL704 Relay, High Voltage & Power System Simulation Lab (0 - 0 - 3) 2

Contact Hours: 36

Course Learning Objectives (CLOs):

The students are expected to learn to independently handle the engineering practices in power systems, High voltage Engineering, Protection by conducting various experiments. They are to learn to formulate the circuit/system/experimental set up/work set up, operate the circuit, record the observations, tabulate the results indicating one specimen calculation, plot the curves if any and finally present the results/inference with justification and prepare laboratory report. Further they get exposure to the contemporary technological happenings and accordingly make use of software packages, tolls to find the solution for power system related problems.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to PO’s (1 to12)/ PSO’s (1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Form Y bus and calculate solution for swing equation	9, POS-3	5	4
CO-2	Carry out load flow analysis, fault studies	9, POS-2	5	4
CO-3	Determine the characteristics of different relays	9, POS-2	5	4
CO-4	Determine breakdown strength of air and oil	9, POS-2	5	4

PO’s	PO-1	PO -2	PO -3	PO -4	PO -5	PO -6	PO -7	PO -8	PO -9	PO-10	PO-11	PO -12	PSO-1	PSO-2	PSO-3
Mapping Level				1.0	2.0				3.0					3	3

Prerequisites: 1. Power system Analysis and Stability
2. High Voltage Engineering

3. Switchgear and Protection

Contents:

Minimum of 10 experiments to be conducted from the list given below.
Expt.1. Y Bus formation by inspection/ singular transformation method.
Expt.2. Swing equation by RK method.
Expt.3. Load flow analysis by GS/NR method.
Expt.4. Fault studies using power system toolbox.
Expt.5. Operating characteristics of electromechanical relay.
Expt.6. Operating characteristics of static relay.
Expt.7. Operating characteristics of Negative sequence relay.
Expt.8. Characteristics of % differential relay.
Expt.9. Operating characteristics of microprocessor based over-current relay.
Expt.10 . Induction motor protection using numerical relay.
Expt.11. Break down strength of air by sphere gap method-demonstration.
Expt.12. Break down strength of transformer oil- demonstration.

Reference Books/Material:

1. Laboratory manuals.
2. Relevant books prescribed for the prerequisite subjects.

18UEEL705	Major Project - Phase I	(0 - 0 - 6) 2

Contact Hours: 72

Course Learning Objectives (CLOs):

The students are expected to learn carrying out literature survey to locate the state-of-the-art technology while formulating/defining the project problem in engineering domain of their interest. The students are expected Select a topic from an emerging area relevant to electrical sciences and/or other relevant branches and define the problem for the project work. The material collection, survey, visits, data collection, preliminary design, analysis etc. is to be done in this phase. The same work will be continued in the next phase in VIII semester.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to PO's (1 to12)/ PSO's (1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Carry out the literature survey to locate the state-of-the-art	2		4, 5, PSO-2, PSO-3

	technology in his Engineering field of interest			
CO-2	Define/formulate the problem for the project work	2, 3	1, 4, 5	PSO-2, PSO-3
CO-3	Design, develop, analyze, test, interpret the results, fabricate, simulate, write code etc. relevant to his project work	3	5	7, 8, 9, 12, PSO-2, PSO-3
CO-4	Summarize the work into a project report and in all can carry out the technical work assigned		10	6, 8, 11, PSO-2, PSO-3

PO's	PO -1	PO-2	PO -3	PO -4	PO-5	PO -6	PO -7	PO -8	PO -9	PO -10	PO-11	PO-12	PSO -1	PSO -2	PSO-3
Mapping Level	2.0	3.0	3.0	1.5	1.6	1.0	1.0	1.0	1.0	2.0	1.0	1.0		1.0	1.0

Prerequisites: Knowledge of both theory and practical courses learnt in all the previous semesters and relevant value-added information.

Contents:

Major project phase-1 in which the students are expected to locate the state of the art technology in his domain of interest by an extensive literature survey and Select a topic from an emerging area relevant to their branch/interdisciplinary and define the problem for the project work. The material collection, survey, visits, data collection, preliminary design, analysis etc. is to be done in this phase. The project shall consist of a team of students not more than 4. Each batch shall be assigned with a guide. A committee consisting of minimum 3 faculty members of which guide is a member shall evaluate at the end for CIE. The weightage of marks shall be 50% for the committee and 50% for the guide. There is a SEE (viva voce) examination which shall be examined by two internal examiners appointed by COE based on the suggestions by the respective HoD.

