NORTH MAHARASHTRA UNIVERSITY, JALGAON (M.S.)

Syllabus for

Final Year Electrical Engineering

Faculty of Engineering and Technology

COURSE OUTLINE

SEMESTER – VII and VIII

W.E.F 2015 – 2016

PROGRAM EDUCATIONAL OBJECTIVES. (PEOs)

The Board of Studies in Electrical Engineering of North Maharashtra University, Jalgaon(India) has defined a set of program educational objectives. The Program Educational Objectives of Electrical Engineering programs are designed to provide graduates with:

PEO1: Professional Knowledge: Graduates shall acquire the fundamental and advanced knowledge in Electrical Engineering subjects along with additional knowledge about other subjects like Mathematics, Basic Sciences, Inter-disciplinary Engineering, Management and Economics to solve basic and complex engineering problem. Graduates will be able to design system within realistic constraints for sustainable developments.

PEO2: Professional Employment: Graduates will have a successful career in Electrical Engineering. Graduates will succeed in getting the entry-level engineering positions in Generation, Transmission, Manufacturing, Government sectors at regional, national levels and an Entrepreneur.

PEO3: Higher Studies & Life Long Learning: Graduates may pursue their professional development through self learning, advanced degree and continue life-long learning. Graduates will be able to use software and modern engineering tools.

PEO4: Social Engineering: Graduates will aware of social responsibility, ethical values, safety standard, economical and environmental issues so that they serve the society better.

PROGRAM OUTCOMES (POs)

a. An ability to apply knowledge of mathematics, science, and engineering.

b. An ability to design and conduct experiments, as well as to analyze and interpret data.

c. An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.

d. An ability to function on multidisciplinary teams.

e. An ability to identify, formulates, and solves engineering problems.

f. An understanding of professional and ethical responsibility.

g. An ability to communicate effectively.

h. The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.

i. Recognition of the need for, and an ability to engage in life-long learning.

j. Knowledge of contemporary issues.

k. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

l. An ability to work professionally in both software and hardware system areas including the design and realization of such systems.

North Maharashtra University, Jalgaon

Syllabus Structure For Final Year Electrical Engineering w.e.f year 2015-16

Semester –VII

Course Code	Name of the Course	Group	Teaching Scheme				Evaluation Scheme				Total	Credits
							Theory		Practical			
			Theory Hrs /week	Tutorial Hrs /week	Practical Hrs /week	Total	ISE	ESE	ICA	ESE		
	Industrial Drives & Control (TH)	D	3	_	_	3	20	80	_	_	100	3
	High Voltage Engineering(TH)	D	3	_	_	3	20	80	_	_	100	3
	Interdisciplinary Elective (TH)	E	3	_	_	3	20	80	_	_	100	3
	Elective – I (TH)	E	3	_	_	3	20	80	_	_	100	3
	Power System Operation And Control(TH)	D	3	_	_	3	20	80	_	_	100	3
	Industrial Drives & Control (LAB)	D	_	_	2	2	_	_	25	25 (PR)	50	1
	High Voltage Engineering (LAB)	D	_	_	2	2	_	_	25	25 (OR)	50	1
	Elective – I (LAB)#	E	_	_	2	2	_	_	25	25 (PR)	50	1
	Project – I (LAB)	D	_	_	2	2	_	_	25	25 (OR)	50	2
	Seminar – II	D	_	_	2	2	_	_	25	_	25	2
	Industrial Visit	D	_	_	_	_	_	_	25	_	25	1
	Total		**15**	**0**	**10**	**25**	**100**	**400**	**150**	**100**	**750**	**23**

ISE: Internal Sessional Examination ESE: End Semester Examination ICA : Internal Continuous Assessment

	Interdisciplinary Elective		Elective – I
1	Energy Audit & Conservation	1	Industrial Electrical Engineering
2	Renewable Energy Sources	2	Digital Signal Processing
		3	Control System –II
		4	Electric Traction Engineering

- # Lab for Elective – I (LAB)
- Interdisciplinary Elective shall be offered by the department to the students of other departments. Students from one department can not register for Interdisciplinary Elective of the same department.
- At least 15 students should register for offering any elective.

North Maharashtra University, Jalgaon

Syllabus Structure For Final Year Electrical Engineering w.e.f year 2015-16

Semester –VIII

Course Code	Name of the Course	Group	Teaching Scheme				Evaluation Scheme				Total	Credits
							Theory		Practical			
			Theory Hrs /week	Tutorial Hrs /week	Practical Hrs /week	Total	ISE	ESE	ICA	ESE		
	Power System Stability (TH)	D	3	_	_	3	20	80	_	_	100	3
	Switchgear & Protection (TH)	D	3	_	_	3	20	80	_	_	100	3
	Elective – II (TH)	E	3	_	_	3	20	80	_	_	100	3
	Elective – III (TH)	E	3	_	_	3	20	80	_	_	100	3
	Power System Stability (LAB)	D	_	_	2	2	_	_	25	25 (OR)	50	1
	Switchgear & Protection (LAB)	D	_	_	2	2	_	_	25	25 (PR)	50	1
	Elective – II (LAB)#	E	_	_	2	2	_	_	25	25 (OR)	50	1
	Industrial Lecture*	C	_	_	1*	1	_	_	50	_	50	2
	Project – II	D	_	_	4	4	_	_	75	75(OR)	150	6
	Total		**12**	**0**	**11**	**23**	**80**	**320**	**200**	**150**	**750**	**23**

ISE: Internal Sessional Examination **ESE: End Semester Examination** **ICA : Internal Continuous Assessment**

	Elective-II		Elective – III
1	Computer Aided Power System Analysis	1	Flexible AC Transmission System and Power Quality
2	Industrial Automation	2	Generation Planning and Load Dispatch
3	Advance Microprocessor	3	High Voltage Transmission
4	Power System Design Practice	4	Electromechanical Energy Conversion.

- # Lab for Elective – II (LAB)
- * Lectures to be delivered by experts from the industry in alternate weeks. Next week group discussion on the lecture delivered.
- At least 15 students should register for offering any elective.

Course Title	Short Title	Course Code
Industrial Derive and Control	**IDC**	

Course Description:

The subject explores the knowledge of different industrial derives, load characteristic, factor effecting on selection of drives depending upon their electrical, mechanical characteristic. The subject also provides the knowledge of microprocessor based electric drives.

	Hours/Week	No. of Weeks	Total Hours	Semester Credits
Lectures	**03**	**15**	**42**	**03**

Prerequisite Course(s) : Knowledge Electrical Machines, Power Electronics and subjects of Electrical Engineering.

Course Objectives:

The objective of subject is the Introduction to different types of drives and applications in various industries. To know the characteristics of various motors and loads. Gain the knowledge about operation of DC motor speed control using converters and choppers. To understand the modes of operation of a drive in various applications. To enable the students identify the need and choice for various drives. To acquire the knowledge of different speed control methods in AC motors using thyristors based control schemes. Identify the use of drives in industries using microprocessor.

Course outcome

After completion of course students will be able to:

1. Apply the knowledge of electrical engineering subjects in different application of industries like manufacturing, maintenance, operation and safety.
2. Understand different speed control methods in D.C and A.C motors using thyristors based control schemes.
3. Understand the characteristic of load and selection of derive in industrial sectors.
4. Conduct practical and analyze data for proper selection of derive in realistic constrain of load requirement.
5. Understand the impact of electrical characteristic of motor in electric traction system.
6. Discharge professional duties in industries with innovative ideas of operation and control of drives.
7. Do higher study in the field of modern derives and control.

Industrial Drives and Control

(Course Contents)

Semester-VII **Examination Scheme:**

Teaching Scheme: **(ESE) End Semester Examination: 80 Marks**

Lectures : 3 Hrs/Week **(ISE) Internal Sessional Examination: 20 Marks**

(ESE) End Semester Exam duration: 03 Hours

Unit- I :- Electric Drives **09 Hours, 16 Marks**

Concept, classification, advantages, parts of drives, choice of electric drives, fundamental torque equation, types of practical mechanical loads, dynamics of electrical drive-stability of an electrical drive, constant**,** torque drive, constant power drive, selection of a D.C and A.C drive, modes of operation.

Selection of Motor Power Rating: Classes of motor duty, determination of motor rating

Unit- II: Converters and control **08 Hours, 16 Marks**

Phase controlled converters: Single phase and three phase half controlled and fully controlled converters, selection of converter circuits. Four quadrant operation, Choppers,

Basic principles of Speed control; closed loop control, current & speed sensing, Phase locked loop, closed loop position control.

Unit-III: : DC motor drives **08 Hours, 16 Marks**

Speed-torque characteristics of DC shunt, PMDC and series motors, single phase and three phase controlled rectifier fed dc drives, multi quadrant operation of dc separately excited motor fed from fully controlled rectifier, chopper controlled dc drives, source current harmonics in choppers, converter ratings and closed loop control

Unit – IV: - Inverters and PWM techniques **08 Hours, 16 Marks**

Voltage source inverters, current source inverters, PWM inverters, sine-triangle comparison, harmonic elimination, hysteresis current controllers, space vector PWM

Unit – V:- AC motor drives **09 Hours, 16 Marks**

Speed control of single phase and three phase induction motors, d-q model of induction motor, VSI control , CSI control, constant flux speed control structure, vector control model, vector control structure.

Energy Conservation in Electric Drives: Losses in Electric drive systems, measurement of Energy conservation in Electric drives. Use of efficient converters, energy efficient operation of drives, Improvement of p.f., improvement of quality of supply.

Reference Books :

1. V. Subramanyam , “Thyristerised Control of Electric Drives”, Tata McGraw Hill, New Dehli.
2. Dubey, Joshi, Sinha, “Thyristor Power Control”, Willey Eastern Publication.
3. M. Rashid, “Power Electronics Circuit Devices & Applications”, Prentice Hall of India.
4. G. K. Dubey , “Fundamentals of Electrical Drives”, Narosa Publishing House.
5. Mohammad A. El-Sarkawi, “Fundamentals of Electrical Drives” , vikas Publishing House.
6. Ned Mohan, “ Electric Machines and Drives”, Wiley India Pvt. Ltd.
7. http://nptel.iitm.ac.in

Course Title	Short Title	Course Code
High Voltage Engineering	**HVE**	

Course Description:

The demand for generation and transmission of large amount of electric power today, necessitates in transmission at extra- high voltages. Electrical engineering students are expected to possess knowledge of high voltage techniques. The subject is not in-depth but explores the knowledge of insulating material, properties, breakdown phenomena in solid, liquid and gases. The subject also provide the platform to understand the generation and measurement of high voltage.

Lectures	**Hours/Week**	**No. of Weeks**	**Total Hours**	**Semester Credits**
	03	**15**	**42**	**03**

Prerequisite Course(s) : Knowledge basic sciences, mathematics and subjects of Electrical Engineering.

Course Objectives:

The objectives are to understand the need of high voltage in tem of technical and economical point of view. Student should understand the properties and breakdown phenomena in solid, liquid and gases. Students also understand the method of generation ,measurement of high voltage and testing.

Course Outcomes:

Upon successful completion of this course the student will be able to:

1. Apply basic knowledge of electrical engineering material for understanding breakdown phenomena in solid, liquid and gases.
2. Understand the lightning stroke and behavior on electrical appliances.
3. Understand the generation and measurement of high voltage for various testing in the field of manufacturing of power plant equipments.
4. Discharge the professional duties in high voltage test laboratories.
5. Higher study in field of high voltage with latest tools and software for sustainable development in EHV transmission field.

High Voltage Engineering

(Course Contents)

Semester-VII **Examination Scheme:**

Teaching Scheme: **(ESE) End Semester Examination: 80 Marks**

Lectures : 3 Hrs/Week **(ISE) Internal Sessional Examination: 20 Marks**

(ESE) End Semester Exam duration: 03 Hours

Unit I: - **Breakdown In Gases, Liquids & Solids** **09 Hours, 16 Marks**

Review and classification of insulating material, Breakdown in gases, Townsend's law. Breakdown in electronegative gases, streamer mechanism of spark, Paschen's law, corona discharge, electronegative gases. Breakdown in pure and commercial liquids, solid dielectric and composite dielectric, Breakdown in vacuum .

Unit II: - **Lightning and Switching Over Voltage Protection** **09 Hours, 16 Marks**

Lighting strokes to lines and towers mechanism & characteristics. Over voltage due to switching surge, system fault. Protection of transmission lines from lightning, lightning arrestors, insulation co-ordination of HV and EHV power system .

Unit III : - **Generation of High Voltage & Currents** **08 Hours, 16 Marks**

Generations of high direct current voltage, generation of high alternating voltage, Generation of Impulse voltage and current , generation of lightning surges Classification of High voltage laboratories, Testing facilities provided in High voltage laboratories, grounding of impulse testing laboratories.

Unit IV: - **Measurement of High Voltage And Currents** **08 Hours, 16 Marks**

Methods of measurement of peak voltage, impulse voltage and high direct current, non destructive measurement and testing, high voltage dielectric loss and capacitance measurements, ratio frequency & partial discharge measurements.

Unit V :-Testing and EHV Line Insulation **08 Hours, 16 Marks**

Basic technology , testing of insulators bushing , cables , transformer, surge diverters & threshold current , capacitance of long objects, Electromagnetic interference, E.H.V line insulation design based upon transient over voltages.

Reference Books:-

1. M.S. Naidu & V.Kamaraju , "High Voltage Engg", Tata McGraw Hill.
2. E.Kuffel and W.S Zaenglo, "High Voltage Engg" , PE Rgamon Press
3. ,Rakash Das Begamudre, "Extra High Voltage Transmission", New Age International Publication.
4. C.L. Wadhawa , "High Voltage Engineering" Wley Eastern
5. R.S.Jha , "High Voltage Engineering"
6. http://nptel.iitm.ac.in

Course Title | Short Title | Course Code

Interdisciplinary Elective

i. Energy Audit and Conservation EAC

Course Description:

This course provides knowledge of limited conventional energy generation, energy audit and conservation, financial analysis, energy efficient motors and other electrical gazed, scope of energy saving in domestic, industrial , agricultures sectors and demand side energy managements .Energy conservation is mandatory and answerable to next generation.

Lectures	Hours/Week	No. of Weeks	Total Hours	Semester Credits
	03	15	42	03

Prerequisite Course(s) : Knowledge basic sciences, mathematics and subjects of engineering.

Course Objectives:

The Objectives of subject are to understand the need of energy audit and conservation , social and environmental cause as per Energy conservation Act . Students will able to know the methodology of energy audit for industries and priority of action plan. Students will able to understand the financial analysis for energy audit like payback period. Students will able to understand scope demand side management, energy efficient motor and energy conservation in motors, lighting, furnace and refrigeration.

Course Outcomes:

Upon successful completion of this course the student will be able to:

1. Apply basic knowledge of science and mathematics and engineering in energy conservation and financial.
2. Understand facts, concepts, principles of energy management and conservation in view of social and environmental cause. Students also able to function on multidisciplinary teams.
3. Analyze the characteristics, process of operation in manufacturing, agricultural and transportation sectors to arrive fruitful suggestions for possible energy conservation.
4. Apply Knowledge of electrical subjects for demand side management for sustainable economic deployments, social and environmental issues as life long practices .
5. Discharging duties in energy conservation by understanding an ethical and social responsibility for answerable to next generation.
6. Do higher studies for manufacturing energy efficient machines compliance of energy conservation Act 2001,2003 and 2010, govt of India .

Interdisciplinary Elective

i. Energy Audit and Conservation

(Course Contents)

Semester-VII **Examination Scheme:**

Teaching Scheme: **(ESE) End Semester Examination: 80 Marks**

Lectures : 3 Hrs/Week **(ISE) Internal Sessional Examination: 20 Marks**

(ESE) End Semester Exam duration: 03 Hours

Unit-I Energy Audit **09 Hours, 16 Marks**

Need and concept of energy audit, pre-requisite of energy conservation, principles of energy audit, type and methodology of energy audit: preliminary energy audit and detailed energy audit, procedures of carrying out energy audit. Identification of energy conservation opportunities and priority, energy audit report writing, Instruments used for energy audit. Energy Conservation Act, Progress made in energy conservation in India.

