ELECTRICAL ENGINEERING

6TH SEMESTER

THEORY-1

ENTREPRENEURESHIP & INDUSTRIAL MANAGEMENT

(Common to Mechanical, ETC Engg. Branch)

TEACHING & EVALUATION SCHEME (2010 - 2011)

DISCIPLINE: ELECTRICAL ENGINEERING					SEMESTER: SIXTH					
SL. NO	Subject	Teaching Scheme			Evaluation Scheme					Total Marks
					Theory			Practical		
						Internal Assesment				
	Theory	L	T	P	End Exam	Class Test	Assignment	End Exam	Sessional	
Th-1	Enterprenurship & Industrial Mgmt.	4	0	0	80	15	5			100
Th-2	Switch Gear & Protective Devices	4	1	0	80	15	5			100
Th-3	Utilization of Electrical Energy & Traction	4	1	0	80	15	5			100
Th-4	Electrical Installation & Estimating	5	1	0	80	15	5			100
Th-5	**Elective**	4	1	0	80	15	5			100
a	Microcontroller & Plc									
b	Control System Engineering									
c	Power system operation									
d	HVDC transmission & distribution									
	Practical									
Pr-1	Electrical Works Practice			6				50	50	100
Pr-2	Project & Seminar			8				100	50	150
Grand Total		**21**	**4**	**14**						**750**

ELECTRICAL ENGINEERING

6TH SEMESTER

THEORY-2

3. SWITCH GEAR AND PROTECTIVE DEVICES

Total Period – 75
Theory : 4p/w
Tutorial : 1p/week

Examination : 3 Hours
Total Marks : 100
Theory – 80, I.A : 15 + 5

A. RATIONALE :

Switch gear and protection plays an important role in the protection of electrical power system. Since the demand of electrical power is increasing the job of generation, transmission & distribution of electrical energy is becoming very completed. To maintain the energy supply to the consumer switching producer with protection are to be maintained moreover new models of switch gear and protection circuits are also being developed. The use of interconnection bus with National power grid type of switch

gear and protecting devices need to be trained in proper manners. In the subject information on above context have been included so that the updated knowledge can be given to the students of Diploma in Electrical Engineering.

B. OBJECTIVES :

To acquire the knowledge of :

a) The basic principles of protection of alternator transformer and feeders.
b) Fuse and Circuit breaker.
c) Protective Relay.
d) Lighting Arrestor.
e) Calculation of symmetrical fault current.

TOPIC WISE DISTRIBUTION OF PERIODS

Sl. No.	Topics	Periods
1.	Faults in power system	13
2.	Fuses	05
3.	Circuit Breaker	15
4.	Protective system	12
5.	Lighting Arrestors & Surge Divertors	08
6.	Introduction to static relay	07
	Total	**60**

COURSE CONTENT OF TERMS OF SPECIFIC OBJECTIVES

1. INTRODUCTION TO SWITCHGEAR

1.1 Essential Features of switchgear.
1.2 Switchgear Equipment.
1.3 Bus-Bar Arrangement.
1.4 Switchgear Accommodation.
1.5 Short Circuit.
1.6 Short circuit.
1.7 Faults in a power system.

2. FAULT CALCULATION

2.1 Symmetrical faults on 3-phase system.
2.2 Limitation of fault current.
2.3 Percentage Reactance.
2.4 Percentage Reactance and Base KVA.
2.5 Short – circuit KVA.
2.6 Reactor control of short circuit currents.
2.7 Location of reactors.
2.8 Steps for symmetrical Fault calculations.
2.9 Solve numerical problems on symmetrical fault.

3. FUSES

3.1 Desirable characteristics of fuse element.
3.2 Fuse Element materials.
3.3 Types of Fuses and important terms used for fuses.
3.4 Low and High voltage fuses.
3.5 Current carrying capacity of fuse element.
3.6 Difference Between a Fuse and Circuit Breaker.

4. CIRCUIT BREAKERS

4.1 Definition and principle of Circuit Breaker.
4.2 Arc phenomenon and principle of Arc Extinction.
4.3 Methods of Arc Extinction.
4.4 Definitions of Arc voltage, Re-striking voltage and Recovery voltage.
4.5 Classification of circuit Breakers.
4.6 Oil circuit Breaker and its classification.
4.7 Plain brake oil circuit breaker.
4.8 Arc control oil circuit breaker.
4.9 Low oil circuit breaker.
4.10 Maintenance of oil circuit breaker.
4.11 Air-Blast circuit breaker and its classification.
4.12 Sulphur Hexa fluoride (SF6) circuit breaker.
4.13 Vacuum circuit breakers.
4.14 Switchgear component.
4.15 Problems of circuit interruption.
4.16 Resistance switching.
4.17 Circuit Breaker Rating.