General Instructions to Students:

1. Students are expected to perform extensive literature survey, identify problem statements and prepare synopsis in consultation with project guide/supervisor. Students are expected to submit synopsis- Initial (Registration Phase-1) approved by project guide, to the project coordinator as per the schedule notified. A copy is to be maintained with students and the guide. This registration/ Initial synopsis

contains the description of the project concept created and acts as a base line for design and Implementation of the system.

2. Notification/schedules and evaluation procedures will be sent to all students in the Google groups created in the department.
3. Evaluation of problem statement/synopsis-Initial (registration phase-1), Literature Survey and SRS (Requirement Analysis Phase-1) are done in the 7th semester.

Sl No	Parameters for Assessment	% of weightage for CIE and SEE
P1	Project Synopsis/ Proposal Evaluation	15
P2	Literature survey/Technology used / Architectural design	15
P3	Requirement Analysis (SRS)	15
P4	Design methodology/Demonstration of tool used for designing	10
P5	Implementation modules	15
P6	Discussion of test cases /Project demonstration	15
P7	Project Report(phase-1 and Phase-2)	10
P8	Paper Publication / Presentation	05

Reference materials/books:

1. Engineering books.
2. Journals.
3. Manuals and data sheets.
4. Software packages.
5. Previous project reports.
6. Product information brochures.
7. Interaction with academia and industrial experts.
8. Internet.

18UEEL706	Internship	(0 - 0 - 6) 2

Duration: 4 Weeks.

The students are to undergo internship in Private industries/R&D organizations/Centers of Excellence/Laboratories of Reputed Institutions/Govt. & Semi Govt. organizations, PSUs, construction companies, entrepreneurial organizations, inter departments within the college etc. to get an exposure to the external world for a period of **4 weeks** in the summer vacation after VI sem and before start of VII semester. The students are to prepare a report on the internship work carried out. The internal faculty shall monitor the student and award CIE marks. The student shall present his/her work before a panel of examiners consisting of HoD, Guide and one faculty member during VII semester as final exam. The performance shall be communicated to the CoE office and the same shall reflect in the VII semester grade card.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to PO's (1 to12)/ PSO's (1 to 3)**		
		Substantial Level(3)	**Moderate Level(2)**	**Slight Level(1)**
CO-1	Know the industrial environment.	1,10	7,9,11	6,12
CO-2	Acquire knowledge and skill to use in professional career.	1	2,4,5	3
CO-3	Acquire the ability of report preparation and presentation skills.	8,10		
CO-4	Follow the code of practice in Electrical & Electronics Engineering related activities.	1		6,8

PO's	**PO-1**	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**	**PSO-1**	**PSO-2**	**PSO-3**
Mapping Level	3.0	2.0	1.0	2.0	2.0	1.0	2.0	2.0	2.0	3.0	2.0	1.0			

Prerequisites: Knowledge of both theory and practical courses learnt in all the previous Semesters and relevant value added information.

VIII Semester

18UEEC800	**Industrial Utilization of Electric Power**	**(4 - 0 - 0) 4**

Contact Hours: 52

Course Learning Objectives (CLOs):

The students are expected to learn the different electric drives, their selection, and dynamics. Further, they are required to evaluate their performance under transient and study state conditions. They are required to know the performance of specific drives like DC motors, Induction motors and Synchronous motors, their suitability and applications in various industries. It is expected that they are to be aware of new control mechanisms of industrial drives.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to PO's (1 to12)/ PSO's (1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Understand the concepts of electrical drives system and dynamics (both transient and steady state) and apply this knowledge to solve numerical.	2		
CO-2	Determine the motor rating selection based on the duty and thermal model for heating and cooling.	2		
CO-3	Analyze the DC Motor Drive characteristics and their control through power electronic systems and apply this knowledge to solve numerical.	2		
CO-4	Analyze the Induction Motor Drive characteristics and their control through power electronic systems and hence be able to solve numerical.	2		
CO-5	Analyze the Synchronous Motor Drive characteristics and their control through power electronic	2		

	systems.			
CO-6	Understand the process involved in important industries and develop reasoning for the application of specific electric therein.	2		

PO's	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
Mapping Level		3.0													

Prerequisites: 1. AC and DC Machines.2. Power Electronics.