Unit II: - Economics of Energy Conservation **09 Hours, 16 Marks**

Simple payback period analysis, advantages & limitations of payback period, time value of money, net present value method and internal rate of return method, Risk and sensitivity analysis; Financing options, Micro factors and macro factor Study and selection of proper tariff for particular application, fixed & variable components in tariff, impact of tariff on energy management.

Unit III: - Energy Management **08 Hours, 16 Marks**

Concept of energy management –energy inputs in industrial ,residential, commercial, agricultural and public sector management of power factor, power factor improvement ,power demand monitoring.

Concept of demand side management (DSM), scope of DSM, DSM planning and implementation ,load management as DSM strategy Advantages of DSM to consumers, utility and society.

Unit IV: - Energy Conservation **08 Hours, 16 Marks**

1. Motive power: potential for saving electrical energy in motors - over sizing or under loading, improving efficiency of an existing motor, energy efficient motors, use of variable or adjustable speed drives for energy conservation , effect of rewinding on performance and consumption.
2. Lighting: level of illumination for different areas. Use of right source of lamp for different applications, energy efficient lamps, type of light fixtures.
3. Heating & Cooling systems: energy saving in furnace , air conditioners and refrigeration.

Unit -V: - Scope of Conservation **08 Hours, 16 Marks**

1. Energy conservation in industrial, agricultural, commercial, domestic and municipal sectors.
2. Energy conservation in generation, Co-generation, Waste heat recovery,
3. Energy conservation in transmission and distribution

Reference books

1. Umesh Rathore, "Energy Management", S K Kataria and Sons.
2. S. C. Tripathy, "Electrical Energy Utilization and Conservation", THM Publication
3. S.Rao, "Energy Technology"' Khanna Pub.
4. Preceding of the Seminar on " Energy Audit & Demand Side Management" held at Govt. College of Engineering, Pune-5 organized by M.S.E.B.(SEA) ON 16.09.1998.
5. B.E. Kushare, "Hand Book on Energy Efficient Motors" , International Cooper Proposition Council ,
6. Bureau of Energy Efficiency

Course Title Short Title Course Code

Interdisciplinary Elective

ii. Renewable Energy Sources RES

Course Description:

Renewable energy sources are interdisciplinary subjects of science and technology. Energy technology is the back-boon of modern civilization and national economy. It is an applied science dealing with various renewable energy routes comprising the exploration and extraction of energy and by-products, transportation, storage, distribution and supply of secondary forms of energy. This course explores available renewable energy sources and provide the platform to study judicious and economic choice of energy for environment friendly and sustain able developments.

	Hours/Week	No. of Weeks	Total Hours	Semester Credits
Lectures	**03**	**15**	**42**	**03**

Prerequisite Course(s) : Knowledge basic sciences, mathematics and subjects of engineering.

Course Objectives:

The objectives of this course are to understand the various renewable energy sources, their conversion technology and application. The course will help to bring down gap between energy demand and energy generation with environment friendly. The course also provides basic knowledge for lifelong learning and higher education in field of energy conversion.

Course Outcomes:

Upon successful completion of this course the student will be able to:

1. Apply basic knowledge of science , mathematics and engineering for understanding energy sources and conversion in useful forms.
2. Understand facts, concepts, principles of exploration and extraction of energy for judicious and economic choice of energy for environment friendly and sustain able developments.
3. Function on interdisciplinary subjects of science and technology and analyze the characteristics of different energy sources.
4. Understand contemporary issues of energy and solve engineering problem of energy extraction from different renewable sources by modern tools.
5. Discharging duties in energy development by understanding an ethical and social responsibility for answerable to next generation.
6. Do higher studies for lifelong learning and higher education in field of energy conversion.

Interdisciplinary Elective
ii. Renewable Energy Sources
(Course Contents)

Semester-VII **Examination Scheme:**
Teaching Scheme: **(ESE) End Semester Examination: 80 Marks**
Lectures : 3 Hrs/Week **(ISE) Internal Sessional Examination: 20 Marks**
(ESE) End Semester Exam duration: 03 Hours

Unit-I Solar Energy **09 Hours, 16 Marks**

Introduction to energy technology and energy sciences, energy and environment, laws of conservation of energy. Essential subsystems in a solar energy plant, phenomena of light and energy, energy from sun, solar constant, power density for various wavelength of sun light, clarity index, angle of latitude and solar insolation at different geographical locations. Solar thermal collectors and its types.

Unit-II Solar Photovoltaic **09 Hours, 16 Marks**

Introduction to solar photovoltaic system, merit and limitations, economic considerations of solar PV system, principle and characteristic of solar cell, efficiency of solar cell , configuration of solar PV panel, solar PV cell technologies and small solar PV system for residence and rural areas.

Unit-III Geothermal Energy **08 Hours, 16 Marks**

Introduction to geothermal energy, geothermal energy resources, origin of geothermal resources, geothermal gradients, hydro geothermal resources, geopressure geothermal resources, geothermal fluid for electric power plants and classification and type of geothermal power plants.

Unit-IV Wind Energy **08 Hours, 16 Marks**

Introduction to wind energy, nature of wind energy conversion system, wind power density, forces on the blades of a propeller, wind turbine efficiency, wind velocity duration characteristic , type of wind turbine-generator unit , planning of wind farm and grid connection.

Unit-V Biomass Energy **08 Hours, 16 Marks**

Introduction to biomass energy resources, biomass conversion process, direct combustion of biomass, gaseous fuels from biomass,

Introduction to urban solid waste –to- energy by incineration process, waste –to- energy incineration process and energy plant, location of plants, wood and wood waste as primary energy source and cogeneration plant.

Reference Books

1. S Rao & Dr. B B Parulekar, " Energy Technology", Khanna Publishers.
2. Dr. H S Mukunda, Understanding Clean Energy and fuels from Biomass", Wiley India
3. http://nptel.iitm.ac.in

Course Title Short Title Course Code

Elective-I

i. Industrial Electrical Engineering IEE

Course Description:

The subject explores the knowledge of different industrial derives, load characteristic, factor effecting on selection of derives depend upon their electrical , mechanical characteristic and service duty.The subject also provides the knowledge of electric traction, ideal requirement of traction motor, operation and control. The subject provides brief knowledge of heat, ventilation and air conditioning system also.

Lectures	Hours/Week	No. of Weeks	Total Hours	Semester Credits
	03	15	42	03

Prerequisite Course(s) : Knowledge Electrical Machines and mathematics .

Course Objectives: The object of subject is not to discuss the working operation of motor. The object is select proper motor for given load characteristic. Selection of motor based on load characteristic, electrical , mechanical characteristic and service duty. The subject also provides the knowledge of electric traction, ideal requirement of traction motor, operation and control. The subject provides brief knowledge of heat, ventilation and air conditioning system also.

Course outcome

After completion of course students will be able to:

1. Apply the knowledge of electrical engineering subjects in different application of industries like manufacturing, maintenance, operation and safety.
2. Understand the characteristic of load and selection of derive in industrial sectors.
3. Conduct practical and analyze data for proper selection of derive in realistic constrain of load requirement.
4. Understand the impact of electrical characteristic of motor in electric traction system.
5. Discharge professional duties in industries with innovative ideas of operation and control of drives.
6. Do higher study in the field of modern derives and control.

Elective-I
i. Industrial Electrical Engineering
(Course Contents)

Semester-VII **Examination Scheme:**

Teaching Scheme: **(ESE) End Semester Examination: 80 Marks**

Lectures : 3 Hrs/Week **(ISE) Internal Sessional Examination: 20 Marks**

(ESE) End Semester Exam duration: 03 Hours

Unit- I :- Electric Drives **09Hrs, 16 Marks**

Type of drives, Nature of load, Section motors, electrical, mechanical , service capacity and rating and Types of Enclosures.

Electrical Characteristic: Starting, Operating and running, speed control and braking characteristics of DC motor , three phase induction motor and single phase induction motor.

Unit- II: - Types of Duties **09Hrs, 16 Marks**

Type of duty: Continuous, intermittent and short time rating , temperature rise and rating calculations for these duties mechanical features , features of load diagram construction, load equalization & use of flywheel.

Unit- III:- Traction Systems **08Hrs, 16 Marks**

Requirements of ideal traction system, Systems of track electrification and their comparison, speed time curve, factors affecting on schedule speed, Tractive effort, Factors affecting in energy consumption and specific energy consumption.

Unit -IV: - **Traction Motors** **08Hrs, 16 Marks**

General features of traction motors, Control of traction motor: starting, speed control and braking of traction motor , Energy returned during regenerative braking ,overhead equipment control gear .

Unit -V: - **Heat Ventilation and Air Conditioning** **08Hrs, 16 Marks**

Refrigeration cycle, Type of refrigeration, air conditioning, type of air conditioning, Heating of building.

Methods of electric heating & its advantages, resistance oven, induction heating electric welding.

Reference Books:

1. J.B.Gupta , "A Course in Electrical Power"
2. V.V.L.Rao, "Utilization of Electrical Energy", TMH
3. O.E.Taylor , "Utilization of Electrical Energy", TMH
4. S.K.Pillai, "A Course in Electrical Energy", TMH
5. H. Partab, "Art & Science of Utilization of Electrical Energy"
6. http://nptel.iitm.ac.in

Course Title | Short Title | Course Code

Elective-I

ii. Digital Signal Processing **DSP**

Course Description:

Signals play a major role in our life. In general a signal can be function of time, distance, position, temperature, pressure etc and it represents some variable of interest associated with system. Signal processing is a method of extracting information from the signal in turn depends upon the type of signal and nature of information it carries. Thus signal processing is concerned with representing signals in mathematical terms and extracting the information.

Lectures	Hours / Week	No. o f Weeks	Total Hours	Semester Credits
	03	15	42	03

Prerequisite Course(s): Knowledge of programming language c and basic Digital electronics.

Course Objectives:

The objectives of subject are to classify the signal and understanding the basic principles of signal and signal processing . Students will able to understand the application of Z- transform and Discrete and Fast Fourier transform in signal processing.

Course outcomes:

Upon successful completion of this course the students will be able to:

1. Apply basic mathematic to classify and understand the signals
2. Analyze to understand the hidden information in signal with the help of different transformation.
3. Ability to determine the frequency, steady state and transient response of LTI systems.
4. Apply the basic algorithm of digital signal processing in the field of electrical protection system.

Elective-I

ii. Digital Signal Processing

(Course Contents)

Semester-VII **Examination Scheme:**

Teaching Scheme: **(ESE) End Semester Examination: 80 Marks**

Lectures: 3 Hrs/Week **(ISE) Internal Sessional Examination: 20 Marks**

(ESE) End Semester Exam duration: 03 Hours

Unit I: Signal and Fourier Analysis **09 Hours, 16 Marks**

Classification of signal, classification of system Fourier Transform: Properties of Fourier Transform, Fourier Transform of some important signals ,Fourier Transform of power and energy signal.

Unit II:Z- Transform and Linear Time Invariant System **09 Hours, 16 Marks**

Definition of Z- Transform, properties of Z- transform, inverse Z- transform Linear Time Invariant System, property of DSP, impulse and frequency response.

Unit III: Discrete and Fast Fourier Transform **08 Hours, 16 Marks**

Discrete convolution, discrete-time Fourier Transform(DTFT), fast Fourier Transform (FFT), computing an inverse DFT , Short Time Fourier Transform (STFT). Continuous wavelet transforms. Discrete Wavelet Transform (DWT).

Unit IV : Finite Impulse Response (FIR) Filter **08 Hours, 16 Marks**

Introduction to Finite Impulse Response Filter, FIR filter design using different windowing techniques & frequency sampling method. Design of linear phase FIR filter. Basic structure of FIR system.

Unit V : Infinite Impulse Response (IIR) Filter **08 Hours, 16 Marks**

Introduction to Infinite Impulse Response Filter, Design Specification of IIR Low pass filter and frequency transformation, Design of IIR filter using Butterworth, Chebyshev approximation. Digital processor,TM320C 2000 Series processor 2812,28335 and 28027.

References:

1. Proakis, Manolakis “Digital Signal Processing: Principles, Algorithms and Applications”, PHI.
2. Oppenheium, Schaffer ,”Digital Signal Processing”, PHI.
3. A. Nagoor Kani , “Digital Signal Processing”, Tata Mc. Graw Hill.
4. Dr. Shaila D Apte ,”Digital Signal Processing”,Second Edition , Wiley India Pvt Ltd
5. S Salivahanan, A Vallavraj and C Gnanapriya, “Digital Signal Processing” Tata Mc. Graw Hill.
6. http://nptel.iitm.ac.in

Course Title Short Title Course Code

Elective-I

iii. Control System-II CS-II

Course Description:

The study of Control System Engineering is essential for the students of Electrical, Electronics, Mechanical, Aerospace & Chemical Engineering. It has applications ranges from Electrical Power System to process Control System. The course explores the knowledge of basic control systems, control system components, mathematical modeling, time response & frequency response analysis. The course also deals in concept of design & its preliminary consideration.

	Hours per Week	No. of Weeks	Total Hours	Semester Credits
Lecture	**3**	**15**	**42**	**3**

Prerequisite Course(s): Knowledge of Mathematics, Control System-I and electrical engineering subject

Course Objectives:

Control system engineering is an exciting field in which to apply engineering talents. The object of course to derive mathematical modeling , transfer –functions, time response and frequency response. The objectives are to find transient response and steady state error in given system.

Course Outcomes:

Upon successful completion of this course the students will be able to:

1. Apply basic mathematical for modeling of control system and responses of first and second order system.
2. Describe the role of control system as an enabling technology in various applications such as in power systems, automation, renewable energy, etc.
3. Understand the response of control system subjected to different input signals, design, set up, and test control system in the laboratory.
4. Analyze and design open and closed control system.
5. Design dc servo motor and stepper motor to meet the characteristics of control system application.
6. Become proficient with computer skills (e.g., PSPICE and MATLAB) for the simulated analysis and design of control system and able to use control system in utility-related applications .

Elective-I

iii. Control System -II

(Course Contents)

Semester-VII **Examination Scheme:**

Teaching Scheme: **(ESE) End Semester Examination: 80 Marks**

Lectures : 3 Hrs/Week **(ISE) Internal Sessional Examination: 20 Marks**

(ESE) End Semester Exam duration: 03 Hours

Unit –I State Space Techniques **09 Hours, 16 Marks**

Concept of state variable. state model, States variable models of SISO/MIMO linear systems, from differential equations, transfer function and block diagrams. state diagram (Signal flow graphs) Decomposition of transfer functions in phase variable forms, canonical forms, Jordan canonical form, transfer function from the state model, transfer matrix. Concept of Controllability and observability of linear systems. State feedback controller using pole placement , observers.

Unit –II Sample Data Control System **09 Hours, 16 Marks**

Representation of sample data (Discrete system) review of Z transforms, sample and hold zero order hold. Sampling theorem Z-transform analysis of sampling data control system. (Open loop and closed loop), Z transfer function of systems. Solutions of different equation by Z transfer methods. Pulse transfer functions of open loop and closed loop system with different sample locations. Stability analysis, relation between S and Z domain, stability by Jury's test and bi-linear transformation and root locus method.

Unit –III Non Linear System Analysis-I **08 Hours, 16 Marks**

Behavior of non linear system, various general non linear ties and their characteristics.
Stability analysis by describing function method. Existence and stability of limit cycles.
Limitation of describing function method.

