Foreword

Technical Teachers' Training Institute (ER), Calcutta has been awarded Academic Consultancy by the Govt. of Mizoram for the 3rd phase of World Bank Project For Quality improvement or Polytechnic Education system in the State.

The quality improvement of the system largely depends on the quality of curriculum and its implementation. It's a common experience that even the best-designed curriculum could not yield desired result due lo lack of proper implementation. Again an excellent curriculum, designed at a particular lime becomes obsolete after laps of a period depending on the life-span of the technology. Periodic revision of curriculum, is therefore, an essential condition for dynamically responding to the changing needs of the world of work. The three year diploma curriculum in Civil, Electrical, Mechanical and Electronics & Telecommunication Engineering has been revised with due emphasis on the

- Present needs of the world of work
- Flexibility in the entry and exit from the system and
- Assessment system

A model of Multi-Point Entry and Credit System (MPECS) has been developed to introduce the above flexibility. It will be observed that the entire curriculum has been divided into broad category of courses viz.

- Foundation
- Hard Core
- Soft Core
- Basic Technology
- Applied Technology &
- Elective courses

It is suggested that appropriate resources in terms of faculty, support staff, laboratory and workshop etc. along with appropriate learning resources and evaluation system be developed for implementation of the curriculum.

I sincerely thank Mrs. B. Sangkhumi, Project Director, Govt. of Mizoram, and her faculty members for their active support and contribution in the revision of the curriculum. My special thanks are due to the external experts, and the faculty members and the support staff of TTTI, Calcutta who have contributed in the revision process.

(**Dr. S, K. Bhattacharya**)
Principal

Tables of Contents

MULTI POINT ENTRY AND CREDIT SYSTEM (MPECS)

Category of Courses	Reference to First Digit of Course Code	Credits to be acquired	No. of Courses
Foundation Course	1	22	06
Hard Core Course	2	17	06
Soft Core Course	3	06	02
Basic Technology Course	4	31	09
Applied Technology Course	5	39	12
Elective Course	6	06	02
TOTAL :		**121**	**37**

Scheme of Studies and Evaluation (MPECS)
Diploma in Electrical Engineering

1. FOUNDATION COURSES:

Sl. No	Code	Course	Study Scheme				Evaluation Scheme						Total Marks	Credit
			Pre-requisite	Contact Hour/Week			Theory			Practical				
				L	T	P	End Exam	Internal Assessment		End Exam	Internal Assessment			
								Class Test	Assignment		Sessional	Viva		
1	101	Communication in English-1		2	1	0	70	15	15	0	0	0	100	3
2	102	Communication in English-11	101	2	1	0	70	15	15	0	0	0	100	3
3	103	Applied Mathematics-I		3	0	0	70	15	15	0	0	0	100	3
4	104	Applied Mathematics-II		3	0	0	70	15	15	0	0	0	100	3
5	105	Engineering Science-1		3	0	4	70	15	15	25	25	0	150	5
6	106	Engineering Science-11	105	3	0	4	70	15	15 ,	25	25	0	150	5
TOTAL				**16**	**2**	**8**	**420**	**90**	**90**	**50**	**50**		**700**	**22**

2. HARD CORE COURSES:

Sl. No	Code	Course	Study Scheme				Evaluation Scheme						Total Marks	Credit
			Pre-requisite	Contact Hour/Week			Theory			Practical				
				L	T	P	End Exam	Internal Assessment		End Exam	Internal Assessment			
								Class Test	Assignment		Sessional	Viva		
1	201	Engineering Drawing –I		0	0	6	0	0	0	50	50	0	100	3
2	202	Engineering Drawing –II	201	0	0	6	0	0	0	50	50	0	100	3
3	203	Workshop Practice – I		0	0	4	0	0	0	0	25	25	50	2
4	204	Workshop Practice – II		0	0	4	0	0	0	0	25	25	50	2
5	205	Mechanics Engineering		3	0	0	70	15	15	0	0	0	100	3
6	206	Introduction to Information Technology	203	2	0	3	50	0	0	25	25	0	100	4
TOTAL				**5**	**0**	**23**	**10**	**15**	**15**	**125**	**175**	**50**	**500**	**17**