Contents:

Unit-I

Introduction to Electrical drives & its dynamics: Parts of electrical drives; Merits & Demerits; choice of electrical drives; status of dc and ac drives. Dynamics of electrical drives; Fundamental torque equation; speed torque conventions; four quadrant operation. Equivalent values of drive parameters. Components of load torques; nature and classification of load torques. Calculation of time and energy loss in transient operations; Steady state stability. **10 Hrs.**

Unit-II

Selection of motor power rating: Thermal model of motor for heating and cooling, Classes of motor duty, determination of motor rating for Continuous duty, fluctuating duty, short time duty and periodic duty. **10 Hrs.**

Unit-III

D C Motor Drives: Starting; Braking; Transient analysis. Single phase fully controlled rectifier control of dc separately excited motor. Three phase fully controlled rectifier control of dc separately excited motor. Multi quadrant operation of dc separately excited motor fed form fully controlled rectifier. Rectifier control of dc series motor. Chopper control of separately excited dc motor. Chopper control of series motor.

10 Hrs.

Unit-IV

Induction motor Drives: Operation with unbalanced source voltage and single phasing; Starting; Braking; Transient analysis. Stator voltage control; Variable voltage, frequency control from voltage sources; Voltage source inverter control; Current source inverter control, Rotor resistance control, Slip power recovery, Speed control of single-phase induction motors. **10 Hrs.**

Unit-V

Synchronous motor Drives: Synchronous motor Drive Basics; Operation form fixed frequency supply; Synchronous motor variable speed drives; Variable frequency control of multiple synchronous motors. Self-controlled synchronous motor drive employing load commutated thyristor inverter. **08 Hrs.**

Industrial Drives: Rolling mill drives; Cement mill drives; Paper mill dries; Textile mill drives. **04 Hrs.**

Reference Books:

1) G.K. Dubey, "Fundamentals of Electrical Drives", 2 Edition, 5/e reprint Narosa publishing house Chennai, 2002.
2) N.K. De and P.K. Sen, "Electrical Drives", PHI, 2007.
3) S.K. Pillai, "A first course on electric drives" 1/eWiley Eastern Ltd 1990.
4) V.R.Moorthi,"Power Electronics, Devices, Circuits and industrial applications",2/e Oxford University Press, 2005.

18UEEO802 Micro Electro Mechanical Systems (MEMS) (3 – 0 – 0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

The students are expected to learn the history of MEMS, motivation, scaling in micro-domain, Mechanical and other properties of materials used in MEMS and Micro-fabrication/Micromachining. They also learn about transduction principles, MEMS modeling, radio frequency (RF) MEMS and optical MEMS. They are required to get exposure to nanotechnology.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to PO's (1 to12)/ PSO's (1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Recite the basics of MEMS technology and apply scaling laws.	1, 2		3
CO-2	Describe materials required and discuss fabrication processes.	1, 2	3	
CO-3	Explain transduction principles and carry out modeling.	1, 2		

CO-4	Discuss the construction and working of RF and Optical MEMS.	1, 2	5	
CO-5	Discuss the issues in handling nano products with the help of MEMS.	2	5	

PO's	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
Mapping Level	3.0	3.0	1.5		2.0										

Prerequisites: Measurements and Instrumentation, Basic Communication (preferred)

Contents:

Unit-I

Introduction to MEMS technology: Introduction to MEMS and motivation, definitions, history of MEMS. How small is different- some natural examples, Scaling laws in electrostatic, electromagnetic, rigidity of structures, heating & cooling, Fluid viscosity and fluid interfaces, etc. Scaling in overall system performance considering multiple physical domains **08 Hrs.**

Unit-II

Mechanical and other properties of materials used in MEMS. Overview of micro-fabrication, Review of microelectronics fabrication processes like photolithography, deposition, doping, etching, structural and surface materials, and other lithography methods, MEMS fabrication methods like surface, bulk, LIGA and wafer bonding methods. **08 Hrs.**

Unit-III

Transduction principles in micro-domain. Basic modeling elements in electrical-mechanical, thermal, and fluid systems, analogy between 2nd order mechanical and electrical systems. Modeling elastic, electrostatic, electromagnetic systems. **08 Hrs.**

Unit-IV

RF-based communication systems, RF – MEMS like MEMS inductors, varactors, tuners, filters, resonators, phase shifters, switches. Optical MEMS: Preview, passive optical components like lenses and mirrors, actuators for active optical MEMS. **08 Hrs.**

Unit-V

Nanotechnology and MEMS: Relation between micro and nanotechnologies. Need and issues in handling nano products with the help of MEMS. **07 Hrs.**

Reference Books:

1) Tai, Ran Hsu," MEMS and Microsystems Design and Manufacture", TMH, 2002, Chang Liu, "Foundations of MEMS" Pearson International Edition, 2006, ISBN 0-13-199204.
2) Nitaigour Premchand Mahalik, "MEMS", 2/e, TMH, 2007.
3) Madou, "Fundamentals of Micro fabrication", CRC Press, 1997, ISBN 0-8493-9451-(Micro fabrication for MEMS + some information on materials and devices.)
4) Nadim Maluf, Kirt Williams, "An Introduction to Micro electromechanical Systems Engineering",2/e, Artech House, 2004.