Unit –IV Non Linear System Analysis-II **08 Hours, 16 Marks**

Liberalization in a small region operating point. Singular point and their nature. Phase plane method of analysis of nonlinear system, construction of phase trajectories by isoclines method. Limit cycle behavior

Unit –V Stability Analysis By Liapunov Method **08 Hours, 16 Marks**

Concept of stability, asymptotic stability in the large, instability, the sense of a Lipunov, Positive of a scale function, quadratic forms. stability theorems, Lipunov fuctions stability of linear time invariant systems, Lipunov equations.
Krasowakii's method for time examining the stability of non-linear time invariant system.

Reference Books:

1. Nagrath & Gopal, “Control System Engineering”, 4th Edition, New age International.
2. K. Ogata, “Modern Control Engineering”, Prentice Hall of India.
3. B.C. Kuo & Farid Golnaraghi, “Automatic Control System” Wiley India Ltd, 2008.
4. Norman s Nise, “Control System Engineering” Wiley India Pvt Ltd
5. Dr. Rajeev Gupta, “NISE’s Control System Engineering” Wiley India Pvt Ltd
6. D.Roy Choudhary, “Modern Control Engineering”, Prentice Hall of India.
7. Ajit K Mandal, “Introduction to Control Engineering” New Age International,2006.
8. R.T. Stefani, B.Shahian, C.J.Savant and G.H. Hostetter, “ Design of Feedback Control Systems”.
9. Narendra Singh Beniwal and Beniwal,”Automatic control system with Matlab Programming “University Science Press.
10. Eugene Xavier S.P. and Joseph Cyril Babu,J.,”Principles of control systems “S.Chand
11. S.Sivangaraju,L.Devi ,”Control Systems Engineering “New Age International Publishers.
12. http://nptel.iitm.ac.in

Course Title Short Title Course Code

Elective-I

iv. Electric Traction Engineering ETE

Course Description

The course explores the knowledge traction engineering, ideal characteristic of traction motor, motor selection, electric braking and speed calculation, transmission and distribution system of electric traction

Lectures	Hours/Week	No. of Weeks	Total Hours	Semester Credits
	03	15	42	03

Prerequisite Course(s) : Knowledge of Power System-I , II and subjects of Electrical Engineering.

Course Objectives:

This course objectives to study the different track electrification , type of supply for electric traction. The course also provides the knowledge of selection of motor based on staring, working and braking characteristic. The course make bridge for higher study in traction engineering.

Course Outcomes:

Upon successful completion of this course the student will be able to:

1. Apply basic knowledge electrical engineering for understand ideal requirement of electric traction.
2. Select the type of motors as per traction load characteristic, control and operation.
3. Analyze the characteristics of traction motor for suitability of different traction systems.
4. Discharging duties as electric traction engineer in technical and professional way.
5. Do higher studies in electric traction with modern tools for increasingly difficult complex electric traction system.

Elective-I
iv Electric Traction Engineering
(Course Contents)

Semester-VII **Examination Scheme:**

Teaching Scheme: **(ESE) End Semester Examination: 80 Marks**

Lectures : 3 Hrs/Week **(ISE) Internal Sessional Examination: 20 Marks**

(ESE) End Semester Exam duration: 03 Hours

Unit -I: - Traction Motors **09Hrs, 16 Marks**

Performance(starting, speed control, torque and braking) of (i) d.c. motors (ii) a.c. single phase series motors at low frequencies and at commercial frequency and (iii) poly phase induction motors, under traction service conditions, specific problems and method of overcoming them, special features of construction effect of differences in driving wheel diameters and speed time curves on division of load, traction motor ratings, speed factor, track and overhead equipments.

Unit -II: - Train Movement and Performance **09Hrs, 16 Marks**

Speed time curve, its analysis and construction, schedule speed and factors affecting it, train resistance and its components. Tractive effort calculations, average acceleration and speed, energy output and consumption.

Unit- III: - Power Transmission and Weight Transference **08Hrs, 16 Marks**

Methods of transmission of power from motor to wheels .Idea about riding quantities of an electric loco motive, grouping of motor and weight transference, adhesive weight factors affecting slip.

Unit -IV: - Power Supply for Traction **08Hrs, 16 Marks**

Overhead and conductor rail system, third rail construction, Bonding of conductor and track rails, overhead construction for trolley, buses and railways, quaternary's construction, temperature effects, current collectors, out times of feeding and distributing system for d.c low frequency, a.c and commercial frequency, a.c. traction voltage drop control, Electrolytic and inductive coordination, power loading curves, Positions of substations and load - sharing .

Unit -V :- Braking On Electrified Railways **08Hrs, 16 Marks**

Mechanical versus electric breaking, rheostatic braking, Regenerative braking, method and energy saved in the process, Magnetic track brakes.

Traction control: Duty cycle, Methods of traction motor control, series-Parallel and other types of controllers, use of interlocks, run back prevented, multiple unit control, Master controllers, Reverses, Dead man's handle, use of Metadyne and Megavolt.

Reference Books:

1. J.B.Gupta , "A Course in Electrical Power"
2. V.V.L.Rao, "Utilization of Electrical Energy", TMH
3. O.E.Taylor , "Utilization of Electrical Energy", TMH
4. S.K.Pillai, "A Course in Electrical Energy", TMH
5. H. Partab, "Art & Science of Utilization of Electrical Energy"
6. http://nptel.iitm.ac.in

Course Title Short Title Course Code

Power System Operation and Control PSOC

Course Description:

Modern power systems have grown larger, expanding over wide geographical area. Interconnection of grids has led to more complex operational problems. Such large systems require very advance computing facilities and techniques. This course explores knowledge of economic load scheduling and dispatch. The course provides knowledge of power system operation and control, need and important, voltage and frequency control. The Course also provides knowledge of static and dynamic behavior of control loops. The Course deals in basic concept of voltage stability, voltage collapse and FACTs devices.

Lectures	Hours/Week	No. of Weeks	Total Hours	Semester Credits
	03	15	42	03

Prerequisite Course(s) : Knowledge of Power System-I, II ,mathematics and other subjects of Electrical Engineering.

Course Objectives:

This course objectives to study power system operation and control. To overcome the stability problem for complex and large capacity units. Voltage and frequency control, static and dynamic behavior. The concept of voltage stability, voltage collapse and FACTs devices. Enhancement of power handling capacity by use of FACTs.

Course Outcomes:

Upon successful completion of this course the student will be able to:

1. Know the complicity of power system and role of engineer in power system operation and control. Able to discharge professional duties in electrical utilities.
2. Know the optimal load scheduling, function & operation of load dispatch centre for economic growth of electric utilities.
3. Know the significance of real power & reactive power flow in the system for effective utilization of electrical installations.
4. Know the concept of automatic voltage control ,their mathematical modeling , static and dynamic analysis.
5. Know the concept of frequency control , mathematical modeling ,static and dynamic response of two area system for higher studies.
6. Understand concept of pool member and their advantages for economical growth and sustainable development.
7. Know the concept of voltage stability and FACT controllers for enhancing power handling capacity of existing transmission lines.

Power System Operation and Control

(Course Contents)

Semester-VII **Examination Scheme:**

Teaching Scheme: **(ESE) End Semester Examination: 80 Marks**

Lectures : 3 Hrs/Week **(ISE) Internal Sessional Examination: 20 Marks**

(ESE) End Semester Exam duration: 03 Hours

UNIT I: **Economic Load Dispatch & Optimal Operation of Power System** **09 Hours, 16 Marks**

Input Output characteristics, Heat-rate characteristics, Incremental fuel rate and cost, Incremental production cost, , optimum scheduling of generation between different units. (Neglecting transmission losses), Transmission loss as a function of plant generation (A simple system connection two generating plants to load) and incremental transmission loss for optimum economy, Calculation of loss coefficients (Two plants system), Optimum scheduling of generation between different plants considering transmission loss concept and significance of penalty factor, Automatic load dispatch, function and applications

UNIT II: **Generator Voltage Control** **09 Hours, 16 Marks**

Automatic voltage control, generator controllers, Cross coupling between P–f and Q–V control channel, automatic voltage regulator, types of exciters and excitation systems, exciter modeling, transfer function modeling for control static performance and dynamic response of AVR loops.

UNIT III: Load Frequency Control **08 Hours, 16 Marks**

Automatic load frequency control, speed governing system and hydraulic valve actuator for individual generator, Turbine modeling, generator and load modeling transfer function representation of power control mechanism of generator.

UNIT IV: Electric Power Control **08 Hours, 16 Marks**

Concept of control area, division of power system into control areas, Load frequency of single areas, two area and multi area (control) power system with and without integral controls. Advantage of pool operation, tie line bias control area exchange.

UNIT V: **Voltage Stability and Compensation** **08 Hours, 16 Marks**

Power system security, Operating stage (State transition diagram), Voltage stability, Comparison of angle and voltage stability, Reactive power flow and voltage collapse, voltage stability analysis and prevention of voltage collapse.

Compensation in power system: Load compensation, load ability of compensated and uncompensated over head transmission line, compensation of transmission line (Shunt& Series). Introduction of FACTS

Reference Books:

1. Olle L. Elgerd, "Electrical Energy System Theory & Introduction ', TMH.
2. I. J. Nagrath & D. P. Kothari, "Modern Power system Analysis ", TMH.
3. Willium D. Stevenson Jr., "Elements of Power System Analysis" , TMH.
4. Dr. K Uma Rao, " Power System Operation & Control", Wiley India Pvt Ltd.
5. Dr. C.S. Indulkar, "Electric Power Control"
6. L.K. Kirchmayer , "Economic Control of Power System"
7. C L Wadhwa, "Electrical Power System Analysis", New Age International Publication.
8. http://nptel.iitm.ac.in

Course Title	Short Title	Course Code
Industrial Drives & Control Lab	**IDC Lab**	

Lab Course Description:

The subject practical explore the knowledge of different industrial derives, load characteristic, factor effecting on selection of derives depend upon their electrical , mechanical characteristic and service duty. The practical also provides the knowledge of electric traction, ideal requirement of traction motor, operation and control. The practical provides brief knowledge of heat, ventilation and air conditioning system also.

Practical	**Hours per Week**	**No. of Weeks**	**Total Hours**	**Semester Credits**
	2	**15**	**28**	**1**

Lab Course Objectives: The object is to select proper motor for given load characteristic. Selection of motor based on load characteristic, electrical, mechanical characteristic and service duty. The practical also provides the knowledge of electric drives, operation and control of electrical drives. The subject provides brief knowledge of four quadrant operation of drives.

Course outcome

After completion of course students will be able to:

1. Apply the knowledge of electrical engineering subjects in different application of industries like manufacturing, maintenance, operation and safety.
2. Understand different speed control methods in D.C and A.C motors using thyristors based control schemes.
3. Understand the characteristic of load and selection of derive in industrial sectors.
4. Conduct practical and analyze data for proper selection of derive in realistic constrain of load requirement.
5. Understand the impact of electrical characteristic of motor in electric traction system.
6. Discharge professional duties in industries with innovative ideas of operation and control of drives.
7. Do higher study in the field of modern derives and control.

Industrial Drives and Control Lab

(Lab Course Contents)

Semester-VII **Examination Scheme:**

Teaching Scheme: **(ICA) Internal Continuous Assessment: 25 Marks**

Practical : 2 Hrs/Week **(ESE) End Semester Examination(PR): 25 Marks**

Teacher should facilitate learning following lab experiments:

1. Determination of Speed Torque characteristic of d.c motor controlled using single phase half controlled rectifier.
2. Determination of Speed Torque characteristic of d.c motor controlled using single phase fully controlled rectifier.
3. Performance analysis of one quadrant chopper control of d.c motor.
4. Performance analysis of two quadrant chopper control of d.c motor.
5. Speed control of single phase induction motor using ac voltage regulator.
6. Study of stepper motor drive circuit.
7. Speed control of universal motor.
8. Study of closed loop control of Dc motor.
9. Study of vector control method for induction motor.
10. Study of reversible drives

Note: Lab file should consist of minimum **Eight** experiments.

Guide lines for ICA :

ICA shall be based on continuous evaluation of student performance throughout semester and practical assignment submitted by the student in the form of journal.

Guide lines for ESE:-

In ESE the student should be asked to perform any one practical. Evaluation will be based on paper work , practical performance and oral in the practical examination.

Course Title	Short Title	Course Code
High Voltage Engineering Lab	**HVE Lab**	

Lab Course Description:

The demand for generation and transmission of large amount of electric power today, necessitates in transmission at extra- high voltages. Electrical engineering students are expected to possess knowledge of high voltage techniques. The subject is not in-depth but explores the knowledge of insulating material, properties, breakdown phenomena in solid, liquid and gases. The subject also provide the platform to understand the generation and measurement of high voltage.

Practical	Hours per Week	No. of Weeks	Total Hours	Semester Credits
	2	**15**	**28**	**1**

Prerequisite Course(s) : Knowledge basic sciences, mathematics and subjects of Electrical Engineering.

Lab Course Objectives: The lab objectives are to understand the need of high voltage in tem of technical and economical point of view. Student should understand the properties and breakdown phenomena in solid, liquid and gases. Students also understand the method of generation ,measurement of high voltage and testing.

Lab Course Outcomes:

Upon successful completion of this lab course the student will be able to:

1. Apply basic knowledge of electrical engineering material for understanding breakdown phenomena in solid, liquid and gases.
2. Understand the lightning stroke and behavior on electrical appliances.
3. Understand the generation and measurement of high voltage for various testing in the field of manufacturing of power plant equipments.
4. Discharge the professional duties in high voltage test laboratories.
5. Higher study in field of high voltage with latest tools and software for sustainable development of EHV transmission field.

High Voltage Engineering Lab

(Lab Course Contents)

Semester-VII **Examination Scheme:**

Teaching Scheme: **(ICA) Internal Continuous Assessment: 25 Marks**

Practical : 2 Hrs/Week **(ESE) End Semester Examination(OR): 25 Marks**

Teacher should facilitate learning following lab experiments:

1. Measurement of insulation resistance of 11KV/110 V.P.T by Megger.
2. Power frequency withstand test on 11KV, 10/5 amp CT.
3. Study of corona discharge.
4. Determination of insulating break-down strength of solid, liquid and gaseous dielectric media.
5. Power frequency high voltage withstand test on cable.
6. Study of impulse generator.
7. Dry & Wet power frequency withstand test for insulator.
8. Flash over test on insulator.
9. Double voltage double frequency withstand test on transformer.
10. Calibration of sphere gap.
11. Study of 100KV high voltage testing set.

Note: Lab file should consist of minimum **Eight** experiments.

Guide lines for ICA :

ICA shall be based on continuous evaluation of student performance throughout semester and practical assignment submitted by the student in the form of journal.

Guide lines for ESE:-

In ESE the student may be asked questions on practical. Evaluation will be based on answers given by student in oral examination.

Course Title Short Title Course Code

Elective-I

i. Industrial Electrical Engineering Lab IEE Lab

Lab Course Description:

The subject practical explore the knowledge of different industrial derives, load characteristic, factor effecting on selection of derives depend upon their electrical , mechanical characteristic and service duty. The practical also provides the knowledge of electric traction, ideal requirement of traction motor, operation and control. The practical provides brief knowledge of heat, ventilation and air conditioning system also.

Practical	Hours per Week	No. of Weeks	Total Hours	Semester Credits
	2	15	28	1

Lab Course Objectives: The objects of lab practical are not to discuss the working operation of motor. The object is select proper motor for given load characteristic. Selection of motor based on load characteristic, electrical , mechanical characteristic and service duty. The practical also provides the knowledge of electric traction, ideal requirement of traction motor, operation and control. The subject provides brief knowledge of heat, ventilation and air conditioning system also.

Lab Course outcomes:

1. Apply the knowledge of electrical engineering subjects in different application of industries like manufacturing, maintenance, operation and safety.
2. Understand the characteristic of load and selection of derive in industrial sectors.
3. Conduct practical and analyze data for proper selection of derive in realistic constrain of load requirement.
4. Understand the impact of electrical characteristic of motor in electric traction system.
5. Discharge professional duties in industries with innovative ideas of operation and control of drives.
6. Do higher study in the field of modern derives and control.