5. PROTECTIVE RELAYS

5.1 Definition of Protective Relay.
5.2 Fundamental requirement of protective relay.
5.3 Basic Relay operation
  a) Electromagnetic Attraction type
  b) Induction type
5.4 Definition of following important terms
5.5 Definition of following important terms.
  a) Pick-up current.
  b) Current setting.
  c) Play setting Multiplier.
  d) Time setting Multiplier.
5.6 Classification of functional relays
5.7 Induction type over current relay (Non-directional)
5.8 Induction type directional power relay.
5.9 Induction type directional over current relay.
5.10 Differential relay
  a) Current differential relay
  b) Voltage balance differential relay.
5.11 Types of protection

6. PROTECTION OF ELECTRICAL POWER EQUIPMENT AND LINES

6.1 Protection of alternator.
6.2 Differential protection of alternators.
6.3 Balanced earth fault protection.
6.4 Protection systems for transformer.
6.5 Buchholz relay.
6.6 Protection of Bus bar.
6.7 Protection of Transmission line.
6.8 Different pilot wire protection (Merz-price voltage Balance system)
6.9 Explain protection of feeder by over current and earth fault relay.

7. PROTECTION AGAINST OVER VOLTAGE AND LIGHTING

7.1 Voltage surge and causes of over voltage.
7.2 Internal cause of over voltage.
7.3 External cause of over voltage (lighting)
7.4 Mechanism of lightning discharge.
7.5 Types of lightning strokes.
7.6 Harmful effect of lightning.
7.7 Lightning arresters.
7.8 Type of lightning Arrestors.
a) Rod-gap lightning arrester.
b) Horn-gap arrester.
c) Volve type arrestor.
7.9 Surge Absorber

8. STATIC RELAY

8.1 Advantage of static relay.
8.2 Instantaneous over current relay.
8.3 Principle of IDMT relay.

TEXT BOOK

1. Principle of power system - by V. K. Mehta

REFERENCE BOOKS

1. Electrical power - by Soni, Gupta and Bhatnagar.
2. Power system protection & switch gear – by Bhuvanesh Oza (TMH)
3. Electrical Power – by S. L. Upal

N. B. : After completion of each topic the students are required to submit assignment on concepts and applications. It is also required to solve mathematical problems as and when applicable.

ELECTRICAL ENGINEERING

6^{TH} SEMESTER

THEORY-3

4. UTILIZATION OF ELECTRICAL ENERGY AND TRACTION

Total Period – 75
Theory : 4p/week
Tutorial : 1p/week

Examination : 3 Hours
Total Marks : 100
Theory – 80, I.A : 15 + 5

A.RATIONALE :

There is great demand for utilization of electrical power in various fields in the form of power for electrolysis and illumination, electrical heating, electrical welding, electrical traction and for electrical drives. Hence these aspects are taken care of in the subject of utilization of electrical energy and traction to give exposure of the student in the senior 6^{th} Semester level.

B. OBJECTIVES :

1. To acquire knowledge of principle of ionic dissociation and electrolysis and loss involving in the process, usage of this process.
2. To compare the advantages of the electrical heating over others and to acquire knowledge of types of electrical heating as employed in the electrical overn induction furnaces and arc furnaces and dielectrical ovens.
3. To acquire knowledge of principle of arc welding and resistant welding, their types and single and multi operator type are welding plants.
4. To define various terms used in illumination engineering to design lighting schemes with specific attention to laws of illumination to explain the working and construction and use of flour sent lamp, SV lamp, H.P. MV and Neon lamps.
5. To classify various types of industrial drives and to choose the right type of drive considering their starting and running characteristics.
6. To classify various methods of traction and traction motor and type of control and types of breaking.

C. TOPIC WISE DISTRIBUTION OF PERIODS

Sl. No.	Topics	Periods
1.	Electrical Process	08
2.	Electrical Heating	08
3.	Principles of Arc Welding	08
4.	Illumination	12
5.	Industrial Derives	10
6.	Electric Traction	14
	Total	**60**

D. COURSE CONTENT OF TERMS OF SPECIFIC OBJECTIVES.

1. ELECTROLYTIC PROCESS

1.1 Definition and Basic principle of Electro Deposition.
1.2 Important terms regarding electrolysis.
1.3 Faradays Laws of Electrolysis.
1.4 Definitions of current efficiency, Energy efficiency.
1.5 Principle of Electro Deposition.
1.6 Factors affecting the amount of Electro Deposition.
1.7 Factors governing the setter electro deposition.
1.8 State simple example of extraction of medals.
1.9 Application of Electrolysis.

2. ELECTRICAL HEATING

2.1 State advantage of electrical heating.
2.2 Explain mode of heat transfer and Stephen's Law.
2.3 Discuss Resistance heating.
   a) Direct Resistance heating
   b) In-Direct Resistance heating.
2.4 Explain principle of Resistance furnace.
2.5 Explain principle of Direct arc furnace and Indirect arc furnace.
2.6 Principle of Induction heating.
2.7 Principle of direct core type, vertical core type and Indirect core type Induction furnace.
2.8 Principle of coreless induction furnace and skin effect.