18UEEE851	**Modern Trends in Grid Integration**	**(3 - 0 - 0) 3**

Contact Hours: 39

Course Learning Objectives (CLOs):

The students are expected to learn and explain power generation by alternate energy source like wind power and solar power. They learn to explain selection of size of units and location for wind and solar systems. They will learn the effects of integration of distributed generation on the performance the system. Further, they will be able to provide practical and useful information about grid integration of distributed generation.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to PO's (1 to12)/ PSO's (1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Recite the concepts and Explain energy generation by wind power and solar power. Discuss the variation in production capacity at different time scales, the size of individual units, and the flexibility in choosing locations with respect to wind and solar systems.	2,3	1	
CO-2	Explain the performance of the system when distributed generation is integrated to the system.	2,3	1	

CO-3	Discuss effects of the integration of DG: the increased risk of overload, increased losses, increased risk of overvoltage and increased levels of power quality disturbances.	2,3	1	
CO-4	Discuss effects of the integration of DG: incorrect operation of the protection.	2,3	1	
CO-5	Discuss the impact the integration of DG on power system stability and operation.	2,3	1	

PO's	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
Mapping Level	2.0	3.0	3.0												

Prerequisites: 1.Electrical Power Generation and Transmission and Distribution.
2. Renewable Energy Sources.

Contents:

Unit-I

Distributed Generation: Introduction, status, Properties of wind power, Power Distribution as a function of wind speed, Solar Power: Status, Properties, Space requirements, Photovoltaic's, Seasonal variation in production capacity, Combined Heat-and-Power: Status, Options for space Heating, Hydropower: Properties of Large Hydro, Properties of small Hydro, Variation with time, Tidal Power, Wave Power, Geothermal Power, Thermal Power Plant. **08 Hrs.**

Unit-II

Distributed Generation (continued): Interface with the Grid. Power System Performance: Impact of Distributed Generation on the Power System, Aims of the Power System, Hosting Capacity Approach, Power Quality, Voltage Quality and Design of Distributed Generation, Hosting Capacity Approach for Events, Increasing the Hosting Capacity. Overloading and Losses: Impact of Distributed Generation, Overloading: Radial Distribution Networks, Active Power Flow Only, Active and Reactive Power Flow Overloading: Redundancy and Meshed Operation, Redundancy in Distribution Networks, Meshed Operation, Losses. **08 Hrs.**

Unit-III

Over loading and Losses (continued): Increasing the Hosting Capacity: Increasing the Load ability Building New Connections, Inter trip Schemes, Advanced protection Schemes, Energy Management Systems. Power Electronics approach, Demand Control, Prioritizing Renewable Energy, Dynamic Load ability.

Voltage Magnitude Variations: Impact of Distributed Generation, Voltage Margin and Hosting Capacity: Voltage Control in Distribution Systems, Voltage Rise Owing to Distributed Generation, Hosting Capacity, estimating hosting capacity without Measurements, Sharing hosting capacity. Design of Distribution Feeders: Basic Design Rules, Terminology, An Individual Generator Along a Medium-Voltage Feeder, Low voltage feeders, Series and Shunt Compensation, A Numerical Approach to Voltage Variations: Example for Two-stage Boosting, General Expressions for Two-Stage Boosting Tap Changers with Line- Drop Compensation: Transformer with One Single Feeder, Adding a Generator. Probabilistic Methods for Design of Distribution Feeders: Need for Probabilistic Methods, The System Studied, Generation with Constant Production, Adding Wind Power. **08 Hrs.**

Unit-IV

Voltage Magnitude Variations (continued): Statistical Approach to Hosting Capacity, Increasing the Hosting Capacity: New or Stronger Feeders, Alternative Methods for Voltage Control Accurate Measurement of the Voltage Magnitude Variations, Allowing Higher Overvoltage's Overvoltage Protection, Over Voltage Curtailment Compensating the generators voltage variations, Distributed generation with voltage control, Coordinated voltage control.