Elective-I

i. Industrial Electrical Engineering Lab

(Lab Course Contents)

Semester-VII **Examination Scheme:**

Teaching Scheme: **(ICA) Internal Continuous Assessment: 25 Marks**

Practical : 2 Hrs/Week **(ESE) End Semester Examination(PR): 25 Marks**

Teacher should facilitate learning following lab experiments:

1. Performance characteristics of DC Series motor by load test.
2. Performance characteristics of DC Series motor by Field Test.
3. Performance characteristics of DC Shunt motor by direct load test.
4. Performance characteristics of single phase induction motor by direct load test.
5. Performance characteristics of three phase induction motor by direct load test.
6. Speed control of DC series motor.
7. Speed control of three-phase slip ring induction motor by rotor resistance method
8. Rheostatic braking of DC shunt motor.
9. Study of Air conditioning system.
10. Study of induction heating &Welding.
11. Study of different types of enclosures.

Note: *(Objectives and conclusion should be oriented on the basis of characteristic of load, selection, and application of motors.)*

Note: Lab file should consist of minimum **Eight** experiments.

Guide lines for ICA :

ICA shall be based on continuous evaluation of student performance throughout semester and practical assignment submitted by the student in the form of journal.

Guide lines for ESE:-

In ESE the student should be asked to perform any one practical. Evaluation will be based on paper work , practical performance and oral in the practical examination.

Course Title Short Title Course Code

Elective-I

ii. Digital Signal Processing Lab DSP Lab

Lab Course Description:

Signals play a major role in our life. In general a signal can be function of time, distance, position, temperature, pressure etc and it represents some variable of interest associated with system. Signal processing is a method of extracting information from the signal in turn depends upon the type of signal and nature of information it carries. Thus signal processing is concerned with representing signals in mathematical terms and extracting the information.

Practical	Hours / Week	No. o f Weeks	Total Hours	Semester Credits
	02	15	28	1

Prerequisite Course(s): Knowledge of programming language c and basic Digital electronics.

Lab Course Objectives:

The lab objectives of subject are to classify the signal and understanding the basic principles of signal and signal processing . Students will able to understand the application of Z- transform and Discrete and Fast Fourier transform in signal processing.

Lab Course outcomes:

Upon successful completion of this course the students will be able to:

1. Apply basic mathematic to classify and understand the signals
2. Analyze to understand the hidden information in signal with the help of different transformation.
3. Ability to determine the frequency, steady state and transient response of LTI systems.
4. Apply the basic algorithm of digital signal processing in the field of electrical protection system.

Elective-I

ii Digital Signal Processing Lab

(Lab Course Contents)

Semester-VII **Examination Scheme:**

Teaching Scheme: **(ICA) Internal Continuous Assessment: 25 Marks**

Practical : 2 Hrs/Week **(ESE) End Semester Examination(PR): 25 Marks**

Teacher should facilitate learning following lab experiments:

1. Shifting and folding of digital signal.
2. Linear convolution.
3. Discrete Fourier transforms.
4. Fast Fourier transforms.
5. Design and implement FIR filter using windowing method.
6. Design and implement IIR filter using Butterwoth approximation.
7. Design and implement IIR filter using Chebeshev approximation.
8. Sine/square wave generation using TMS32OC67XX.
9. FIR filter implementation using TMS32OC67XX.
10. IIR filter implementation using TMS32OC67XX.
11. Filtering Using Discrete Wavelet transforms.

Note: Lab file should consist of minimum **Eight** experiments.

Guide lines for ICA :

ICA shall be based on continuous evaluation of student performance throughout semester and practical assignment submitted by the student in the form of journal.

Guide lines for ESE:-

In ESE the student should be asked to perform any one practical. Evaluation will be based on paper work , practical performance and oral in the practical examination.

Course Title Short Title Course Code

Elective-I

iii. Control System-II Lab CS-II Lab

Lab Course Description:

The study of Control System Engineering is essential for the students of Electrical, Electronics, Mechanical, Aerospace & Chemical Engineering. It has applications ranges from Electrical Power System to process Control System. The course explores the knowledge of basic control systems, control system components, mathematical modeling, time response & frequency response analysis. The course also deals in concept of design & its preliminary consideration.

	Hours per Week	No. of Weeks	Total Hours	Semester Credits
Practical	**2**	**15**	**28**	**1**

Prerequisite Course(s): Mathematics and subjects of electrical engineering

Lab Course Objectives: Control system engineering is an exciting field in which to apply engineering talents. The object of practical to derive mathematical modeling, transfer –functions, time response and frequency response. The objectives are to find transient response and steady state error in given system.

Lab Course Outcomes:

Upon successful completion of this practical course the students will be able to:

1. Apply basic of mathematical modeling of control system and responses of first and second order system.
2. Describe the role of Control system as an enabling technology in various applications such as in power systems, energy conservation, renewable energy, transportation etc.
3. Understand the response of control system subjected to different input signals, design, set up, and test control system in the laboratory.
4. Analyze and design open and closed control system.
5. Design dc servo motor and stepper motor to meet the characteristics of control system application.
6. Become proficient with computer skills (e.g., PSPICE and MATLAB) for the simulated analysis and design of control system and able to use control system in utility-related applications.

iii Control System-II Lab

(Lab contents)

Semester-V II **Examination Scheme:**

Teaching Scheme: **(ICA) Internal Continuous Assessment: 25 Marks**

Practical : 2 Hrs/Week **(ESE) End Semester Examination(PR): 25 Marks**

Teacher should facilitate learning following lab experiments:

1. To Study of different MATLAB tools for Control System.
2. Find the Response of the Discrete Time Control System for any two standard inputs.
3. Simulation on State Transition Matrix.
4. State Space Analysis using MATLAB.
5. Pole-Zero plot using MATLAB.
6. To check the controllability and Observability for the given system.
7. Design of control system using pole placement technique.
8. Simulation on multivariable control system.
9. Design of State observer.
10. Design of Discrete Time Control System based on minimization of quadratic performance index.
11. To determine time domain response of a second order system for step input and obtain performance parameters by using MATLAB. .
12. To convert transfer function of a system into state space form and vice-versa, by using MATLAB.

Note: The minimum eight experiments are to be performed from the list of experiments.

Guide lines for ICA :

ICA shall be based on continuous evaluation of student performance throughout semester and practical assignment submitted by the student in the form of journal.

Guide lines for ESE:-

In ESE the student should be asked to perform any one practical. Evaluation will be based on paper work , practical performance and oral in the practical examination.

Course Title Short Title Course Code

iv. Electric Traction Engineering Lab ETE Lab

Lab Course description:

The course explores the knowledge traction engineering, ideal characteristic of traction motor, motor selection, electric braking and speed calculation, transmission and distribution system of electric traction

Practical	Hours per Week	No. of Weeks	Total Hours	Semester Credits
	2	15	28	1

Lab Course Objectives:

The objects of lab practical are not to discuss the working operation of motor. The object is select proper motor for given load characteristic. Selection of motor based on load characteristic, electrical , mechanical characteristic and service duty. The practical also provides the knowledge of electric traction, ideal requirement of traction motor, operation and control.

Lab Course Outcomes:

Upon successful completion of this lab course the student will be able to:

1. Apply basic knowledge electrical engineering for understand ideal requirement of electric traction.
2. Select the type of motors as per traction load characteristic, control and operation.
3. Analyze the characteristics of traction motor for suitability of different traction systems.
4. Discharging duties as electric traction engineer in technical and professional way.
5. Do higher studies in electric traction with modern tools for increasingly difficult complex electric traction system.

Elective-I Lab
iv Electric Traction Engineering
(Lab Course Contents)

Semester-VII **Examination Scheme:**
Teaching Scheme: **(ICA) Internal Continuous Assessment: 25 Marks**
Practical : 2 Hrs/Week **(ESE) End Semester Examination(PR): 25 Marks**

Teacher should facilitate learning following lab experiments:

1. Performance characteristics of DC Series motor by load test.
2. Performance characteristics of DC Series motor by Field Test.
3. Performance characteristics of DC Shunt motor by direct load test.
4. Performance characteristics of single phase induction motor by direct load test.
5. Performance characteristics of three phase induction motor by direct load test.
6. Speed control of DC series motor.
7. Speed control of three-phase slip ring induction motor by rotor resistance method
8. Rheostatic braking of DC shunt motor.
9. Study traction transformer.
10. Study of Metadyne for electric locomotive.
11. Study of electric traction substation.

Note: *(Objectives and conclusion should be oriented on the basis of characteristic of load, selection, and application of motors.)*

Note: Lab file should consist of minimum **Eight** experiments.

Guide lines for ICA :
ICA shall be based on continuous evaluation of student performance throughout semester and practical assignment submitted by the student in the form of journal.

Guide lines for ESE:-
In ESE the student should be asked to perform any one practical. Evaluation will be based on paper work , practical performance and oral in the practical examination.

Course Title	Short Title	Course Code
Project-I	**P-I**	

Course Description:
The course explores the knowledge of design, experiment and analysis of data. The course develops ability to work on multidisciplinary teams, Identify, formulate, and solve engineering problems in view of economic, environmental and societal context.

	Hours per Week	No. Of Weeks	Total Hours	Semester Credits
Practical	**2**	**15**	**28**	**2**

Prerequisite Course(s): Knowledge of science, mathematics, computer programming and core subject of engineering.

Course Objectives: The objectives of project are to develop ability to work in group. The scope of work is design and conduct experiments, as well as to analyze and interpret data within realistic constrain such as economic, environmental, social, safety and manufacturability. The project work provides plate form for planning, material procurement, preparing specification and execution of work. The project also develop to work on multidisciplinary teams, communicate effectively and Knowledge of contemporary issues.

Course Outcomes:
Upon successful completion of this course the students will be able to:

1. Apply knowledge of mathematics, science, and engineering.
2. Design and conduct experiments, as well as to analyze and interpret data.
3. Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
4. Function on multidisciplinary teams, communicate effectively and Knowledge of contemporary issues.
5. Identify, formulate, and solve engineering problems by understanding professional and ethical responsibility.
6. Understand the impact of engineering solutions in a global, economic, environmental, and societal context.
7. Recognition of the need for, and an ability to engage in life-long learning.
8. Use the techniques, skills, modern engineering tools and software necessary for engineering practice.

Project-I

(Lab Course Contents)

Semester-VII **Examination Scheme:**

Teaching Scheme: **(ICA) Internal Continuous Assessment: 25 Marks**

Practical : 2 Hrs/Week **(ESE) End Semester Examination (OR) :25Marks**

1. It is expected that the broad area of Project-I shall be finalized by the student in the beginning of the VII semester / extension of Minor project undertaken may be Project-I.
2. A group of Minimum 3 and Maximum 5 students shall be allotted for Project-I and same project group for Project-II.
3. Exhaustive survey of literature based on a clear definition of the scope and focus of the topic should be carried out by the students. The **Synopsis/Abstract** on the selected topic, after detail literature survey should be submitted to the Project coordinator appointed by Head of the department.
4. Project-I may involve literature survey, problem identification, work methodology preparing specification and material procurement, collection of data , conduction of experiments and analysis. The project work shall involve sufficient work so that students get acquainted with different aspects of fabrication, design or analysis.
5. Approximately more than 50% work should be completed by the end of VII semester.
6. Each student group is required to maintain log book for documenting various activities of Project-I and submit group project report in the form of thermal bound at the end of semester –VII. Submit the progress report in following format:
    a. *Title*
    b. *Abstract*
    c. *Introduction*
    d. *Problem identification and project objectives*
    e. *Literature survey*
    f. *Case study/Analysis/Design Methodology*
    g. *Work to be completed (Progress status)*
    h. *Expected result and conclusion*
    i. *References.*

7. Evaluation Committee comprising of the Guide, Project Coordinator and Expert appointed by the Head of the department will award the marks based on the work completed by the end of semester and the presentation based on the project work.

Guide lines for ICA : The Internal Continuous Assessment shall be based on the active participation of the students in the Project work and knowledge / skill acquired. Assessment of the project-I for award of ICA marks shall be done jointly by the guide and departmental committee as per the guidelines given in **Table-A.**

Guide lines for ESE: The End Semester Examination for Project shall consist of demonstration if any, presentation and oral examinations based on the project report**.**

Assessment of Project-I

Name of the Project: _____

Name of the Guide: _____

Table-A

SN	Name of Student	Problem Identification and project objectives	Literature Survey	Project Methodology/ Design/PCB/ hardware/ simulation/ programming	Progress Status	Present ation	Total
		5	5	5	5	5	25

Course Title | Short Title | Course Code

Seminar-II

Course Description: The course explores the knowledge of presentation and effective communication. The course develops ability to work on multidisciplinary teams, Identify, formulate, and solve engineering problems in view of economic, environmental and societal context.

	Hours per Week	No. Of Weeks	Total Hours	Semester Credits
Practical	**2**	**14**	**28**	**2**

Prerequisite Course(s): Knowledge of science, mathematics, computer programming and core subject of engineering.

Course Objectives: The objectives of Seminar –II are to develop ability express our view, presentation and effective communication. The scope of seminar-II is study various national and international journal for design , experiments conduct , as well as to analyze and interpret data within realistic constrain such as economic, environmental, social, safety and manufacturability.

Course Outcomes:

Upon successful completion of this course the students will be able to:

1. Understand literature survey for selection of seminar topics.
2. Apply knowledge of mathematics, science, and engineering for effective presentation of selected topic.
3. Communicate effectively and Knowledge of contemporary issues.
4. Identify, formulate, and solve engineering problems by understanding professional and ethical responsibility.
5. Practice the use of various resources to locate and extract information using offline & online tools, journals.
6. Practice the preparation and presentation of scientific papers and seminars in an exhaustive manner.
7. Understand the impact of engineering solutions in a global, economic, environmental, and societal context.

Seminar-II

(Course Contents)

Semester-VII **Examination Scheme:**

Teaching Scheme: **(ICA) Internal Continuous Assessment: 25 Marks**

Practical : 2 Hrs/Week

1. Each Student shall select a topic for seminar which is not covered in curriculum. Seminar topic should not be repeated and registration of the same shall be done on first come first serve basis.
2. Topic of Seminar shall be registered within a three weeks from commencement of VII Semester and shall be approved by the committee.
3. The three-member committee appointed by Head of the department shall be constituted for finalizing the topics of Seminar-II. Seminar shall be related state of the art topic of his choice approved by the committee.
4. Each student should deliver a seminar in scheduled period (Specified in time table or time framed by department) and submit the seminar report (paper bound copy/Thermal bound)in following format:
    a. *Title*
    b. *Abstract*
    c. *Introduction*
    d. *Literature survey*
    e. *Concept*
    f. *Functional and Technical Details*
    g. *Applications*
    h. Comparison with similar topics / methods
    i. *Future scope*
    j. *References*

ASSESSMENT OF SEMINAR-II

Guide lines for ICA: ICA shall be based on topic selection , presentation and Seminar-II report submitted by the student in the form of thermal bound. Assessment of the Seminar-II for award of ICA marks shall be done jointly by the guide and a departmental committee, as per the guidelines given in **Table- B**

Name of Guide: _____

Table-B

SN	Name of Student	Seminar Topic	Topic Selection	Literature survey	Report writing	Depth of under-standing	Presentation	Total
			5	5	5	5	5	25

Course Title	Short Title	Course Code
Industrial Visit	**IV**	

Course Description: The course explores the knowledge industry organization, new trends in manufacturing, maintenance and safety. The industrial visit provide the practical visualization of theoretical study of various engineering subject.