3. SOFT CORE COURSE : (*Any two to be taken*)

Sl. No.	Code	Course	Study Scheme				Evaluation Scheme						Total Mark	Credit
			Pre-requisite	Contact Hour/Week			Theory			Practical				
				L	T	P	End Exam	Internal Assessment		End Exam	Internal Assessment			
								Class Test	Assignment		Sessional	Viva		
13	301	Engineering Economics & Accountancy		3	0	0	70	15	15	0	0	0	100	3
14	302	Element of Management and Industrial Legislation		3	0	0	70	15	15	0	0	0	100	3
15	303	Entrepreneurship Development		3	0	0	70	15	15	0	0	0	100	3
16	304	Element of Electronics	105,106	3	0	0	70	15	15	0	0	0	100	3
17	305	Materials Science	105,106	3	0	0	70	15	15	0	0	0	100	3
18	306	Environmental Education		3	0	0	70	15	15	0	0	0	100	3
TOTAL				**6**	**0**	**0**	**140**	**30**	**30**	**0**	**0**	**0**	**200**	**6**

4. BASIC TECHNOLOGY COURSES FOR MECHANICAL ENGINEERING:

Sl. No.	Code	Course	Study Scheme				Evaluation Scheme						Total Mark	Credit
			Pre-requisite	Contact Hour/Week			Theory			Practical				
				L	T	P	End Exam	Internal Assessment		End Exam	Internal Assessment			
								Class Test	Assignment		Sessional	Viva		
19	401	Mechanics of materials	205	3		2	70	15	15		25	25	150	4
20	M402	Thermal Engineering	105,106	3	0	0	70	15	15				100	3
21	M403	Fluid Mechanics	205	3	0	2	70	15	15		25	25	150	4
22	M404	Element of Electrical Engineering		3	0	2	70	15	15		25	25	150	4
23	M405	Mechanical Drawing	202	0	0	6				100	50	50	200	3
24	M406	Theory of Machine	205	3	0	0	70	15	15				100	3
25	M407	Workshop Practice –III		0	0	4					100	50	150	2
26	M408	Manufacturing Process – I		3	0	0	70	15	15				100	3
27	M409	Workshop Practice - IV		0	0	4					100	50	150	2
TOTAL				**18**	**0**	**20**							**1250**	**28**

5. APPLIED TECHNOLOGY COURSES FOR MECHANICAL ENGINEERING:

Sl. No.	Code	Course	Study Scheme				Evaluation Scheme						Total Mark	Credit
			Pre-requisite	Contact Hour/Week			Theory			Practical				
				L	T	P	End Exam	Internal Assessment		End Exam	Internal Assessment			
								Class Test	Assignment		Sessional	Viva		
28	M501	Fluid Machines	M403	3	0	2	70	15	15		25	25	150	4
29	M502	Thermal Engineering – II	M402	3	0	0	70	15	15				100	3
30	M503	Manufacturing Process-II		3	0	0	70	15	15				100	3
31	M504	Machine Tools – I	204,205	3	0	0	70	15	15				100	3
32	M505	Machine Design & Drawing	M405	2	0	4	50			100	50		200	4
33	M506	Production Management		3	0	0	70	15	15				100	3
34	M507	Mechanical Measurement	M408	4	0	0	70	15	15				100	4
35	M508	Machine Tools – II	M504	3	0	0	70	15	15				100	3
36	M509	Workshop Practice –V		0	0	4					100	50	150	2
37	M510	Mechanical Estimation	M405	2	0	2	50				50	50	150	3
38	M511	Projects		0	0	6					100	50	150	3
39	M512	Plant Maintenance Engineering		3	0	0	70	15	15				100	3
40	M513	Seminar, Tech. & Industrial Tour		0	0	6					100	50	150	3
TOTAL				**28**	**0**	**26**							**1650**	**41**