Power Quality Disturbances: Impact of Distributed Generation, Fast Voltage Fluctuations: Fast Fluctuations in Wind Power, Fast Fluctuations in Solar Power, Rapid Voltage Changes, Very Short Variations. Voltage Unbalance: Weaker Transmission System, Stronger Distribution System, Large Single- Phase Generators, Stronger Distribution Grid Voltage Unbalance. **08 Hrs.**

Unit-V

Power Quality Disturbances(continued): Low-Frequency Harmonics: Wind Power: Induction Generators, Generators with Power Electronics Interfaces, Synchronous Generators, Measurement Example, Harmonic Resonances, Weaker Transmission Grid, Stronger Distribution Grid. High-Frequency Distortion: Emission by Individual Generators, Grouping Below and Above 2 kHz, Limits Below and Above 2 kHz, Voltage Dips: Synchronous Machines Balanced Dips and Unbalanced Dips, Induction generators and unbalanced dips. Increasing the Hosting Capacity: Strengthening the Grid, Emission Limits for Generator Units, Emission Limits for Other Customers, Higher Disturbance Levels, Passive Harmonic Filters, Power Electronics Converters, Reducing the Number of Dips, Broadband and High-Frequency Distortion. **07 Hrs.**

Textbook:

1) Integration of Distributed Generation in the Power System, Math Bollen, Wiley, 2011

18UEEE852 Power System Dynamics and Stability (3 - 0 - 0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

The students are expected to learn power system stability concepts, states of operation and system security &system dynamic problems. They learn to carry out mathematical analysis of steady state stability, analysis of transient stability and simplified representation of excitation control. They will learn the modeling of synchronous machine and about excitation & prime mover controllers. Further, they will get exposed to static VAR compensators, dynamics of a synchronous generator synchronous machine model, calculation of initial conditions, analysis of a single machine system and application of power system stabilizers.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to PO's (1 to12)/ PSO's (1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Recite the concepts and definitions of power system stability. Review the classical methods of modeling power system.	2,3	1	
CO-2	Model and analyze synchronous machines	2,3	1	
CO-3	Model excitation system and prime mover controls. Model Transmission line SVC and loads.	2,3	1	
CO-4	Analyze the dynamics of single machine system connected to infinite bus.	2,3	1	
CO-5	Decide on choosing the necessary stabilizers	2,3	1	

PO's	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
Mapping Level	2.0	3.0	3.0												

Prerequisites: 1. Power System Analysis and Stability
2. Computer Techniques in Power Systems
3. Electrical Power Generation and Transmission
4. Electrical Power Distribution and Utilization

Contents:

Unit-I

Review of Classical methods: Basic concepts and definitions: Rotor angle stability, voltage stability and voltage collapse, Mid-term and long-term stability Classification of stability, states of operation and system security &system dynamic problem. System model, some mathematical analysis of steady state stability, analysis of transient stability and simplified representation of excitation control. **08 Hrs.**

Unit-II

Modeling of synchronous machine: Introduction, synchronous machine, park's transformation, analysis of steady state performance per unit equivalent circuits of synchronous machine, determination of parameters of equivalent circuits, measurements for obtaining data, saturation models, transient analysis of a synchronous machine. **08 Hrs.**

Unit-III

Excitation and prime mover controllers: Excitation system Modelling, prime mover control systems. Modeling of Transmission line, SVC and loads. **08 Hrs.**

Unit-IV

Analysis of a single machine system: System model, synchronous machine model, calculation of initial conditions, inclusion of SVC Model. Small signal analysis with block diagram representation, synchronizing and damping torque analysis, small signal model, nonlinear oscillators. **09 Hrs.**

Unit-V

Application of power system stabilizers: Basic concepts, control signals, structure and tuning of PSS, field implementation and operating experience. **06 Hrs.**

Reference Books:

1) P. W. Sauer & M.A.Pai," Power system dynamics and stability",2/e, Pearson education, Asia Inc., 2003.
2) K. R. Padiyar, "Power system dynamics, stability and control" 2/e, BS Publications, Hyderabad, 2002.

3) P. Kundur, “Power system stability and control”, 1/e, Tata Mcgraw-Hill, Inc. 1994.

18UEEE853 Power System Restructuring and Power Quality (3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

Restructure of power systems is gaining importance in the competitive environment and current situation around the world. This subject gives the students a focused insight of operating power systems in restructured scenario and its benefits and its effects. Moreover, the different types of transmission open access and pricing issues of various countries shall be studied in this subject. The students also learn the power quality issues in the restructured environment.