	Hours per Week	No. Of Weeks	Total Hours	Semester Credits
Practical	**-**	**-**	**-**	**1**

Course Objectives: The main objective behind these visits is to explain the working of industrial equipments in running conditions to the students and tell them about the expectations of the industrialists from the fresh engineers.

Course Outcomes:

Upon successful completion of this course the students will be able to:

1. Understand organizational set up of an industry.
2. Develop our self for expectations of the industrialists from the fresh engineers.
3. Understand manufacturing, material handling , maintenance , safety standard and environmental consideration in industry.
4. Function on multidisciplinary teams, communicate effectively and Knowledge of contemporary issues.
5. Identify, formulate, and solve engineering problems by understanding professional and ethical responsibility.
6. Understand the impact of engineering solutions in a global, economic, environmental, and societal context.

Industrial Visit

(Course Contents)

Semester-VII **Examination Scheme:**

Teaching Scheme: **(ICA) Internal Continuous Assessment: 25 Marks**

1. Industry visits for minimum two industries shall be carried out by each student preferably or college shall arrange the industrial visit during the vacation period otherwise during the regular VII semester.
2. The student should obtain appropriate certificates of visit from the concerned organizations just after the visits.
3. Every Student should submit Industrial Visit report individually at the end of Semester-VII(First Term of Final Year)
4. The report(Thermal Bound) should contain information about the following points:
   a. *The organization - activities of organization and administrative setup technical personnel and their main duties.*
   b. *The project / industry brief description with sketches and salient technical information.*
   c. *The work / processes observed with specification of materials, products, equipments etc. and role of engineers in that organization.*
   d. *Suggestions (if any) for improvement in the working of those organizations.*
5. The evaluation of the report of technical visits will be made by panel of three teachers appointed by Head of the department based on following points:

Guide lines for ICA : ICA shall be based on knowledge gain by student and Industrial Visit Report submitted by the student in the form of Thermal bound. Assessment of the Industrial Visit for award of ICA marks shall be done jointly by industrial visit coordinators departmental committee based on viva -voce as per the guidelines given in **Table- C**

Table-C

SN	Name of Student	Name of Industry	Report writing	Depth of Under-standing	Total
			15	**10**	**25**

NORTH MAHARASHTRA UNIVERSITY, JALGAON (M.S.)

Syllabus for

Final Year Electrical Engineering

Faculty of Engineering and Technology

COURSE OUTLINE

SEMESTER –VIII

W.E.F 2015 – 2016

Course Title	Short Title	Course Code
Power System Stability	**PSS**	

Course Description:

At present the demand for electricity is rising phenomenally especially in developing country like India. This persistent demand is leading to operation of the power system at its limit. On top of this the need for reliable, stable and quality power is also on the rise due to electric power sensitive industries like information technology, communication, electronics etc. In this scenario, meeting the electric power demand is not the only criteria but also it is the responsibility of the power system engineers to provide a stable and quality power to the consumers. These issues highlight the necessity of understanding the power system stability. In this course we will try to understand how to asses the stability of a power system, how to improve the stability and finally how to prevent system becoming unstable.

Lectures	**Hours/Week**	**No. of Weeks**	**Total Hours**	**Semester Credits**
	03	**15**	**42**	**03**

Prerequisite Course(s) : Knowledge of Power System and Electrical Machines.

General Objectives:

This course objectives to study power system stability and reliability. To overcome the stability problem for complex and large capacity units. Classification of stability on the basis of nature of perturbation and evaluation time. In this course we will try to understand how to asses the stability of a power system, how to improve the stability and finally how to prevent system becoming unstable.

Course Outcomes:

Upon successful completion of this course the student will be able to:

1. To Apply basic knowledge of science and mathematics and electrical engineering in stability studies.
2. Understand facts, concepts and classification of stability on the basis of perturbation and economical aspect of energy exchange.
3. To analyze the characteristics of synchronous alternator under small and large disturbances.
4. Apply Knowledge of electrical subjects for solving stability problem and use method for enhancing stability .
5. Discharging duties as power system engineer in technical and professional way.
6. Do higher studies in stability with modern tools for increasingly difficult complex interconnected power system.

Power System Stability

(Course Contents)

Semester-VIII **Examination Scheme:**

Teaching Scheme: **(ESE) End Semester Examination: 80 Marks**

Lectures : 3 Hrs/Week **(ISE) Internal Sessional Examination: 20 Marks**

(ESE) End Semester Exam duration: 03 Hours

UNIT-I: Basic Concept **09 Hours, 16 Marks**

Meaning of stability, rotor, voltage and frequency stability steady state transient & dynamic stability limits, Park's transformation equations, Analysis of transient and subtransient state operation of salient and non salient pole machines, phasor diagrams, voltage behind the transient and subtransient impedances, time constants. Determination of parameters and time constants.

UNIT II: - Steady State Stability **09 Hours, 16 Marks**

SSSL of short transmission lines, Analytical and graphical methods of solutions, loosy lines effect of inertia conservative criterion, synchronizing co efficient multi machine system.

UNIT III: - Factors Affecting Steady State Stability **08 Hours, 16 Marks**

Effect of saturation, saturated reactance, equivalent reactance, graphical method to find equivalent effect of short circuit ration effect of governor action, effect of automatic voltage regulator.

UNIT IV: - Transient State Stability **08 Hours, 16 Marks**

Review of transient stability, swing equation, assumption for swing equation and classical model , shortcoming of classical model, equal area criterion, critical cleaning angle and critical clearing time, point by point solution for transient stability.

UNIT V: - Factors Affecting Transient State Stability **08 Hours, 16 Marks**

Effects of types of fault, effect of grounding, effect of high speed reclosing Precalculated swing curves and their use, effects of fault clearing time, effects of excitation and governing action, Methods of improving stability, multi-machine problem .

Reference Books:

1. Aderson and Ford, “Power System Operation and Control”, IEEE
2. E .W. Kimbark , “Power Systems Stability”, Vol- I & II , Wiley India Pvt Ltd
3. S. B.Cray , “ Power System Stability” , John Wiley
4. Nagrath & Kothari , “ Modern Power System Analysi”,TMH
5. P. S Bimbhra, “Generalized Electrical Machinery”, Khanna Publishers
6. Peter W. Sauer and M A Pai, “Power System Dynamics and Stability”, Pearson Education.
7. http://nptel.iitm.ac.in

Course Title	Short Title	Course Code
Switch Gear and Protection	**SGP**	

Course Description :

Switchgear and Protection is a fascinating subject . A protection scheme in a power system is designed to continuously monitor the power system to ensure maximum continuity of electrical supply with minimum damage to life, equipment and property. The subject explores the knowledge of arc interruption, different type of circuit breakers and relay. This knowledge is help full for understanding the characteristic feature and proper selection of protective elements in different protective scheme. The subject also provides knowledge different protection for major and individual power system elements.

Lectures	**Hours/Week**	**No. of Weeks**	**Total Hours**	**Semester Credits**
	03	**15**	**42**	**03**

Course Objectives: The objectives of subject are that students will able understand the fault characteristic of individual power system elements. One should also be knowledgeable about the tripping characteristics of various protective relays. The students able to understand the job of protection engineer is to devise such scheme where closest possible match between the fault characteristic and tripping characteristic is obtained. The students will able understand protected zone and able to design protective scheme such that relay will detect undesirable conditions and then trip to disconnect the area affected, but remain restrained at all other time. Student should be equipped with sound concept of power system protection to enable them handling unforeseen circumstances in real life.

Course Outcomes:

1. Apply the basic knowledge of science for understanding arc generation and interruption in medium and high voltage circuit.
2. Conduct practical based on testing of relay and analysis data for matching different fault characteristics.
3. Select different protective relay and circuit breakers based on their characteristic feature for different protective scheme.
4. Understand continuously monitor the power system to ensure maximum continuity of electrical supply with minimum damage to life, equipment and property and best safety practices.
5. Discharge his professional duties in field of power system protection, maintenance and manufacturing sector.
6. Do higher study of updated protection technology for complex power system .

Switchgear and Protection
(Course Contents)

Semester-VIII **Examination Scheme:**
Teaching Scheme: **(ESE) End Semester Examination: 80 Marks**
Lectures : 3 Hrs/Week **(ISE) Internal Sessional Examination: 20 Marks**
(ESE) End Semester Exam duration: 03 Hours

Unit – I:- Arc Phenomena and Interruption **09 Hours, 16 Marks**

Basic requirement of Switching and protection , arc phenomenon, maintenance of arc, properties of arc, interruption theories, transient recovery Voltage, transient analysis, RRRV, Interruption of capacitive current, current chopping,

Unit – II:-Circuit Breakers and Fuses **09 Hours, 16 Marks**

Construction & Operation , class , breaking capacity, characteristic and application of: Bulk oil circuit breaker, Minimum oil circuit breaker, air blast circuit breaker, SF6 , Vacuum Circuit Breaker , Earth leakage & Miniature circuit breaker and HRC fuses.

Unit – III:-Protective Relay-I **08 Hours, 16 Marks**

Protection system and its attributes: sensitivity, selectivity, speed, reliability and dependability, trip circuit, organization of protection, zones of protection and maloperation. Construction ,working and characteristic features of electromagnetic relay: Over current, instantaneous over-current , definite time over-current, inverse time over-current relay ,directional over current relay and differential relay.

Unit –IV:- Protective Relay-II **08 Hours, 16 Marks**

Construction ,working and characteristic features of electromagnetic relay: Impedance relay , reactance relay, Mho relay and their trip law using universal torque equation.
Static Over current relay: Single and double actuating quantity relay, basic principle of static over current relay and directional over current relay.
Evolution Digital relay: basic component of digital relay, digital sub units digital relay as unit. Microprocessor based relay, block diagram, relay for motor and advantages.

Unit –V: Protection Schemes **08 Hours, 16 Marks**

Different type of protective scheme: Over current protection, Differential protection, earth fault protection , distance protection and carrier –aided protection. Protective scheme for generator, transformer, bus-bar , transmission line and motor.

Reference Books :-

1. Y G Paithankar and S R Bhide, “Fundamentals of Power System Protection” PHI
2. T.S. Madharao , “ Power System Protection (Static Relay)”, Tata MacGraw Hill.
3. C.R.Mason , “The Art and Science of Protective Relaying”
4. B.Ram &Vishwakarma D.N , “Power System Protection & Switch Gear”,TMH
5. Sunil S.Rao , “Switchgear & Protection”, Khurana Pun
6. B.Ravindranath & M. Chandar, “Power System Protection & Switch Gear”, New age International.
7. A.G. Phadke & Thorpe, “Power System Protection their Theory & Practice “, Chapman & Hall.
8. E. W Kimbark, “ Power Systems Stability” Vol-II, Wiley India Pvt. Ltd.
9. http://nptel.iitm.ac.in

Course Title Short Title Course Code

Elective-II

i. Computer Aided Power System Analysis CAPSA

Course Description :

The present day power systems are characterized by large highly interconnected network. Extensive system studies are required at almost all stages of its planning, operation and control. Simulation and analysis of such a large system is possible only with the help of digital computers. Most of the time, a power system, theoretically, remains under steady state.

Load flow or power flow study is the most frequently carried out steady state analysis, which determines system voltage profile and line flows/losses. The ever growing concern towards secure operation of power systems requires security analysis to be carried out at planning as well as operation stage, which involves analyzing system states following contingencies.

A fault in the power system network results in excessive current flowing through its various components. Fault analysis is important in determining the short circuit levels, which is utilized in proper selection of equipments and determining the protection requirements. A disturbance in the system, including a fault, may sometimes lead to unstable operation of the system.

This course will cover the modeling issues and analysis methods for the power flow, short circuit, contingency and stability analyses, required to be carried out for the power systems.

	Hours/Week	No. of Weeks	Total Hours	Semester Credits
Lectures	**03**	**15**	**42**	**03**

Prerequisite Course(s): Knowledge of Power System at second & third year Engineering.

Course Objectives:

Computer aided power system analysis provides modern tool for the analyses of the complex electrical power system with less computational time and more accuracy The objectives of Computer aided power system analysis is to model issues and analyze methods for the power flow, short circuit, contingency and stability analyses, required to be carried out for the continuous monitoring of power systems.

Course Outcomes:

After successful completion of this lab students will be able to:

1. To describe the role of Computer aided power system analysis as an enabling tool in various analysis such as power flow, short circuit, contingency and stability analyses.
2. To understand the network topology for the representation of power system components and networks.
3. To form the bus impedance and admittance matrices by algorithms.
4. To perform the short circuit studies for proper selection of protection scheme.
5. To perform the load flow studies using N-R method, Gauss seidal method and fast decoupled method.
6. To evaluate simultaneous faults by matrix Transformations.
7. To learn the role of Computer aided power system analysis in utility-related applications which are becoming extremely important.

Elective-II
Computer Aided Power System Analysis
(Course Contents)

Semester-VIII **Examination Scheme:**

Teaching Scheme: **(ESE) End Semester Examination: 80 Marks**

Lectures : 3 Hrs/Week **(ISE) Internal Sessional Examination: 20 Marks**

(ESE) End Semester Exam duration: 03 Hours

Unit-I: Network Topology **09 Hours, 16 Marks**

Modeling of Power System Components, Basic Concepts, Single Phase, Three Phase Models, Matrix, Representation of Networks Topology of Electric power system-Network Graphs, Incidence matrices, fundamental loop and cutest matrix, primitive impedance and admittance matrix, singular transformation of network matrix.

Unit – II: Incidence Matrix **09 Hours, 16 Marks**

Formation of bus impedance and admittance matrices by algorithm – Modification of bus impedance and admittance matrix to account for change in networks. Derivation of loop impedance matrix. Algorithm for formulation of 3- phase bus impedance matrix.

Unit – III: Short Circuit Studies **08 Hours, 16 Marks**

Three phase network, Symmetrical components. Thevenin's theorem and short circuit analysis of multimode power system using bus impedance matrix. Short circuit calculations for balanced and unbalanced short circuit bus impedance and loop impedance matrices.

Unit – IV: Load Flow Studies **08 Hours, 16 Marks**

Slack bus, loop buses, voltage control buses, Load flow equations, power flow model using bus admittance matrix, Power flow solution through Gauss-Seidal and N-R methods sensitivity analysis, Second order N-R method, fast decoupled load flow method, Sparsity of matrix.

Unit – V : Fault Analysis **08 Hours, 16 Marks**

Simultaneous faults, Simultaneous Faults by two port network Theory (Z, Y and H-type Faults), Simultaneous faults by matrix Transformations, Analytical simplifications of series and shunt fault.

Reference Books:

1. J. J. Gringer,W.D. Stevenson, "Power System Analysis", McGraw Hill. 1994
2. G.W.Stagg and Al Ebiad,"Computer Methods in Power System Analysis", Mc Graw Hill,
3. I.J.Nagrath and D.P.Kothari, "Modern Power System Analysis", Tata McGraw Hill,1980.
4. G.L.Kusic, "Computer Aided Power System Analysis", Prentice Hall, 1986.
5. Hadi Sadat, "Power System Analysis", Tata McGraw Hill.
6. http://nptel.iitm.ac.in

Course Title | Short Title | Course Code

Elective-II

ii. Industrial Automation IA

Course Description:

This course describes PLC & SCADA based Industrial Automation system which will improve the knowledge of the students about industrial processes using automation. The course will cover SCADA & PLC systems in terms of their architecture, their interface to the process hardware, the functionality and the application development facilities. Also provide an industrial SCADA & PLC system is used for the development of the controls of machinery.

	Hours/Week	No. of Weeks	Total Hours	Semester Credits
Lectures	**03**	**15**	**42**	**03**

Prerequisite Course(s): Knowledge of c-programming, Industrial organization and management subject of third year, industrial drives and control subject of final year.