6. ELECTIVE COURSES FOR MECHANICAL ENGINEERING (*Any two to be taken)*

Sl. No.	Code	Course	Study Scheme				Evaluation Scheme						Total Mark	Credit
			Pre-requisite	Contact Hour/Week			Theory			Practical				
				L	T	P	End Exam	Internal Assessment		End Exam	Internal Assessment			
								Class Test	Assign ment		Sessio nal	Viva		
41	M601	Foundry Technology	M408	3	0	0	70	15	15				100	3
42	M602	Automobile Engineering	M502	3	0	0	70	15	15				100	3
43	M603	Refrigerator & Air Conditioning	M502	3	0	0	70	15	15				100	3
44	M604	Production Technology	M408, M503	3	0	0	70	15	15				100	3
45	M605	Welding Technology	M408	3	0	0	70	15	15				100	3
Total of Two Courses				**6**	**0**	**0**							**200**	**6**

ELECTRICAL ENGINEERING MATERIAL

L T P Curr. Ref.No.: E- 401
3 0 0
Total Contact hrs.:45 Total marks: 10 Theory
Theory : 45 End Term Exam: 70
Pro requisite: 105, 106
Credit: 3

Rationale: -

The knowledge of Electrical Engineering Material in Electrical Engineering plays an important role. The technicians who will be completing to course under Diploma Engineering Scheme will be entrusted to select the proper materials for the use as conductor, semiconductor and insulator Lot of impregnating and surface treatment materials are also to be used in this area. Moreover resistance materials are also used for different purposes as potential divider, heating and controlling element. This subject provides the necessary information regarding all above materials so that the student can select the suitable materials for the definite purposes. Some provision have been made so that the composition of the material electrical, chemical and mechanical properties are studied so that the student can develop some competencies the real thing for real job. The can also be able to select the substitute of the material whenever it is not in the stock during replacement.

Aim: -

a) To describe the properties of different electrical Engineering Materials
b) To develop the skill for selection of right material for right job
c) To develop the skill for suggesting the substitute of the replacement material when it is not available in ready stock

Detailed Course Content: -

Unit	Topic/Sub Topic	Hours
1.	Materials for Conductors and Resistors	6

1.1 Classify electrical material based on
- 1.1.1 Their properties and applications
- 1.1.2 Their atomic structure

1.2 To describe the properties of
- 1.2.1 Conductors
- 1.2.2 Superconductors

1.3 To state the important Electrical & Mechanical characteristics of
- 1.3.1 good conducting materials
- 1.3.2 commonly used conducting materials e.g. copper. Aluminium, Brass, Bronze, mercury, silver, zinc, lead. Nickel, Tin, Tungsten, Molybdenum, steel, phosphor, Bronze

1.4 State the properties required for
- 1.4.1 Overhead purpose
- 1.4.2 Underground purpose
- 1.4.3 Underground cables
- 1.4.4 Electrical windings
- 1.4.5 Carbon brushes

1.5 Describe the application and properties of important resistance materials like Tungsten, Carbon, Nichrome manganin. Eureka, Platinum

2.1 To define Dielectric strength

2.2 To describe

2.2.1 Dielectric loss
2.2.2 Dissipation factor
2.2.3 the factors affecting dielectric loss

2.3 To state the relation between Relative permittivity and Dielectric strength

2.4 To describe
2.4.1 The effect of polarisation
2.4.2 Charging and discharging of a Dielectric conduction

2.5 To describe conduction through
2.5.1 Gaseous Dielectric
2.5.2 LHquid Dielectric
2.5.3 Solid Dielectric

2.6 To state the application of Dielectncs

2.7 To describe the properties of
2.7.1 Impregnated paper capacitor
2.7.2 Electrolytic capacitors Insulating Materials

3.1 Describe the properties of Insulating Material in the light of
3.1.1 Electrical Properties
3.1.2 Visual Properties
3.1.3 Mechanical properties
3.1.4 Thermal Properties
3.1.5 Chemical properties