Course Outcomes (COs)

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to PO’s (1 to12)/ PSO’s (1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Recite the concept of Deregulation of the Electricity Supply Industry.		3	5
CO-2	Explain role of independent system operator (ISO) & GENCOs in operational planning activities and ancillary service.		1	5
CO-3	Describe transmission open access, pricing of power transactions and congestion management in restructured scenario.	3		5
CO-4	Explain the basic concept of power quality phenomenon occurring in a power system.		1	5

PO's	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
Mapping Level	2.0		2.5		1.0										

Prerequisites: [1] Power system Analysis [2] Power Transmission & Distribution
[3] Power system Operation and Control
[4] Power system planning.

Contents:

Unit – I

Restructure of the Electricity Supply Industry

Introduction, meaning of deregulation, background to deregulation and the current situation around the world, benefits from a competitive electricity market, after effects of deregulation. **08 Hrs**.

Unit - II

Power systems Operation in restructured Environment

Introduction, role of independent system operator (ISO), operational planning activities of ISO, Operational planning activities of Gencos. Ancillary services in restructured scenario. **07 Hrs.**

Unit –III

Transmission Open Access and Pricing Issues

Introduction, power wheeling, transmission open access, cost components in transmission, pricing of power transactions, transmission open access and pricing mechanisms in various countries, developments in international transmission pricing in Europe, security management in deregulated environment, congestion management in deregulation. **08 Hrs.**

Unit – IV

Introduction to Power Quality: Power Quality, Voltage Quality, concerned about Power Quality, The Power Quality Evaluation Procedure, and General Classes of Power Quality Problems Transients, Long-Duration Voltage Variations, Short-Duration Voltage Variations, Voltage Imbalance, Waveform Distortion, Voltage Fluctuation, Power Frequency Variations, Power Quality Terms, Ambiguous Terms, CBEMA and ITI Curves. **08 Hrs**.

Unit – V

Voltage Sags and Interruptions: Sources of Sags and Interruptions, Transient Over voltages Sources of Transient Over voltages,

Harmonic Distortion: Voltage versus Current Distortion, Harmonics versus Transients, Harmonic Indexes, Harmonic Sources from Commercial Loads, Harmonic Sources from Industrial Loads, Locating Harmonic Sources, Effects of Harmonic Distortion. **08 Hrs**.

Reference Books:

1) Kankar Bhattacharya, Math H J Bollan, Jaap E Daalder, “Operation of Restructured Power systems”, Kluwer Academic Publishers, 2001.
2) Loi Lei Lai, “Power systems Restructuring and Deregulation; Trading, Performance and Information Technology”, John Wiley and Sons, Ltd, 2002
3) Roger. C. Dugan, Mark. F. McGranagham, Surya Santoso, H. Wayne Beaty, “Electrical Power Systems Quality‟ McGraw Hill, 2003.
4) Math H J Bollen, “Understanding Power Quality Problems; Voltage Sags and Interruptions”, Wiley India, 2011

18UEEE854 Reliability Engineering (3 – 0 – 0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

The students are expected to learn Concept of reliability, reliability indices, component reliability, and system reliability failure models for non-repairable components fault tree analysis and Monte- Carlo simulation. They are required to know the basic probability theory, probability concepts, permutation and combination, practical engineering concepts, Venn diagram rules for combining probabilities, probability distribution, random variables density distribution, system reliability evaluation using probability distribution, series system, parallel system, partially redundant system, and mean time to failure stand by system.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to PO's (1 to12)/ PSO's (1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Recite the concept reliability, significance of reliability and system reliability		2,3	1, PSO2
CO-2	Carry out analysis of state enumeration techniques		2,3	1
CO-3	Select components fault tree analysis and Monte- Carlo simulation		2,3	1

CO-4	Design electromagnets for lifting objects and design cooling system for transformers.		2,3	1

PO's	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
Mapping Level	1	2	2											1	

Prerequisites: 1. Mathematics

Contents:

Unit-I

Introduction: Concept of reliability, reliability indices, component reliability – Introduction, non-repairable component, hazard models, components with preventive maintenance, repairable components. **08 Hrs.**

Unit-II

System Reliability: Network methods, Introduction; series configuration parallel configuration, mixed configuration, the r out of n configuration d composition method minimal – tie and minimal – cut methods logic diagrams. **07 Hrs.**

Unit-III

System reliability state space method system representation basic concepts state probability state frequency and duration system of two independent component two components with dependent failures combining state failure effect analysis state enumeration methods. **07 Hrs.**

Unit-IV

System reliability other methods dependent failure models for non-repairable components fault tree analysis Monte- Carlo simulation. **08 Hrs.**

Unit-V

Basic probability theory probability concepts permutation and combination practical engineering concepts Venn diagram rules for combining probabilities, probability distribution random variables density and distribution. **09 Hrs.**

Reference Books:

1) L. S. Srinath, “Concepts in reliability engineering”,2/e,East West Press Ltd,.1985.
2) J. Endrenyi, “Reliability modeling in electrical power system”, 1/e, John Wiley & Sons, 1978.