Course Objectives:

The objectives of subject are that students will able to understand the role of industrial automation for different processes based on PLC system and its requirement. It also provide basic operation of programmable logic control and its function. Students will learn the input-output devices for the PLC, its operation, its selection according to application and its interfacing. It explores the knowledge of different configuration of PLC, its programming techniques for various application, and it's interfacing with industrial machineries. It also help to understand the application in different industries like power sector, in pharmaceuticals, in automobile industry etc and its installation.

Course Outcomes:

Upon successful completion this course a students will be to

1. Apply the knowledge of automation in machine control.
2. Design and conduct practical in realistic constrain on motors such that it is applicable in manufacturing, testing and maintenance field.
3. Design the automation system for fast and value added quality product for economical growth through technological development.
4. Solve engineering solution for fast growing industrial sector with reliable atomized system using PLC and SCADA system.
5. Discharge professional duty in multidisciplinary teams of installation ,maintenance and operation with séance of safety standards.
6. Do higher study in field of automation and able use updated software and tools.

Elective-II
Industrial Automation
(Course Contents)

Semester-VIII **Examination Scheme:**

Teaching Scheme: **(ESE) End Semester Examination: 80 Marks**

Lectures: 3 Hrs/Week **(ISE) Internal Sessional Examination: 20 Marks**

(ESE) End Semester Exam duration: 03 Hours

Unit I:Introduction to Industrial Automation, basics of PLC and Automation strategy. 09 Hours, 16 Marks

Introduction to Industrial Automation, Role of automation industry, Programmable Logic Controller, Basic operation, PLC architecture and components, Programming language, PLC application and Manufacturers, Introduction to Automation tools like PLC, SCADA, DCS, Hybrid DCS etc.

Unit II: - Basics PLC Functions and configuration. 09 Hours, 16 Marks

PLC registers, PLC modules, Addressing System, Field Input/ Output system, PLC timers functions, PLC counters, Industrial process Timing application, Selection of PLC and I/O modules

Unit III:- Instructions , Data handling functions. 08 Hours, 16 Marks

PLC logical instruction, PLC arithmetic instruction, PLC repetitive clock functions, PLC numbering systems, conversion function, PLC master relay control function, Jump , Data Move instructions and other data handling functions, scaling instructions.

Unit-IV: Programming of PLC 08 Hours, 16 Marks

Introduction Ladder/ FBD language, PLC configuration with I/O designations, addressing system in programming, Process to develop ladder language in software, Uploading/ Downloading the program to/ from PLC, To develop ladder for ON/OFF controlling of motor, Traffic signal light, etc.

Unit-V:Application of PLC/Industrial application and Introduction to SCADA system. 08 Hours, 16 Marks

Application development and automation for following industries:-

1. Power
2. Pharmaceuticals
3. Automobile
4. Rubber industry etc.

Introduction to SCADA system

Reference Books:

1. John Webb & Ronald, "PLC Principles and Application**" ,** Prentice Hall India.
2. S.K.Sigh, "Computer Aided Process Control" ,Prentice Hall India.
3. John Hackworth & Frederick D Hackworth, "PLC: Programming Methods and Applications",Pearson Education.
4. Krushnakant, "Computer Based Process Control" Prentice Hall India.
5. Prof. Rajesh Mehra and Er. Vikram Vij, "PLC and SCADA", Laxmi Publication, Delhi.
6. http://nptel.iitm.ac.in

Course Title | Short Title | Course Code

Elective-II

iii. Advance Microprocessor AM

Course Description:

The course explores knowledge of 8086 microprocessor. The course comprises of architecture, assemble language programming and interfacing of peripherals and their applications. It also explores the knowledge of Pentium microprocessor.

Lectures	Hours/Week	No. of Weeks	Total Hours	Semester Credits
	03	15	42	03

Prerequisite Course(s) : Microprocessor and Microcontroller at TE Electrical

General Objectives:

To meet the challenges of growing technology , student will be conversant with the programmable aspect of microprocessor and microcontroller. Programming is a process of problem solving and communication in language of mnemonics. The object of course is to understand microprocessor and Pentium microprocessor demand, concept and develop skill in two discipline hardware and programming.

Course Outcomes:

Upon successful completion of this course the students will be able to:

1. Apply basic electronic subject and software algorithm application for understanding architectures assemble language of microprocessor and Pentium microprocessor. .
2. Know the pin configuration and memory organization of 8086 microprocessor and Pentium microprocessor.
3. Develop assemble language programming and interfacing peripherals for wide application in electrical engineering.
4. Develop assembly language source code for applications that use I/O ports, timer and single/multiple interrupts
5. Apply techniques for measurement of electrical quantities by microprocessor.
6. Apply the knowledge of microprocessor and Pentium microprocessor. in application of microprocessor based electrical protection system.
7. Do higher study in the field of automation, operation and control of power system by microprocessor and Pentium microprocessor.

Elective-II
Advance Microprocessor
(Course Contents)

Semester-VIII **Examination Scheme:**

Teaching Scheme: **(ESE) End Semester Examination: 80 Marks**

Lectures: 3 Hrs/Week **(ISE) Internal Sessional Examination: 20 Marks**

(ESE) End Semester Exam duration: 03 Hours

Unit I: 8086 Architecture **09 Hours, 16 Marks**

Introduction to 8086 microprocessor, Register Organization, Memory Segmentation. Programming Model. Memory addresses. Physical memory organization. Architecture of 8086, signal descriptions of 8086- common function signals. Interrupts of 8086.

Unit II: Instruction Set and Assembly Language Programming of 8086

9 Hours, 16 Marks

Instruction formats, addressing modes, instruction set, assembler directives, macros, simple programs involving logical, branch and call instructions, sorting, evaluating arithmetic expressions, string manipulations.

Unit III:- I/O Interface **08 Hours, 16 Marks**

8255 Programmable Peripheral interface, various modes of operation of 8255 PPI, interfacing of 8255 with 8086,stepper motor interfacing, D/A and A/D converter.

Unit-IV: Interfacing with advanced devices **08 Hours, 16 Marks**

Memory interfacing to 8086, Interrupt structure of 8086, interrupt vectortable, Interrupt service routine. Introduction to DOS and BIOS interrupts, Interfacing Interrupt Controller 8259 DMA Controller 8257 to 8086.

Unit-V: Introduction to Pentium microprocessor **08 Hours, 16 Marks**

Historical evolution of 80286,386, 486 processors. Pentium features and Architectures, Pentium Real mode, Pentium RISC features, Pentium super-scalar architecture - Pipelining, Instruction paring rules, Branch prediction, Instruction and Data caches. The Floating point Unitfeatures, pipeline stages & data types.

Reference Books:

1. D.V.Hall, "Microprocessors and Interfacing" Tata McGraw Hill Publication, New Delhi.
2. A. Ray, K. Bhurchandi, "Advanced Microprocessors and Peripherals: Architecture, Programming & Interfacing", Tata McGraw Hill, Third edition, 2004.
3. John E. Uffenbeck, "The 8086/ 8088 Family: Design, Programming and Interfacing", Pearson, 1987.
4. Barry B Bray, "The Intel Microprocessors-Architecture, Programming and Interfacing", Pearson LPE/PHI, Second edition.
5. M.T.Savaliya, "8086 Programming and Advanced Processor Architecture", Wiley India.
6. James Antonakos , "The Pentium Microprocessor" , 2004, Pearson Education ISBN – 81-7808-545-3
7. Intel 8 bit Microcontroller manual.
8. http://nptel.iitm.ac.in

Course Title Short Title Course Code

Elective-II

iv. Power System Design Practice PSDP

Course Description:

This course starts from fundamental concept such as constants of overhead transmission line and the performance of transmission lines and proceed to discuss the design of transmission lines both electrical and mechanical. Also design of EHVAC and HVDC transmission and power has been described. Power system control and methods of compensation are also discussed. Latter part of this deals with the design of distribution systems including their economics. Also the ratings, specification, application, various types of circuit breakers and arrester have been described.

	Hours/Week	No. of Weeks	Total Hours	Semester Credits
Lectures	**03**	**15**	**42**	**03**

Prerequisite Course(s): Knowledge of Power system and Power System Switchgear and protection.

Course Objectives: The course explores design concept of electrical power system. The course provides ideas of electrical and mechanical design concept of Transmission line. The course also gives economical consideration, project execution and site selection concept. The course also explores the knowledge of substation layout.

Course Outcomes:

Upon successful completion this course a students will be able to:

1. Apply the basic concept of electrical and mechanical for designing the transmission line and substation.
2. Design the project in view of practical and realistic constrain.
3. Understand the selection of various substation equipment and their location with safety standard.
4. Select the material for better technical performance and economical consideration.
5. Perform their professional duties in project execution and operation in the field of design and installation.
6. Able use updated software and tool for designing of substation and transmission line.

Elective-II
Power System Design Practice
(Course Contents)

Semester-VIII **Examination Scheme:**
Teaching Scheme: **(ESE) End Semester Examination: 80 Marks**
Lectures: 3 Hrs/Week **(ISE) Internal Sessional Examination: 20 Marks**
(ESE) End Semester Exam duration: 03 Hours

Unit I: - Transmission Design Fundamentals **09 Hours, 16 Marks**

Selection of voltage for high voltage transmission line, choice of conductor, spacing of conductor, Insulators, specification of transmission line, surge impedance loading, Electrical & mechanical design of transmission line. Design of EHV transmission lines, Transmission of electric power at extra high voltage, design consideration of EHV line, insulation coordination, Radio and television interference.

Unit II: - Design of Distribution Systems **09 Hours, 16 Marks**

Type of distribution system arrangement, primary and secondary distribution design, calculation of distribution sizes: voltage drop and regulation, deign of rural and industrial distribution system

Unit III: - Circuit Breakers **08 Hours, 16 Marks**

Circuit breakers: operating mechanism, testing rating and selection, operating under special conditions, specification and technical details for tender preparations.

Unit IV: Lighting Arrestors **08 Hours, 16 Marks**

Rating characteristics, testing technical defects, standards followed for details insulation co ordination. Power transformers different types, tapping , fittings, cooling, cost comparison, testing technical details for ordering and tender preparations.

Unit V: Shunt Capacitors **08 Hours, 16 Marks**

Need, construction, location, connections, protection, analysis, special types, testing, technical details. Earthing: Earthing systems, step potential, touch potential and transfer potential.

Reference Books:

1. Pratapsingh Satnam & P.V. Gupta, “Substation Designed Equipments”, Dhanpat Rai & Sons.
2. M. V. Deshpande, “Electrical Power System Design” TMH
3. B.R.Gupta, “Power System Analysis and Design,’’ Wheeler Publishing co.

Course Title Short Title Course Code

Elective-III

i. Flexible AC Transmission System and Power Quality FPQ

Course Description:

Flexible AC Transmission System (FACTS) is one aspect of the power electronics revolution that is taking place in all area of electric energy. In the transmission area, application of power electronics consists of HVDC and FACTS. Is a new technology based on power electronics offers an opportunity to enhance controllability, stability and power transfer capability of AC transmission system. The subject also explores the knowledge of power quality, effect and source of power quality.

Lectures	Hours/Week	No. of Weeks	Total Hours	Semester Credits
	03	15	42	03

Prerequisite Course(s) : Knowledge mathematics and subjects of Electrical Engineering.

Course Objectives:

This course objectives to study power transmission by EHV AC and FACTS. Enhancement of controllability, stability and power transfer capability of AC transmission system. Study different FACTS component and power quality issues.

Course Outcomes:

Upon successful completion of this course the student will be able to:

1. Apply basic knowledge power electronic for enhancing power transfer capability of AC transmission system.
2. Understand FACTS, concepts its location in transmission network.
3. Analyze the characteristics FACTS controller and able to solve engineering problems.
4. Understand the sources of harmonics and its mitigation.
5. Discharging duties as power system engineer in technical and professional way.
6. Do higher studies in stability with modern tools for increasingly complex interconnected power system.

Elective-III
Flexible AC Transmission System and Power Quality
(Course Contents)

Semester-VIII **Examination Scheme:**
Teaching Scheme: **(ESE) End Semester Examination: 80 Marks**
Lectures : 3 Hrs/Week **(ISE) Internal Sessional Examination: 20 Marks**
(ESE) End Semester Exam duration: 03 Hours

Unit -I:- FACTS Concept **09 Hours, 16 Marks**

Transmission interconnection and opportunity for FACTS, Basic type of FACTS controller, Brief description of FACTs controller: Shunt, series and combination of shunt and series. Comparison of HVDC and FACTS.

Unit-II:-Static Shunt Compensators: SVC and STATCOM **09 Hours, 16 Marks**

Object of shunt compensation, Midpoint voltage regulation for line segmentation, end of line voltage support. Method of controllable VAR generation: variable impedance type and switching type VAR generators, STATCOM.

Unit-III:- Static Series Compensators **08 Hours, 16 Marks**

Objectives of Series Compensation: Concept of series capacitive compensation, voltage stability. Variable impedance type series compensators: Thyristor switched series capacitor(TSSC) and Thyristor controlled series capacitor (TCSC).

Unit -IV:- Power Quality **08 Hours, 16 Marks**

Power quality definition, need for power quality, nonlinear loads, Type of power quality problems: voltage sags, voltage swells, under-voltage, interruption, transients, voltage unbalance, voltage fluctuation , harmonics and electrical noise. Sources of power quality problems.

Unit -V:- Power Quality effects and Solutions **08 Hours, 16 Marks**

Effect of harmonics in pure resistive, inductive and capacitive circuit, effect of harmonic on induction motor , transformer , power factor correction and lighting installation. Power quality standard and mitigation by active and passive filter.

References,

1. N.G.Hingorani, “Understandig FACTS” , IEEE Press, 1999
2. Yang hue Song, “Flexible AC Transmission Systems (FACTS)”, IEEE Press, 199
3. Surajit Chattopadhyay , Madhuchhanda Mitra and Samarjit Sengupta, “Electric Power Quality”, Springer
4. http://nptel.iitm.ac.in

Course Title Short Title Course Code

Elective-III

ii. Generation Planning and Load Dispatch GPLD

Course Description:

Electric energy generation is an old subject but it is now rejuvenated with important new development. With this in view greater awareness of the environmental effects of electrical generation and economical consideration the subject contain different topics. The subject explores the knowledge the new trends and considerations in generation, generation planning , load forecasting, economics and reliability of generation system.

Lectures	Hours/Week	No. of Weeks	Total Hours	Semester Credits
	03	15	42	03

Prerequisite Course(s) : Knowledge management and subjects of Electrical Engineering.

Course Objectives:

This course objectives to understand the different power generation organization. The students will able to understand the generation planning , coordination and scheduling between different power plant, economical aspects, load forecasting and reliability of generation system.

Course Outcomes:

Upon successful completion of this course the student will be able to:

1. Understand the new trends in power generation for sustainable development.
2. Understand different issues in electrical generation like economical, forecasting, environmental and safety.
3. Analyze cost of generation and load scheduling in different type of power plants.
4. Understand concept of reliability in electrical power generation system.
5. Discharging duties as power system engineer in technical and professional way.
6. Do higher studies in generation planning with modern tools for increasingly complex interconnected power system.

Elective-III
Generation Planning and Load Dispatch
(Course Contents)

Semester-VII **Examination Scheme:**

Teaching Scheme: **(ESE) End Semester Examination: 80 Marks**

Lectures : 3 Hrs/Week **(ISE) Internal Sessional Examination: 20 Marks**

(ESE) End Semester Exam duration: 03 Hours

Unit-I: - Generation **09 Hours, 16 Marks**

Growth of electrical energy consumption, electrical energy sources, organization of power sector, role of private sector in energy management, Indian electricity grid code. Environmental issue in electric power generation.

Cogeneration: Scope, advantages, cogeneration technology and industries suitable for cogeneration. Captive power generation: advantages, constrain, government policies, energy banking and energy wheeling. Distributed power generation: advantages and function Electricity deregulation : need advantages, power player ,metering and energy billing deregulation. Roll of load dispatch centers.