2.9 Principle of dielectric heating and its application principle of microware heating and its application.

2.10 Principle of Microwave heating and its application.

3. PRINCIPLES OF ARC WELDING

3.1 Explain principle of arc welding.

3.2 Explain D. C. & A. C. phenomena

3.3 Explain study of D.C. & A. C. are welding plants of single and multi-operation type.

3.4 Explain types of are welding.

3.5 Explain principles of resistance welding.

3.6 Explain Descriptive study of resistance welding plant.

4. ILLUMINATION

4.1 Nature of Radiation and its spectrum.

4.2 Terms used in Illuminations.

a) Luminous intensity
b) Lumen
c) Intensity of illumination
d) MMCP
e) MSCP
f) MHSCP
g) Brightness
h) Solid angle
i) Luminous efficiency

4.3 Explain the inverse square law and the cosine law.

4.4 Explain polar curves

4.5 Describe light distribution and control and related definitions like maintenance factor and depreciation factors.

4.6 Design simple lighting schemes and depreciation factor.

4.7 Explain Filament lamps, effect of variation of voltage on working of filament lamps.

4.8 Explain Discharge lamps.

4.8.1 State Basic idea about excitation in gas discharge lamps.

4.8.2 State constructional factures and operation of :- Fluorescent lamp. (PL and PLL Lams)

4.8.3 Sodium vapour lamps.

4.8.4 High presser mercury vapour lamps.

4.8.5 Neon signs.

4.8.6 High lumen output & low consumption fluorescent lamps.

5.INDURESTIAL DRIVES

5.1 Stage group and individual drive.

5.2 Explain choice of electric drives.

5.3 Explain starting and running characteristics of DC and AC motor.

5.4 State Application of :

DC motor

3 phase induction motor

3 phase synchronous motors.

Single phase induction, series and repulsion motor industry.

6. ELECTRIC TRACTION

6.1 Explain system of traction.

6.2 Explain DC and AC traction motor.

6.3 Explain single phase motor for traction.

6.4 Explain control of motor

6.4.1 Tapped field control
6.4.2 Metadyne control
6.4.3 Rheostatic control 11

6.5 Explain Braking of the following types.
6.5.1 Regenerative Braking
6.5.2 Braking with 1-phase series motor
6.5.3 Magnetic Braking

TEXT BOOKS

1. Utilization of Electrical Energy by Traction by G. C. Garg (Khana).

REFERENCE BOOKS

1 A course of electric power by Soni, Gupta & Bhatnagar
2 Utilization of Electrical Energy by E. I. Taylor

N. B. : After completion of each topic the students are required to submit assignment on concepts and applications. It is also required to solve mathematical problems as and when applicable.

ELECTRICAL ENGINEERING

6th SEMESTER

THEORY-4

2. ELECTRICAL INSTALLATION AND ESTIMATING

Total Period – 90
Theory : 5p/week
Tutorial : 1p/week

Examination : 3 Hours
Total Marks : 100
Theory – 80, I.A : 15 + 5

A.RATIONALE :

In the power transmission and distribution sectors, before taking a project an estimate of material is required in various stages like i) transmission line construction ii) distribution line construction iii) erection of domestic installation iv) service connection to industrial installation.

A calculation of number of different materials in the form of an estimate is prepared by the technician. Hence this subject Electrical installation and Estimating introduced in the final semester.

B. OBJECTIVES :

1. To write down detailed specification and numbers required of different materials.
2. To determine the size and material of conductor and cable from electrical and mechanical consideration. As such to prepare a detailed list of materials with complete specifications.

C. TOPIC WISE DISTRIBUTION OF PERIODS

Sl. No.	Topic	Periods
1.	Internal wiring	08
2.	IE rules and standards	06
3.	Estimate of material for domestic wiring	07
4.	Estimate of material for workshop wiring	07
5.	Estimate of material for single phase service connection	08
6.	Estimate of material for service connection to factory	08
7.	Estimate of materials for L. T. Distribution	09
8.	Estimate of materials for H. T. Distribution	11
9.	Material estimate for substation	11
	Total	**75**

D. COURSE CONTENT : - (IN TERMS OF SPECIFIC OBJECTIVES)

1. INDIAN ELECTRICITY RULES

1.1 Definitions, Ampere, Apparatus, Accessible, Bare, cablew, circuit, circuit breaker, conductor voltage (low, medium, high, EH), live, dead, cut-out, conduit, system, danger, Installation, earthing system, span, volt, switch gear, etc.

1.2 General safety precautions, rule 29, 30, 31, 32, 33, 34, 35, 36, 40, 41, 43, 44, 45, 46.

1.3 General conditions relating to supply and use of energy : rule 47, 48, 49, 50, 51, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 70.