3) Roy Billintan& Ronald. N. Allar, “Reliability Evaluation of Engineering System”,2/e, 1992

18UEEE855 Analog and Digital Communication (3 – 0 – 0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

The students are expected to learn about basics of analog and digital communications, modulation techniques, data & pulse communication. Further, they come to know source and error coding schemes and advanced mobile communication phone system, GSM, CDMA etc.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to		**Mapping to PO's (1 to12)/ PSO's (1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Explain basics of analog communication and compare analog communication systems	1		
CO-2	Describe modulation techniques and compare ASK, FSK, MSK, PSK etc.	1		
CO-3	Describe basics of Data Communication, Circuits, Codes, error detection, error correction Techniques and Data communication Hardware serial & parallel interfaces	1	5	PSO-2
CO-4	Explain Source encoding theorems, and Error Control Coding.	1	5	
CO-5	Describe AMPS, GSM, CDMA, Channel Assignment, Multiple Access Schemes - Satellite Communication – Bluetooth technology	1		

PO's	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
Mapping Level	3.0				2.0									1.0	

Prerequisites: 1. A course on Analog Electronic circuits
2. A course on Digital Electronics

Contents:

Unit-I

Analog Communication

Noise: Source of Noise - External Noise- Internal Noise- Noise Calculation. Introduction to Communication Systems: Modulation – Types - Need for Modulation. Theory of Amplitude Modulation - Evolution and Description of SSB Techniques - Theory of Frequency and Phase Modulation – Comparison of various Analog Communication System (AM – FM – PM). **08 Hrs.**

Unit –II

Digital Communication

Amplitude Shift Keying (ASK) – Frequency Shift Keying (FSK) Minimum Shift Keying (MSK) –Phase Shift Keying (PSK) – BPSK – QPSK – 8 PSK – 16 PSK - Quadrature Amplitude Modulation (QAM) – 8 QAM – 16 QAM – Bandwidth Efficiency– Comparison of various Digital Communication System (ASK – FSK – PSK – QAM). **08 Hrs.**

Unit - III

Data and Pulse Communication:

History of Data Communication - Standards Organizations for Data Communication- Data Communication Circuits - Data Communication Codes - Error Detection and Correction Techniques - Data communication Hardware - serial and parallel interfaces. Pulse Communication: Pulse Amplitude Modulation (PAM) – Pulse Time Modulation (PTM) – Pulse code Modulation (PCM) - Comparison of various Pulse Communication System (PAM – PTM – PCM). **08 Hrs.**

Unit -IV

Source and Error Control Coding: Entropy, Source encoding theorem, Shannon fano coding, Huffman coding, mutual information, channel capacity, channel coding theorem, Error Control Coding, linear block codes, cyclic codes, convolution codes, viterbi decoding algorithm. **07 Hrs.**

Unit -V

Multi-User Radio Communication

Advanced Mobile Phone System (AMPS) - Global System for Mobile Communications (GSM) - Code division multiple access (CDMA) – Cellular Concept and Frequency Reuse - Channel Assignment and Hand off - Overview of Multiple Access Schemes - Satellite Communication - Bluetooth. **08 Hrs.**

Reference Books:

1) Wayne Tomasi, “Advanced Electronic Communication Systems”, 6th Edition, Pearson Education, 2009.
2) Simon Haykin, “Communication Systems”, 4th Edition, John Wiley & Sons, 2004 35
3) Rappaport T.S, "Wireless Communications: Principles and Practice", 2nd Edition, Pearson Education, 2007.
4) H.Taub, D L Schilling and G Saha, “Principles of Communication”, 3rd Edition, Pearson Education, 2007.
5) B.P.Lathi, “Modern Analog and Digital Communication Systems”, 3rd Edition, Oxford University Press, 2007.
6) Blake, “Electronic Communication Systems”, Thomson Delmar Publications, 2002.
7) Martin S.Roden, “Analog and Digital Communication System”, 3rd Edition, Prentice Hall of India, 2002.
8) B.Sklar, “Digital Communication Fundamentals and Applications” 2ndEdition Pearson Education 2007.