Unit-II:-Generation Planning **09 Hours, 16 Marks**

Objectives of generation system planning, long term and short term planning, Low range& short range hydro thermal scheduling of generation the short term and long term hydro thermal scheduling of generation, co ordination equation.

Policy studies, co-ordination of steam, hydro & nuclear power stations. Optimum generation allocation- line losses neglected & including the effect of transmission losses for thermal power generations.

Unit-III:- Load Energy Forecasting **08 Hours, 16 Marks**

Classification of loads, load forecasting methodology. peak demand forecasting- non whether sensitive forecast- weather sensitive forecast-total forecast- annual and monthly peak demand forecast.

Unit-IV: - Generation System Cost Analysis **08 Hours, 16 Marks**

Capacity cost, generation cost, depreciation, effect of load factor on unit energy cost, analysis of fixed and operating cost of steam plant, hydro plants and nuclear plant, Roll of diversity in power system economics, Fuel inventories, off peak energy utilization.

Unit-V:-Generation System Reliability Analysis **08 Hours, 16 Marks**

Probabilistic generation unit- model &load model effective load- reliability analysis for isolated system , reliability of interconnected system.

Reference Books:

1. B.R. Gupta, " Generation of Electric Energy" Euresia Publishing House Pvt. Ltd.
2. R.L.Sullivan, "Power System Planning" , McGraw Hill.
3. Kirchmayers L.K., " Economic Control of Interconnected System" John Wiley & Sons, New York.

Course Title | Short Title | Course Code

Elective-III

iii. **High Voltage Transmission** **HVT**

Course Description:

The subject explores the knowledge of high voltage transmission, advantage of high voltage system. The subject provides the knowledge of stability study and causes of over voltage in EHV system. Modern DC power transmission is relatively new technology because of advent of thyristor valves and related technology. The HVDC technology is still undergoing many changes due to continuing innovations directed at improving reliability and reducing cost of converting station. The subject explores the knowledge of HVD in economical and technical constrain.

Lectures	Hours/Week	No. of Weeks	Total Hours	Credits
	03	15	42	03

Prerequisite Course(s) : Knowledge management and subjects of Electrical Engineering.

Course Objectives:

The subject objectives to explore the knowledge of high voltage transmission, advantage of high voltage system. Effect of high voltage like corona loss and audible effects. The objective is to explores the knowledge of HVD in economical and technical constrain. Comparison between EHV and HVDC.

Course Out comes:

After completion of subject students will be able to:

1. Apply knowledge of power transmission to understand new trends in EHV and HVDC transmission system.
2. Analyze the line parameter data to understand power handling capacity of EHV transmission line.
3. Understand technical and economical aspect of EHV and HVDC transmission system .
4. Discharge the professional duties in EHV and HVDC transmission system.
5. Do higher study in the subject for economical development with value added reliability.

Elective-III
High Voltage Transmission
(Course Contents)

Semester-VIII **Examination Scheme:**
Teaching Scheme: **(ESE) End Semester Examination: 80 Marks**
Lectures : 3 Hrs/Week **(ISE) Internal Sessional Examination: 20 Marks**
(ESE) End Semester Exam duration: 03 Hours

Unit -I:-EHV AC Transmission **09 Hours, 16 Marks**

Role of EHV AC Transmission, Standard of transmission voltage, average line parameter, power transmission, power-handling capacity and line loss, corona effect: power loss and audible noise, copper loss and corona loss, corona loss formula, audible noise generation and characteristic. Electrostatic field of EHV lines. Traveling waves and standing waves, Line energization with trapped-charge voltage.

Unit -II:-Maximum Power Transfer and Stability Limit **09 Hours, 16 Marks**

Power Transfer at voltage stability limit of EHV lines, Magnitude of receiving end voltage, Voltage Magnitude of receiving end voltage during maximum power transfer. Magnitude of Maximum power and stability limit. Optimal reactive power at voltage stability limit Voltage collapse in EHV lines, reactive power requirement for voltage in long line. Voltage stability

Unit -III:- Over-voltages in EHV System **08 Hours, 16 Marks**

Origin of over voltage and their types , Over Voltage in EHV system caused by switching operation, by interruption of inductive and capacitive currents, Ferro-response over voltage, calculation surges, Power frequency voltage control and over voltages, Power circle diagram. Surge impedance and insulation coordination.

Unit -IV:-HVDC Transmission **08 Hours, 16 Marks**

Comparison of EHV and HVDC transmission system based on: Economics of power transmission, technical performance and reliability. Description of HVDC transmission system : type of link, converting stations. Principle of DC link converter, characteristic, modification and control characteristic

Unit -V:-Reactive power control and stability **08 Hours, 16 Marks**

Reactive power requirement in steady state, conventional control strategies, alternate control and forced commutation, sources of reactive power, stability: synchronous and asynchronous link.

References Book:

1. A.Chakrabarti, D.P.Kothari, A.K. Mukhopdadhyay, "Performance, Operational & Control of EHV Power System", Wheeler publications.
2. Rakosh Das Begamudre "Extra high-voltage A.C. Transmission Engineering" New Age International.
3. S. Rao, "EHVAC & HVDC Transmission Engineering & Practice" , Khanna Publications.
4. K R padiyar, "HVDC Power Transmission System" New Age International Publication.
5. http://nptel.iitm.ac.in

Course Title | Short Title | Course Code

Elective-III

iv. Electromechanical Energy Conversion EEC

Course Description:

Conversion of other forms of energies into electrical energy is a command practice.The main advantage of this conversion is that energy in electrical form can be transmitted , utilized and controlled more easily, reliably and efficiently. Energy conversion devices are required first for converting other forms of energies into electrical energy and then converting electrical energy into required useful form. An electro-mechanical energy conversion device is one which converts electrical energy or mechanical energy into electrical energy. Operating principles of energy conversion devices are similar, but their structural details differ depending upon their function.

Lectures	Hours/Week	No. of Weeks	Total Hours	Credits
	03	15	42	03

Prerequisite Course(s) : Knowledge management and subjects of Electrical Engineering.

Course Objectives: The objective of course to provide knowledge and techniques of energy conversion. Understand the mathematical equations related to energy flow. The course objective is to understand the constructional features of machines for efficient conversion process.

Course Outcomes:

1. Apply basic science, mathematics and engineering for understanding energy conversion.
2. Analyze the mathematical equation related to energy conversion .
3. Design energy conversion system, component, or process to meet desired needs within realistic constraints such manufacturability, and sustainability.
4. Higher study multidisciplinary subject for efficient conversion of energy for tomorrow.

Elective-III
Electromechanical Energy Conversion.
(Course Contents)

Semester-VIII **Examination Scheme:**
Teaching Scheme: **(ESE) End Semester Examination: 80 Marks**
Lectures : 3 Hrs/Week **(ISE) Internal Sessional Examination: 20 Marks**
(ESE) End Semester Exam duration: 03 Hours

Unit -I: - Magnetically Coupled Circuits And Transformer: 09 Hours, 16 Marks
Self and mutual flux linkages and inductances. Voltage Equation of coupled circuits. Coefficients of coupling and leakage coefficient. Two winding transformers: Steady state and transient analysis using mutual and self inductances. Variable frequency transformers. Energy flow considerations.

Unit -II: - Electromechanical Energy Conversion Principles: **09 Hours, 16 Marks**
Electromechanical System, Energy process in electromagnetic systems.
Law of conversation of energy as applied to electromechanical system. Linear and non-linear, singly and doubly excited magnetic systems; Energy and co-energy, various expressions for forces and torques; Energy, forces and torque in a system of rigid currents. Application to various magnetic field transducers.

Unit-III: -Electric Field And Transducers 08 Hours, 16 Marks
Quasi-static electric fields as coupling medium, Energy forces and torques in a system of charged conductors, Application of electric field transducers. Incremental motion transducers (detailed analysis of few cases).

Unit IV: - Basic Rotating Machines 08 Hours, 16 Marks
Common structural features of rotating machines. Machine windings and their basic properties. Distributed bindings as current sheets. Equivalence between concentrated and distributed windings M.M.F. and flux distribution and various windings. Rotating magnetic field.

Unit -V: - Types of Rotating Machines 08 Hours, 16 Marks
Commutator, Synchronous and asynchronous machines Induced e.m.f.s and electromagnetic torque in non salient pole machines**.**

Reference Books:

1. Rakosh Das, Begamudre, "Electromachinical Energy Conversion" Wiley Eastern Publication.
2. Gourishankar, "Electromechnical Energy Conversion".
3. Fitzgerald, Kingsley & Kusko, "Eletric Machinary" McGraw Hill Kogo Kusha Ltd.
4. Dr. P S Bimbhra, "Electrical Machinary", Khanna Publication.
5. Dr. P S Bimbhra, "Generalized Electrical Machinary", Khanna Publication.
6. R K Srivastava, " Electrical Machines" Second Eddition, Cengage Learning.

Course Title	Short Title	Course Code
Power System Stability Lab	**PSS Lab**	

Lab Course Description:

In this laboratory, course emphasis on imparting the practical knowledge and understanding of basic principles of power system stability, synchronous machine parameters and time constants. Concept power system stability on small and large disturbances. Method to determine steady state and transient stability limits .

Practical	**Hours per Week**	**No. of Weeks**	**Total Hours**	**Semester Credits**
	2	**15**	**28**	**1**

Prerequisite Course(s): Knowledge of Electrical Machines and power system analysis of second and third year Engineering.

Lab Course Objectives:

The objective of the laboratory is to impart the fundamental knowledge of basic principles of power system stability, synchronous machine parameters and time constants. To apply the specific procedures for analyze the experimental results. The students will able to understand the characteristic of Synchronous alternator on infinite bus. Application of different methods to determine steady state and transient stability limits This makes bridge on theoretical knowledge and practical practices.

Lab Course Outcomes:

After successful completion of this lab students will be able to:

1. Apply basic knowledge of science and mathematics and electrical engineering in stability studies.
2. Understand facts, concepts and classification of stability on the basis of perturbation and economical aspect of energy exchange.
3. Analyze the characteristics of synchronous alternator under small and large disturbances.
4. Apply Knowledge of electrical subjects for solving stability problem and able to use method for enhancing stability.
5. Discharging duties as power system engineer in technical and professional way.
6. Do higher studies in stability with modern tools for increasingly difficult complex interconnected power system.

Power System Stability Lab

(Lab Course Contents)

Semester-VIII **Examination Scheme:**

Teaching Scheme: **(ICA) Internal Continuous Assessment: 25 Marks**

Practical : 2 Hrs/Week **(ESE) End Semester Examination(OR): 25 Marks**

Teacher should facilitate learning following lab experiments:

1. Determination of Parameters and time constants of synchronous machines.
2. Synchronous machine of infinite bus: Effect of Excitation
3. Effect of saturation and & determination of equivalent reactance of synchronous machines.
4. Retardation test on synchronous machines to find moment of inertia of rotating part and angular momentum.
5. To obtain power angle characteristics of lossy & lossless lines.
6. To study transient stability by point by point method.
7. To determine the steady state stability limit of short transmission line.
8. To determine SSSL of long transmission line.
9. Study of clerk's diagram.
10. Study of different types of automatic voltage regulator.

Note: Lab file should consist of minimum **Eight** experiments.

Guide lines for ICA :

ICA shall be based on continuous evaluation of student performance throughout semester and practical assignment submitted by the student in the form of journal.

Guide lines for ESE:-

In ESE the student may be asked questions on practical. Evaluation will be based on answers given by student in oral examination.

Course Title	Short Title	Course Code
Switchgear and Protection	**SGP Lab**	

Lab Course Description :

Switchgear and Protection is a fascinating subject . A protection scheme in a power system is designed to continuously monitor the power system to ensure maximum continuity of electrical supply with minimum damage to life, equipment and property. The subject practical explores the knowledge of arc interruption, different type of circuit breakers and relay. This knowledge is help full for understanding the characteristic feature and proper selection of protective elements in different protective scheme. The practical also provide knowledge different protection for major and individual power system elements .

Practical	**Hours per Week**	**No. of Weeks**	**Total Hours**	**Semester Credits**
	2	**15**	**28**	**1**

Lab Course Objectives: The objectives of subject that students will able understand the fault characteristic of individual power system elements. One should also be knowledgeable about the tripping characteristics of various protective relays. The students able to understand the job of protection engineer is to devise such scheme where closest possible match between the fault characteristic and tripping characteristic is obtained. The students will able understand protected zone and able to design protective scheme such that relay will detect undesirable conditions and then trip to disconnect the area affected, but remain restrained at all other time. Student should be equipped with sound concept pf power system protection to enable them handling unforeseen circumstances in real life.

Lab Course Outcomes:

1. Apply the basic knowledge of science for understanding arc generation and interruption in medium and high voltage circuit.
2. Conduct practical based on testing of relay and analysis data for matching different fault characteristics.
3. Select different protective relay and circuit breakers based on their characteristic feature for different protective scheme.
4. Understand continuously monitor the power system to ensure maximum continuity of electrical supply with minimum damage to life, equipment and property and best safety practices.
5. Discharge his professional duties in field of power system protection, maintenance and manufacturing sector.
6. Do higher study of updated protection technology for complex power system .

Switchgear and Protection

(Lab Course Contents)

Semester-VIII **Examination Scheme:**

Teaching Scheme: **(ICA) Internal Continuous Assessment: 25 Marks**

Practical : 2 Hrs/Week **(ESE) End Semester Examination(PR): 25 Marks**

Teacher should facilitate learning following lab experiments:

1. To conduct and study of Arc extinction phenomenon: Application in air circuit breaker.
2. Study of relaying components and control circuit developments.
3. To conduct and plot the characteristic of rewirable fuses and MCB
4. To conduct and plot operating characteristics of Inverse time over current relay.
5. To conduct Over current & earth fault protection scheme for alternator.
6. To conduct Protection of 3 phase transformer using differential relay (Merz-Price protection scheme)
7. To conduct and study the through fault stability of differential protection scheme applied to transformer.
8. To conduct Protection of transmission line.
9. Study of MHO distance relay to plot. a) R- X diagram b) Relay voltage Vs Admittance characteristic.
10. Study of Static relay.
11. Demonstration of microprocessor base protection.

Note: Lab file should consist of minimum **Eight** experiments.

Guide lines for ICA :

ICA shall be based on continuous evaluation of student performance throughout semester and practical assignment submitted by the student in the form of journal.

Guide lines for ESE:-

In ESE the student should be asked to perform any one practical. Evaluation will be based on practical, paper work , performance and oral in the practical examination.

Course Title Short Title Course Code

Elective-II

Computer Aided Power System Analysis Lab CMPSA Lab

Course Description:

This laboratory course is designed to impart the computer programming skill to solve the complex power system problems such as the power flow, short circuit, contingency and stability analyses. This course also gives an exposure to various modern computing software such as MATLAB/PSCAD/ETAP which are widely used in industry.

Practical	Hours per Week	No. of Weeks	Total Hours	Semester Credits
	2	15	28	1

Prerequisite Course(s): Knowledge of C language, power system analysis and numerical techniques.

General Objectives:

The objective of the laboratory is to impart the fundamental knowledge of MATLAB programming to solve power system problems. Students will able to develop their ability to apply the numerical techniques and computer programming skills to solve power flow and short circuit problems. The students will able to use MATLAB/PSCAD/ETAP at basic level for the power system analysis.

Course Outcomes:

After successful completion of this lab students will be able to:

1. Apply basic knowledge of numerical techniques, power system and computer programming for the analysis of power flow, short circuit, contingency etc.
2. Use MATLAB/PSCAD/ETAP for power system analysis.
3. Form the bus impedance and admittance matrices by algorithms.
4. Perform load flow by Newton Raphson, Gauss seidal and fast decoupled Method.
5. Perform short circuit study.
6. Perform fault analysis on Power System network of an Electric Utility Company
7. Understand the IEC and ANSI standards for Short circuit analysis.
8. Do higher studies and use modern sophisticated computing tools for complex power system analysis.