1.4 OH lines : Rule 74, 75, 76, 77, 78, 79, 80, 86, 87, 88, 89, 90, 91

2. ELECTRICAL INSTALLATIONS

2.1 Electrical installations, domestics, industrial, Wiring System, Internal distribution of Electrical Energy. Methods of wiring, systems of wiring, wire and cable, conductor materials used in cables, insulating materials mechanical protection. Types of cables used in internal wiring, multi-stranded cables, voltage grinding of cables, general specifications of cables.

2.2 ACCESSORIES : Main switch and distribution boards, conduits, conduit accessories and fittings, lighting accessories and fittings, fuses, important definitions, determination of size of fuse – wire, fuse units. Earthing conductor, earthing, IS specifications regarding earthing of electrical installations, points to be earthed. Determination of size of earth wire and earth plate for domestic and industrial installations. Material required for GI pipe earthing.

2.3 LIGHTING SCHEME : Aspects of good lighting services. Types of lighting schemes, design of lighting schemes, factory lighting, public lighting installations, street lighting, general rules for wiring, determination of number of points (light, fan, socket, outlets), determination of total load, determination of Number of sub-circuits.

3. INTERNAL WIRING

3.1 Type of internal wiring, cleat wiring, CTS wiring, wooden casing capping, metal sheathed wiring, conduit wiring, their advantage and disadvantages comparison and applications.

3.2 Prepare one estimate of materials required for CTS wiring for small domestic installation of one room and one verandah within 25 m^2 with given light, fan & plug points.

3.3 Prepare one estimate of materials required for conduit wiring for small domestic installation of one room and one verandha within 25 m^2 with given light, fan & plug points.

3.4 Prepare one estimate of materials required for concealed wiring for domestic installation of two rooms and one latrine, bath, kitchen & verandah within 80m^2 with given light, fan & plug points.

3.5 Prepare one estimate of materials required for erection of conduct wiring to a small workshop installation about 30m^2 and load within 10 KW.

4. OVER HEAD INSTALLATION

4.1 Main components of overhead lines, line supports, factors Governing Height of pole, conductor materials, determination of size of conductor for overhead transmission line, cross arms, pole brackets and clamps, guys and stays, conductors configurations, spacing and clearances, span lengths, overhead line insulators, types of insulators, lighting arresters, danger plates, anti-climbing devices, bird guards, beads of jumpers, jumpers, tee-offs, guarding of overhead lines.

4.2 Prepare an estimate of materials required for LT distribution line within load of 100 KW maximum and standard spans involving calculation of the size of conductor (from conductor chart), current carrying capacity and voltage regulation consideration using ACSR.

4.3. Prepare an estimate of materials required for LT distribution line within load of 100 KW maximum and standard spans involving calculation of the size of conductor (from conductor chart), current carrying capacity and voltage regulation consideration using ACSR.

4.4 Prepare an estimate of materials required for HT distribution line (11 KV) within 2 km and load of 2000 KVA maximum and standard spans involving calculation of the size of conductor (from conductor chart), current carrying capacity and voltage regulation of the size of conductor (from conductor chart), current carrying capacity and voltage regulation consideration using ACSR.

5. OVER HEAD SERVICE LINES

5.1 Components of service lines, service line (cables and conductors), bearer wire, lacing rod. Ariel fuse, service support, energy box and meters etc.

5.2 Prepare and estimate for providing single phase supply of load of 5 KW (light, fan, socket) to a single stored residential building.

5.3 Prepare and estimate for providing single phase supply load of 3KW to each floor of a double stored building having separate energy meter.

5.4 Prepare one estimate of materials required for service connection to a factory building with load within 15 KW using insulated wire.

5.5 Prepare one estimate of materials required for service connection to a factory building with load within 15 KW using bare conductor and insulated wire combined.

6. ESTIMATING FOR DISTRIBUTION SUBSTATIONS

6.1 Prepare one materials estimate for following types of transformer substations.

a) Pole mounted substation

b) Plinth Mounted substation.

TEXT BOOK :

1. Electrical Insulation and Estimating – by Surjit Singh (Dhanpat)

N. B. : After completion of each topic the students are required to submit assignment on concepts and applications. It is also required to solve mathematical problems as and when applicable.

ELECTRICAL ENGINEERING

6TH SEMESTER

THEORY- 5 (ELECTIVE)

MICRO CONTROLLER & PLC – ELECTIVE (a)

Total-75period	Examination – 3 Hours
Theory – 4p/week	Total Marks-100
Tutorial – 1p/week	Theory – 80 marks, IA-15+5

A.RATIONAL

The microprocessor has been with us for some Twenty Five years but it has limited applications, more complicated hardware, limited use with computer and more cost resulted in failure in market on other hand micro controller which is a true computer on a chip more simple in hardware, millions of application more general purpose device and capable of having several different functions depending on the wishes of the programme. So now a day, use of micro controller is increasing in industries and therefore, it is necessary for the students to study this course.