18UEEL803	Technical Seminar	(0 - 0 - 3) 1

Contact Hours: 52

Course Learning Objectives (CLOs):

The students are expected to learn how to carry out literature survey to locate the state-of-the-art technology in engineering domain of their interest. They are required to carry out selection of an emerging topic beyond the syllabus relevant to Electrical, Electronics and Computer related areas, study the same in detail, understand the concept, analyze, and present effectively before the target audience. Further, they are expected to know how to write a paper in the required format. They are also required to learn the effective communication and modalities of technical interactions.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to PO's (1 to12)/ PSO's (1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Select a technical topic in emerging area by referring to renowned journals		2	6, PSO-3
CO-2	To study and understand the concept given in the paper		2	6, 8, PSO-2, PSO-3

	/literature			
CO-3	Compile the information and prepare a write up/report/paper			1, 2, 6, 8, 9, 11, PSO-2, PSO-3
CO-4	Make presentation with effective communication and in all will come to know the state-of-the-art technology in E&E Engg. and allied branches		5, 9,10	8, PSO-2, PSO-3

PO's	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3
Mapping Level	1.0	1.6			2.0	1.0		1.0	1.5	1.0	1.0			1.0	1.0

Prerequisites: Knowledge of both theory and practical courses learnt in all the previous Semesters.

Contents:

1. Select a topic from an emerging area relevant to electrical sciences beyond curriculum and understand, analyze, and present it for 15 minutes followed by 5 minutes for questions and answers. Further, they are to submit the seminar material in the form of a paper in IEEE format. All the students are required to attend all the 52 slots.

2. Present the technical innovative/novel work carried out in the laboratory.

18UEEL804	Major Project - Phase II	(0 – 0 –14) 7

Contact Hours: 100

Course Learning Objectives (CLOs):

The students are expected to learn working in a team and on multidisciplinary projects. They are expected to carry out the intensive literature survey to locate the state-of-the-art technology in his engineering field of interest. They must learn to formulate/define the problem for the project work. They will learn to design, develop, analyze, test, interpret the results, fabricate, simulate, write code etc. relevant to their project work. They are also expected to acquire the skills of summarizing the work into a project report and in all, can carry out the technical work assigned to them independently.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to PO's (1 to12)/ PSO's (1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Carry out the literature survey to locate the state-of-the-art technology in his Engineering field of interest	2		4, 5, PSO-2, PSO-3
CO-2	Define/formulate the problem for the project work	2,3	1,4,5	PSO-2, PSO-3
CO-3	Design, develop, analyze, test, interpret the results, fabricate, simulate, write code etc. relevant to his project work	3	5	7,8,9,12, PSO-2, PSO-3
CO-4	Summarize the work into a project report and in all can carry out the technical work assigned		10	6,8,11, PSO-2, PSO-3

PO's	**PO-1**	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**	**PSO-1**	**PSO-2**	**PSO-3**
Mapping Level		3.0	3.0	1.5	1.66	1.0	1.0	1.0	1.0	2.0	1.0	1.0		1.0	1.0

Prerequisites: Knowledge of both theory and practical courses learnt in all the previous Semesters and relevant value-added information.

Major project phase-2 is the continuation from **Major project phase – I** in which the students are expected to go for material collection, survey, visits, data collection, preliminary design, analysis, model development, code writing, field work etc. The same project team formed for phase –I will continue the work under the guidance of the same faculty member. For all the projects, problems may be domain specific or interdisciplinary also in nature. A committee consisting of minimum 3 faculty members of which guide is a member shall evaluate at the end for CIE. There is a viva voce examination which shall be examined by two examiners one internal and one external to the college appointed by COE based on the suggestions by the respective HoD.

Reference materials/books:

1. Engineering books.
2. Journals.
3. Manuals and data sheets.
4. Software packages.
5. Previous project reports.
6. Product information brochures.
7. Interaction with academia and industrial experts.
8. Internet etc.

General Instructions to Students:

1. Students are expected to Design the problem modules in consultation with project guide/supervisor. Students are expected to submit Design Phase (Design Aspects in Phase-2) approved by project guide, to the project coordinator as per the schedule notified. A copy is to be maintained with students and the guide. Designs will be the base line for the implementation module.
2. Notification/schedules and evaluation procedures will be sent to all students in the Google groups created in the department.
3. Evaluation of Design Phase, implementation of each module Exploring different test cases with respect to each module is done in 8th semester.
4. Final Project Report will be prepared includes the content of Phase-1 and Phase-2.