Elective-II
Computer Aided Power System Analysis Lab
(Lab Course Contents)

Semester-V **Examination Scheme:**
Teaching Scheme: **(ICA) Internal Continuous Assessment: 25 Marks**
Practical : 2 Hrs/Week **(ESE) End Semester Examination(OR): 25 Marks**

Teacher should facilitate learning following lab experiments/Computer programs using MATLAB/Simulink or PSCAD or ETAP:

1. Program for determination of the parameters of the equivalent circuit.
2. Program for building of Z_{Bus} by addition of branch.
3. Program for building of Z_{Bus} by addition of link.
4. Program for illustration of the Ferranti Effect.
5. Program for the formation of Y_{Bus} by Singular Transformation.
6. Program for load flow by Newton Raphson Method.
7. Program for Balanced Three phase short circuit.
8. Program for Unbalanced short circuits.
9. Program for Fault analysis of Power System network of an Electric Utility Company.
10. Study of IEC and ANSI standards for Short circuit analysis.
11. Introduction to PSCAD
12. Introduction to ETAP

Note: Lab file should consist of minimum **Eight** experiments.

Guide lines for ICA :
ICA shall be based on continuous evaluation of student performance throughout semester and practical assignment submitted by the student in the form of journal.

Guide lines for ESE:-
In ESE the student may be asked questions on practical. Evaluation will be based on answers given by student in oral examination.

Course Title | Short Title | Course Code

Elective-II

Industrial Automation Lab | IA Lab

Lab Course Description:

This lab course describes PLC & SCADA based Industrial Automation system which will improve the knowledge of the students about industrial processes using automation. The course will cover SCADA & PLC systems in terms of their architecture, their interface to the process hardware, the functionality and the application development facilities. Also provide an industrial SCADA & PLC system is used for the development of the controls of machinery.

	Hours/Week	No. of Weeks	Total Hours	Semester Credits
Practical	**02**	**15**	**28**	**01**

Prerequisite Course(s): Knowledge of c-programming, Industrial organization and management subject of third year, industrial drives and control subject of final year.

Lab Course Objectives:

The objectives of lab course are that students will able to understand the role of industrial automation for different processes based on PLC system and its requirement. It also provide basic operation of programmable logic control and its function. Students will learn the input-output devices for the PLC, its operation, its selection according to application and its interfacing. It explores the knowledge of different configuration of PLC, its programming techniques for various application, and it's interfacing with industrial machineries. It also help to understand the application in different industries like power sector, in pharmaceuticals, in automobile industry etc and its installation.

Course Outcomes:

Upon successful completion this course a students will be to

1. Apply the knowledge of automation in machine control.
2. Design and conduct practical in realistic constrain on motors such that it is applicable in manufacturing, testing and maintenance field.
3. Design the automation system for fast and value added quality product for economical growth through technological development.
4. Solve engineering solution for fast growing industrial sector with reliable atomized system using PLC and SCADA system.
5. Discharge professional duty in multidisciplinary teams of installation ,maintenance and operation with séance of safety standards.
6. Do higher study in field of automation and able use updated software and tools.

Elective-II
Industrial Automation Lab
(Lab Course Contents)

Semester-VIII **Examination Scheme:**
Teaching Scheme: **(ICA) Internal Continuous Assessment: 25 Marks**
Practical : 2 Hrs/Week **(ESE) End Semester Examination(OR): 25 Marks**

Teacher should facilitate learning following lab experiments.

1. Study of programmable logic controller.
2. Study of programming languages.
3. Develop and implement any PLC program using ladder/FBD programming language.
4. Interfacing of PLC to any SCADA through modbus protocol.
5. Developing and implementing any control loop using PLC system.
6. Study of SCADA system.
7. Study of DCS system.
8. Study of interfacing devices/ protocols like modbus, Profibus etc.
9. To controller conveyer belt system from online programming system.
10. To develop total controlling panel for settlement of conveyor based automation system.

Note: Lab file should consist of minimum **Eight** experiments.

Guide lines for ICA :
ICA shall be based on continuous evaluation of student performance throughout semester and practical assignment submitted by the student in the form of journal.

Guide lines for ESE:-
In ESE the student may be asked questions on practical. Evaluation will be based on answers given by students in oral examination.

Course Title | Short Title | Course Code

Elective-II

Advance Microprocessor Lab | AM Lab

Course Description:

The course explores knowledge of 8086 microprocessor. The lab course comprises of architecture, assemble language programming and interfacing of peripherals and their applications. It also explores the knowledge of Pentium microprocessor.

Practical	Hours/Week	No. of Weeks	Total Hours	Semester Credits
	02	15	28	01

Prerequisite Course(s) : Microprocessor and Microcontroller at TE Electrical

General Objectives:

To meet the challenges of growing technology , student will be conversant with the programmable aspect of microprocessor and microcontroller. Programming is a process of problem solving and communication in language of mnemonics. The object of course is to understand microprocessor and Pentium microprocessor demand, concept and develop skill in two discipline hardware and programming.

Course Outcomes:

Upon successful completion of this course the students will be able to:

1. Apply basic electronic subject and software algorithm application for understanding architectures assemble language of microprocessor and Pentium microprocessor. .
2. Know the pin configuration and memory organization of 8086 microprocessor and Pentium microprocessor.
3. Develop assemble language programming and interfacing peripherals for wide application in electrical engineering.
4. Develop assembly language source code for applications that use I/O ports, timer and single/multiple interrupts
5. Apply techniques for measurement of electrical quantities by microprocessor.
6. Apply the knowledge of microprocessor and Pentium microprocessor. in application of microprocessor based electrical protection system.
7. Do higher study in the field of automation, operation and control of power system by microprocessor and Pentium microprocessor.

Elective-II
Advance Microprocessor Lab
(Lab Course Contents)

Semester-VIII **Examination Scheme:**
Teaching Scheme: **(ICA) Internal Continuous Assessment: 25 Marks**
Practical : 2 Hrs/Week **(ESE) End Semester Examination(OR): 25 Marks**

Teacher should facilitate learning following lab experiments:

1. Study of architecture and instructions set of 8086 microprocessor.
2. Study of architecture of Pentium microprocessor.
3. Microprocessor 8086 assembly language programs based on data transfer instruction
4. Microprocessor 8086 assembly language programs based on arithmetic instruction
5. Microprocessor 8086 assembly language programs based on logical instruction
6. Applications of microprocessor 8086 in measurement of electrical quantity.
7. Applications of microprocessor 8086 in Electrical drives and speed control for stepper motor.
8. Program to convert the temperature in degree centigrade to ferniest by 8086 microprocessor.
9. Program to find highest and lowest marks in the examination by 8086 microprocessor
10. Program to sort the numbers in ascending order and descending order by 8086 microprocessor.
11. Program to find the number of negative numbers in the array by 8086 microprocessor.
12. Program for conversion of BCD to Hex and Hex to BCD

Note: The term work should include a minimum **eight** experiments on hardware kits and simulation.

Guide lines for ICA :
ICA shall be based on continuous evaluation of student performance throughout semester and practical assignment submitted by the student in the form of journal.

Guide lines for ESE:-
In ESE the student may be asked questions on practical. Evaluation will be based on answers given by students in oral examination.

Course Title | Short Title | Course Code

Elective-II

Power System Design Practice | PSDP Lab

Lab Course Description:

This course starts from fundamental concept such as constants of overhead transmission line and the performance of transmission lines and proceed to discuss the design of transmission lines both electrical and mechanical. Also design of EHVAC and HVDC transmission and power has been described. Power system control and methods of compensation are also discussed. Latter part of this deals with the design of distribution systems including their economics. Also the ratings, specification, application, various types of circuit breakers and arrester have been described.

	Hours/Week	No. of Weeks	Total Hours	Semester Credits
Practical	**02**	**15**	**28**	**01**

Prerequisite Course(s): Knowledge of Power system and Power System Switchgear and protection.

Lab Course Objectives: The course explores design concept of electrical power system. The course provides ideas of electrical and mechanical design concept of Transmission line. The course also gives economical consideration, project execution and site selection concept. The course also explores the knowledge of substation layout.

Lab Course Outcomes:

Upon successful completion this course a students will be able to:

1. Apply the basic concept of electrical and mechanical for designing transmission line and substation.
2. Design the project in view of practical and realistic constrain.
3. Understand the selection of various substation equipment and their location with safety standard.
4. Select the material for better technical performance and economical consideration.
5. Perform their professional duties in project execution and operation in the field of design and installation.
6. Able use updated software and tool for designing of substation and transmission line.

Elective-II
Power System Design Practice Lab
(Lab Course Contents)

Semester-VIII **Examination Scheme:**
Teaching Scheme: **(ICA) Internal Continuous Assessment: 25 Marks**
Practical : 2 Hrs/Week **(ESE) End Semester Examination(OR): 25 Marks**

Teacher should facilitate learning through drawing sheet from the following

1. Draw the substation layout for 400KV.and design the three phase transmission line with electrical consideration.
2. Sag-Tension calculation
3. Different busbar arrangement and isolating switches.
4. Different types of circuit breaker.
5. Different types of Lightning Arresters
6. Design of Earthing system for 132/400KV substation.

Note: Lab file should consist of minimum **five** drawing sheet along with report.

Guide lines for ICA :

ICA shall be based on continuous evaluation of student performance throughout semester and practical assignment submitted by the student in the form of journal and drawing sheet.

Guide lines for ESE:-

In ESE the student may be asked questions on drawing sheet. Evaluation will be based on answers given by students in oral examination.

Course Title	Short Title	Course Code
Industrial Lecture	**IL**	

Course Description:

The gap between industry's needs and the academic community's aspirations appears to be considerably large. There exists a strong feeling, at least in the academic circles, that unless technology driven initiatives find a surer place in the industrial sector in this country, the academia-industry interaction is likely to remain confined to developmental activities with limited exploratory or research-based content As institutes committed primarily to creation and growth of technological knowledge, technical institutes have an important role to play in the industrial sector of the country's economy. This fact by way of encouraging mechanisms to foster interaction between the academia and industry. Typically, academic interest in the multidimensionality of a problem leads to a tendency to explore a variety of options to arrive at a solution. This industrial lecture develops ability of student for expectations of the industrialists from the fresh engineers.

	Hours per Week	No. Of Weeks	Total Hours	Semester Credits
Lecture	**1**	**15**	**14**	**2**

Course Objectives: The domains in which interaction is possible are:

a. Placement and entrepreneurship development.
b. Industry participation in technology development involving some exploratory work.
c. Academic intervention in solving specific industry problems.
d. Laboratory utilization by industry.
e. Continuing education program.

Course Outcomes:

Upon successful completion of this course the students will be able to:

1. Understand need ,requirement and expectation of industry from fresh engineers.
2. Understand importance of laboratory practices throughout carrier of engineer. Design and conduct experiments, as well as to analyze and interpret data.
3. Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
4. Function on multidisciplinary teams, communicate effectively.
5. Identify, formulate, and solve engineering problems by understanding professional and ethical responsibility.
6. Recognition of the need for, and an ability to engage in life-long learning use of modern engineering tools.

Industrial Lecture

(Course Contents)

Semester-VIII **Examination Scheme:**

Teaching Scheme: **(ICA) Internal Continuous Assessment: 50Marks**

Lecture : 1 Hrs/Week

1. There is a need to create avenues for a close academia and industry interaction through all the phases of technology development, starting from conceptualization down to commercialization.
2. List of renowned persons from industry shall be prepared by the committee appointed by Head of the department. After approval from the Principal, Minimum five Industrial lectures in alternate week shall be arranged, which shall be delivered by the experts/Officials from Industries/Govt. organizations/ Private Sectors/Public Sectors / R&D Labs covering the various aspects.
3. Topics of Industrial Lectures shall be Technical in nature and should not be the specific contents from the curriculum.
4. Minimum **five** Lectures to be delivered by experts from the industry in alternate weeks.
5. Students shall submit the report based on minimum five lectures giving summary of the lecture delivered.
6. The summary should contain brief resume of the expert, brief information of his organization and brief summary of the lecture in bullet point form.

Guide lines for ICA : Assessment of the Industrial Lecture for award of ICA marks shall be done jointly by departmental committee as per attendance in industrial lecture, report submitted by student and overall performance in semester as per the guidelines given in **Table- D**

Table-D

SN	Name of Student	Attendance (05 Marks per Lecture)	Dept of Understanding (03 Marks per Lecture)	Report Writing	Total
		25	**15**	**10**	**50**

Course Title	Short Title	Course Code
Project-II	**P-II**	

Course Description:

The course explores the knowledge of design, experiment and analysis of data. The course develops ability to work on multidisciplinary teams, Identify, formulate, and solve engineering problems in view of economic, environmental and societal context.

	Hours per Week	No. Of Weeks	Total Hours	Semester Credits
Laboratory	**4**	**15**	**48**	**6**

Prerequisite Course(s): Knowledge of science, mathematics, computer programming and core subject of engineering.

Course Objectives: The objectives of project are to develop ability to work in group. The scope of work is design and conduct experiments, as well as to analyze and interpret data within realistic constrain such as economic, environmental, social, safety and manufacturability. The project work provides plate form for planning, material procurement, preparing specification and execution of work. The project also develop to work on multidisciplinary teams, communicate effectively and Knowledge of contemporary issues.

Course Outcomes:

Upon successful completion of this course the students will be able to:

1. Apply knowledge of mathematics, science, and engineering.
2. Design and conduct experiments, as well as to analyze and interpret data.
3. Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
4. Function on multidisciplinary teams, communicate effectively and Knowledge of contemporary issues.
5. Identify, formulate, and solve engineering problems by understanding professional and ethical responsibility.
6. Understand the impact of engineering solutions in a global, economic, environmental, and societal context.
7. Recognition of the need for, and an ability to engage in life-long and self learning.
8. Use the techniques, skills, modern engineering tools and software necessary for engineering practice.

Project-II

(Lab Course Contents)

Semester-VIII **Examination Scheme:**

Teaching Scheme: **(ICA) Internal Continuous Assessment: 75Marks**

Practical : 2 Hrs/Week **(ESE) End Semester Examination (OR) :75Marks**

1. Project-I work decided in VII semester shall be continued as Project-II
2. Students should complete implementation of ideas given in synopsis/Abstract, so that project work should be completed before end of semester.
3. Project-II may involve fabrication, design , experimentation , data analysis within realistic constraints such as economic, environmental, social, ethical, health and safety, manufacturability, and sustainability. The stage also includes testing , possible results and report writing
4. Each students project group is required to maintain log book for documenting various activities of Project-II and submit group project report at the end of Semester-VIII in the form of Hard bound.
    a. *Title*
    b. *Abstract*
    c. *Introduction*
    d. *Problem identification and project objectives*
    e. *Literature survey*
    f. *Case study/Analysis/Design Methodology*
    g. *Project design and implementation details*
    h. *Result and conclusion*
    i. *Future scope*
    j. *references.*

Guide lines for ICA : ICA shall be based on continuous evaluation of students performance throughout semester in project-II and report submitted by the students project group in the form Hard bound. Assessment of the project-II for award of ICA marks shall be done jointly by the guide and departmental committee as per the guidelines given in **Table-D.**

Guide lines for ESE:-

In ESE the student may be asked for demonstration and questions on Project. Evaluation will be based on answers given by students in oral examination.

Assessment of Project-II

Name of the Project: _____

Name of the Guide: _____

Table-D

		Assessment by Guide (50 Marks)				Assessment by Committee (25 Marks)		
SN	**Name of Student**	**Attendance , Participa-tion and team work**	**Material procurement/ assembling/Designing/Programming**	**Case study/ Execution**	**Project Report**	**Dept of Understan-ding**	**Presentation**	**Total**
Marks		**10**	**15**	**15**	**10**	**10**	**15**	**75**