B. OBJECTIVES

After studying this subject, student will able to

- Study design and maintain the micro controller circuits
- Programme for micro controllers for different operations and applications in industries.
- Develop different use of micro controller.
- Acquire knowledge about various components of PLC.
- Acquire knowledge about programming of PLC.

C. TOPIC WISE DISTRIBUTION OF PERIOD

Sl. No.	Topic	Periods
1.	Introduction to microcontroller and micro processor	4
2.	Intel 8051 microcontroller.	5
3.	Instructions and programming	10

4.	8051 Interrupts and serial communication	6
5.	ATMAL micro controller	5
6.	Application of MCS-51 & ATMEL -8951	6
7.	PIC micro controller	6
8.	Programmable Logic Controller	9
9.	PLC programming	9
	Total	**60**

D. COURS CONTENTS IN TERMS OF SPECIFIC OBJECTIVE

1. **INTRODUCTION TO MICRO CONTROLLERS AND MICROPROCESSORS**
   - 1.1 Conception of microcontroller and microprocessor.
   - 1.2 History of Microcontroller.
   - 1.3 Embedded vers external memory devices.
   - 1.4 8 bit and 16 bit microcontroller.
   - 1.5 CISC and R.I & C processor.
   - 1.6 Harvard and Vonneumann Architecture.
   - 1.7 MSC-51 and 89Cxx51 microcontrollers.
   - 1.8 PIC microcontrollers.

2. **8051 MICRO CONTROLLER**
   - 2.1 MCS-51 Architecture with description of each block.
   - 2.2 Registors in MCS-51
   - 2.3 MCS-51 pin description and connections.
   - 2.4 MCS-51 parallel port and memory organisation
3. **INSTRUCTIONS AND PROGRAMMING**
   - 3.1 MCS-51 Instructions or set and its grouping.
   - 3.2 MCS-51-addressing modes.
   - 3.3 Simple programming examples using different branch instructions.
   - 3.4 Programme with Branching Instructions.
   - 3.5 Programme using stack printer.
   - 3.6 Programming tools
4. **MCS-51 INTERRUPT, TIMER/COUNTER AND SERIAL COMMUNICATION.**
   - 4.1 Interrupts.
   - 4.2 Timer and counter.
   - 4.3 Serial communication.
5. **ATMEL MICROCONTROLLER**
   - 5.1 Architecture of TMEL 89C51 and 89 C 2051.
   - 5.2 Pin description of 89C51 and 89C2051.
   - 5.3 Use of flash memory.
   - 5.4 Power saving option.
6. **APPLICATION OF MCS-51, ATMEL-89051 AND 89C2051**
   - 6.1 Square wave generator.
   - 6.2 Pulse generation and pulse width modulation.
   - 6.3 Sinc wave generator.

6.4 Frequency counter.

7. PIC MICROCONTROLLERS

7.1 PIC 166X/7X architecture.
7.2 Pin configuration and description of 16C6X/7x
7.3 PIC Reset action.
7.4 PIC memory organization.
7.5 PIC Addressing mode and 1/10 port.
7.6 PIC Timer.

8. PROGRAMMABLE LOGIC CONTROLLER

8.1 Introduction, Definition and advantage.

8.2 Parts of PLC.

8.3 Principle of operation and modifying it.

8.4 Comparision between PLC and computer.

8.5 PIC size and application.

8.6 PIC I/O section and discrete I/O mode.

8.7 Special I/O module and I/O specification.

8.8 PIC CPU.

8.9 PIC memory organization and types.

8.10 Programming device.

8.11 PLC programming.

9. PLC PROGRAMMING

9.1 Hardwired Device Verses programmed logic.

9.2 PIC programming language.

9.3 Instruction addressing.

9.4 Branch Instruction.

9.5 Internal Relay Instruction.

9.6 Entering the ladder diagram.

9.7 Modes of operation.

9.8 Lacking Relay design to control the level of water in storage tank.

TEXT BOOKS

1. Microcontroller, Theory and Application – by Ajaya V. Deshmukh (TMH)
2. Programmable logic controllers – by Frank. D. Petruzella (TMH)

REFERENCE BOOK

1. The 8051 Microcontroller Architecture, Programming and Application – by K. J. Ayala

ELECTRICAL ENGINEERING

6TH SEMESTER

THEORY

CONTROL SYSTEMS ENGINEERING - (ELECTIVE) (b)

Total Period – 75
Theory – 4p/week
Tutorial – 1p/week

Examination : 3 Hours
Total Marks : 100
Theory – 80, I.A : 15 + 5

A. RATIONALE :

Automatic control has played a vital role in the advance of Engineering and Science. It has become an important and integral part of modern manufacturing and industrial process. So knowledge of automatic control system is very essential on the part of a Engineer. Basic approach to the automatic control system has been given in the subjects so that students can enhance their knowledge in their future professional carrier.

B. OBJECTIVE :

- To aquare knowledge about time response analysis of control system.
- To be able to timdout steady state error and error constants.
- To aquare knowledge about the analysis of stability in Root locus technique.
- To learn about frequency response analysis of control system.
- To be able to use Bode plot and Niquit plot.

C. TOPICS WISE DISTRIBUTIONN OF PERIODS

SL. No.	Topics	Periods
1.	Single flow graph	10
2.	Time response of system	15
3.	Analysis of stability	12
4.	Frequency response of system	15

5.	Niquiest	8
	Total	**60**

D. COURSE CONTENTS IN TERMS OF SPECIFIC OBJECTIVES

1. SIGNAL FLOOR GRAPH.

1.1 Review of block diagrams and transfer functions of feedback.

1.2 Construction of signal flow graph.

1.3 Basic properties of signal flow graph.

1.4 Signal flow graph algebra.

1.5 Construction of signal flow graph for central system.

2. TIME RESPONSE OF SYSTEM.

2.1 Time response of control system.

2.2 Standard Test signal.

a) Step signal, b) Ramp Signal

c) Parabolic Signal d) Impulse Signal

2.3 Time Response of first order system with –

a) Unit step response

b) Unit impulse response.

2.4 Time response of second order system to the to unit step response.

2.5 Time response specification.

2.6 Derivation of expression for rise time, peak time, peak overshoot, settling time and steady state error.

2.7 Steady state error and error constants.

2.8 Types of control system.

2.9 Effect of adding poles and zero to transfer function.

2.10 Response with P, PI, PD and PID controller.

3. ANALYSIS OF STABILITY BY ROOT LOCUS TECHNIQUE.

3.1 Rout locus concept.

3.2 Construction of root locus.

3.3 Rules for construction of the root locus.

3.4 Effect of adding poles and zeros.

4. FREQUENCY RESPONSE ANALYSIS.

4.1 Correlation between time response and frequency response.

4.2 Polar plots.

4.3 Bode plots.

4.4 All pass and minimum phase system.

4.5 Computation of Gain margin and phase margin.

4.6 Log magnitude versus phase plot.

4.7 Closed loop frequency response.

5. NIQUIST PLOT

5.1 Principle of argument.

5.2 Niquist stability criterion.

5.3 Niquist stability criterion applied to inverse polar plot.

5.4 Effect of addition of poles and zeros to G(S) H(S) on the shape of Niquist plot.
5.5 Assessment of relative stability.
5.6 Constant M and N circle Nicholas chart.

TEXT BOOK

i) Control System – by A. Ananda Kumar (PHI)

REFERENCE BOOKS

i) Control system Engineering – by I. J. Nagarath and M. Gopal (WEN)
ii) Control system of Engineering – by Ramesh Babu (Scientific)

ELECTRICAL ENGINEERING

6^{TH} SEMESTER

THEORY-5

1. ELECTIVE

POWER SYSTEM OPERATION (c)

Total Period – 75
Theory : 4p/week
Tutorial : 1p/week

Examination : 3 Hours
Total Marks : 100
Theory – 80, I.A : 15 + 5

A. COURSE CONTENT

1. SOURCES OF ELECTRICAL ENERGY

1.1 Explain importation of electric power plant.
1.2 State and explain source of electrical energy.
1.3 Explain conventional and non-conventional method of electric power generation.
1.4 Given block diagram of hydro electric thermal and nuclear power plant.

2. RENEWABLE ENERGY

Explain with block diagram.
2.1 Solar Generation.
2.2 Tidal Generation.
2.3 Wind power Generation.
2.4 Geothermal power Generation.

3. ECONOMICAL LOADING AND ECONOMIC ASPECTS

3.1 Explain factors governing plant location.
3.2 Explain selection of site.
3.3 No of units load, curves.
3.4 Economic loading of the plant.
3.5 Capacity scheduling inter connection of power system and load division.
3.6 Cost generation of electrical energy.

4. MAJOR EQUIPMENTS

4.1 Show and explain Arrangement of Generators and Bus Bars.
4.2 Show Panel equipments

4.3 Control Panel equipments
4.4 Electrical and Mechanical measuring devices.
4.5 Repair and maintenance scheme in the plant.
4.6 Necessity of store and spare.

5. SUB-STATION PROTECTIVE EQUIPMENTS

5.1 Explain Necessity and arrangement of protective devices.
5.2 Explain protective devices for.
- 5.2.1 Alternator
- 5.2.2 High voltage transformer.
- 5.2.3 Bus Bar.

5.3 Explain Reactors with location and use.
5.4 Explain protective devices for transmission lines.

6. SUB-STATION

State & Explain
6.1 Classification & Choice
6.2 Advantages of cut door-substation.
6.3 Bus bar arrangements of high voltages and low voltage side.
6.4 Control panel equipments.
6.5 Commissioning testing.

7. POLLUTION IN THE POWER PLANT

7.1 Sources of pollution.
7.2 Process control for water. Air, Solid Waste.
7.3 Methods adopted for minimizing pollution.

8. VOLTAGE CONTROL

8.1 Explain method of voltage control by reactive power sharing.

TEXT BOOKS

1. Power – by P. C. Sharma
2. Electrical Power - by S. L. Uppal
3. Electrical power system and design - by M. V. Deshpande
4. Testing maintenance and repair of electrical machine and equipment by Jaggi.

N. B. : After completion of each topic the students are required to submit assignment on concepts and applications. It is also required to solve mathematical problems as and when applicable.

ELECTRICAL ENGINEERING

6TH SEMESTER

THEORY-5

1. ELECTIVE

HVDC TRANSMISSION AND DISTRIBUTION-ELECTIVE (d)

Total Period – 75
Theory : 4p/week
Practical : 1p/week

Examination : 3 Hours
Total Marks : 100
Theory – 80, I.A : 15 + 5

A. COURSE CONTENT

1. General Background

Energy transmission. Hierachical AC Transmission voltages levels. Tasks, choice, applications, EHV-AC transmission. Configuration of reactive power, HVDC systems. Applications, configuration, Equipment in HVDC substations, HVDC Cable transmission. Interconnected AC networks. Voltage control and frequency control. Power flow in AC line and in HVDC line. AC and HVDC Interconnections. EHV – AC versus HVDC. Economic comparision. Prospects of HVDC. Transmission planning. Communication in Transmission Network. Scope of subject. Summery and questions.

HVDC Transmission

2. HVDC Power Flow

Subscripts and symbols. Thyrister principle and control. Power conversion principle. Direct Voltage Ud-1 and Ud-2. Power at Rectifier-end pd-1. Power at Inverter-end PD-2. Power loss in DC system. Power in middle of HVDC line. Power at sending end. Power at receiving end. General equations. Solved Numberical Examples on pd and ud. Summery and questions.

3. Steady State ud/Id Characteristic.

Functional Requirements. AC Questions. Steady state Uu/Id characteristics. Principle of Stable Operation. Intersection of rectifier and Inverter characteristics. Margin control. Setting of Rectifier control and inverter control. Reversal of HVDC Power flow. Operating modes of Bipolar 2T HVDC system. Starting and stopping of HVDC Power flow. Summary.

4. Converter Connections, Rectifier and Inverter Waveforms Rectifier Bridge Connections, and waveforms on AC and DC side six pulse Bridge (Graetz Bridge.) 12-pluse Bridge. Phase control and delay Angle. Effect of phase control on DC voltage.
Valve voltage. Inversion. Connections of converter bridge. Communicating Reactance. Angle of Overlap Extinction Angle. Control of DC voltage. Configuration of Bipolar 2T HVDC system, valves and converters.

5. Equations of voltage and current on AC and DC side. Assumptions Average and RMS value. Symbols, Rectifier No load Voltage Equation with Zero delay Angle and with delay angle. Control DC voltage. Voltage equation for S-unit Converter. Rectifier voltage. With £ and u. Current on Primary and secondary sides. Fundamental component of current. Rating of converter transformer. Equivalent circuit of Rectifier. Characteristics of rectifier. Equation of Inverter Equivalent circuit of inverter. Complete Equivalent circuit of HVDC system. Terms and definitions. Rectifier and inverter Equations. Minimum extinction angle. Practical Significance of equations summery and questions.

6. Fundamental of Harmonics and Network Harmonic Impedance.

Fourier Analysis. Characteristics, Terms and definitions. Fourier series. Characteristics AC current Harmonics. Non characteristics AC current Harmonics. Harmful effects. Interaction with AC Network, Adequateness of AC Harmonic Filters, summery and questions.

7. Harmonic Filters.
Terms and definitions. Filter. Surge Suppressors, Damping circuits. Resonance. Quality Factor. Band width. Shunt filters. Series of Single frequency tuned filters. Double Frequency Tuned Filters. Cost considerations of AC Harmonic Filters. Rating of AC Capacitors in Tuned Branch. Harmonics in DC voltage. DC Harmonics Filters. Summery and questions.

8. Reactive power Compensation in HVDC Substations.
Reactive power requirements of HVDC Converters, P.Q.S, Reactive power Q required by converter, and HVDc Substation. Reactive power equations. Effect of delay angle and Extinction angle. Short circuit Ratio (SCR). Impedance of AC Network. Equivalent short circuit ratio. SCR in planning of HVDC. Transient voltage rise. Summery and questions.

9. Earth Electrode and Earth Return.
Configuration of terminal station. Lay out of a Bipolar Terminal Station. Concept behind lay out. Choice of converter connections. Valve hall and control building Converter Valves. HVDC yard.

10. Configuration and Layout of HVDC Terminal
Configuration of terminal station. Layout of a Bipolar Terminal Station. Concept behind lay out. Choice of converter connections. Valve hall and control building Converter Valves. HVDC Yard.
Rihand Delhi Bipolar HVD system. Back to back HVDC Coupling station. Summery and questions.

11. HVDC Circuit breaker and Mettalic Return Transfer Breaker and Parallel Tap Circuit breaker.
Application of MRTB and Parallel Tap. Interruption of DC Currents of high switching energy. Commutation principle Commutation circuit. Switching energy Main circuit Breaker. Mettalic Return Transfer Breaker. (MRTB). Types of HVDC Circuit Breakers. A, B. Capability and characteristic of HVDC Breaker. Switching Times Short circuit Ratio. Effective short circuit ratio. Parallel tapping of HVDC line. Summary and Questions.

ELECTRICAL ENGINEERING

6TH SEMESTER

PRACTICAL-1

6. ELCTRICAL WORKSHOP PRACTICE

Total Period – 90
Practical : 6p/week

Examination : 4 Hours
Total Marks : 100
Practical – 50,
Sessional : 50

1. Preparation of pips Earthing installation for residential building.
2. Preparation of Britannia T-joint and Married joint.
3. Connection and Testing of fluorescent lamp, high pressure M.V. Lamp, sodium vapour lamp, metal halide lamps, CFI and latest developed lamps – measure inductance of each choke.
4. Prepare battery charger.
5. Residential building wiring practice for CTS and conduit wiring and testing.
6. Fault finding & repairing of fan motor.
7. Fault finding & repairing of D.C. Generator.
8. Battery charging and test the voltage and specific gravity.
9. Construction of a fan speed regulator using TRIAC.
10. Fault finding of D. C. motor starter and A.C. Motor Starter.
11. Power cable jointing with cable box and joining compounds.
12. Using crimpling tools and sockets for LT & HT Cables.
13. Over hauling of single phase induction motor.
14. Overhauling of 3 phase induction motor.
15. Overhauling of single phase/3 phase variac.
16. Overhauling of D.C Shunt motor.

ELECTRICAL ENGINEERING

6TH SEMESTER

PRACTICAL-2

PROJECT WORK & SEMINAR

Total Period – 120
Practical – 8p/week

Total Marks : 150
End Exam. – 100,
Sessional : 50

A. PERSONALE

The project work is to integrate the knowledge, skill and attitudes developed after completion of the subjects for developing competency in a particular specialized job. In this activity the role of teacher is a facilitator co-ordinator. The students will select a topic, perform design work, place the indents and get the raw materials either from the department or from the local market and implement the design. The leadership quality. Coordination of job and maintaining a good communal harmony is important factor of this type of activity. It is the process, which is to be evaluated along with students knowledge and their dedication. The success of the project is no doubt the goal but the group activity will also be critically evaluated.

B. OBJECTIVES

On completion of the project work the students will able to

1. Select a suitable topic.
2. Designing of the job.
3. Scheduling the job.
4. Indenting.
5. Procuring of materials.
6. Developing leadership quality.
7. Developing cost awareness.
8. Effective utilization of time.
9. Develop marketing strategies.

C. COURSE CONTENT (in terms of specific objective)

TOPIC – 1 MINOR PROJECT (Group of 8 to 10 students)

Suggested list of projects

Some Fabrication of small equipment / machines / circuits

1. Fabrication of a Tube light Choke.
2. Assembly of small electronic circuits.

3. Assembly of an experimental boards.
4. Rewinding of no-volt coil.
5. Construction battery charger.
6. Construction of automatic water level controller.
7. Preparation of useful charts for Laboratory.

TOPIC-2 – MAJOR PROJECT (Group of 8 to 10 students)

Suggested major project

1. Designing and winding of single phase transformer (up to 1KVA)
2. Rewinding of 3 phase induction motor (3-HP)
3. Rewinding of single phase capacitor motor.
4. Fabrication semi automatic star-delta starter.
5. Assembling of single phase voltage stabilizer (1 KVA)
6. Assembling of desert cooler.
7. Assembling of electronic speed controller of D.C Shunt motor.
8. Prepare wiring layout of Polytechnic building.
9. Preparation of layout of Hydro electric power plant on acrylic sheet.
10. Preparation of layout of Thermal Power plant on a acrylic sheet.

NOTE :

A group of 8 to 10 students have to perform any one exercise and prepare its report. In the project work there are Two main topics. In topic No. 1 one minor project is to be prepared. In topic no.2 one major project is to be prepared and Project report should be in details, which includes list of components used, testing of component, fabrication and work distribution, testing and fault finding, drawing of circuit diagram and costing etc.

SEMINAR :

Project report should be defended in the classroom in the presence of at least two Experts (better to be one from industries) and Questions and doubts from the students as well as from experts should also be invited.