3.2 To classify the Insulating Materials in terms of temperature ranges (e.g. Class 0, Class Y)

3.3 To write the formulae for the calculation of life of insulating material

3.4 To describe the composition and properties of insulating materials e.g.
3.4.1 Fibrous Insulating materials
3.4.2 Ceramics
3.4.3 Mica
3.4.4 Glass
3.4.5 Natural synthetic and hard rubber
3.4.6 Insulating resins
3.4.7 thermosetting and thermoplastic materials Insulating Waxes, Varnishes and coolants

4.1 To describe properties and application of
4.1.1 Insulating varnishes
4.1.2 Coolants in Electrical machines

4.2 To list the name and important properties of some common type of coolants (e.g Transformer oil, Nitrogen, Silicon Varnish)

4.3 Describe the effect of Contamination Magnetic Material

5.1 To define
5.1.1 Ferromagnetic material
5.1.2 Paramagnetic material
5.1.3 Diamagnetic material
5.1.4 Curie point

5.2 To draw and explain the hysteresis loop for different materials like hard sheet, wrought iron and alloy steel

5.3 To state the effect of adding impurities in Ferromagnetic materials

5.4 State the properties of
5.4.1 electromagnetic steel and alloys
5.4.2 CRGO
5.4.3 Dynamo Grade steel 5.5.4 Ferrites

5.4.5 ALNICO

5.4.6 Hard Ferrites Special purpose Materials and processes

6.1To describe the important properties of the materials used in thermocouple

6.2 To state the important combination temperature ranges and c.m.f. generated

6.3 To state the construction and properties bimetals

6.4 To state the combination and important properties of hard and soft solders

6.5 To state the combination and important materials for fusmg materials

6.6 To state the classification and their respective properties of contact material

6.7 To describe and state the properties of different fluorescent material

6.8 To describe the method of colour generation in discharge tubes by using inert gases

6.9 To describe the process of galvanising, anodising powder coating on metals

7 Plastic

7.1 To state the composition properties and filled of applications of (a) Thermo setting Plastic (b) Thermoplastic (c) Synthetic rubber and neoprene

Assignment: -

1. List the materials to be used as heating element
2. State important properties required for the selection of conductors in overhead transmission
3. State the composition of following

3.1 Bronze 3.2 Brass 3.3 Nichrome

Reference:

Electrical Engineering Material by N. Alagappan, NT Kumar
TATA McGraw Hill Publishing Company Limited

ELECTRICAL CIRCUITS

L	T	P		
3	0	2		Cum. Ref. No.: E-402
Total Contact htrs.:75			Total marks: 150	Theory:
Theory: 45				End Term Exam: 70
Practical: 30				I.A.: 30
Pre requisite: 105,106				Practical:

Credit: 4 End Term Exam: Nil
I.A : 50

Rationale: -

The concept of electrical Circuit is very essential for the study of the other subjects in Electrical Engineering. This subject covers the basic electrical principles both on d.c. and a.c. circuits. The fundamental principles of Magnetic circuits have also been covered. The concept of transients and Fourier have been included here

Aim:-

- To develop the concept on basic electrical circuit principles
- To develop problem solving ability on electrical circuit principles

Detailed Course Content

Unit	Topic/Sub Topic	HOURS

1. Magnetic Circuits
   - 1.1 To define
     - 1.1.1 Magnetising force
     - 1.1.2 Magnetic intensity
     - 1.1.3 Magnetomotive force
     - 1.1.4 Magnetic flux
   - 1.2 Write the relation between Magnetic flux and magnetic intensity
   - 1.3 To define
     - 1.3.1 Magnetic Cycle of magnetisation
     - 1.3.2 Magnetic hysteresis
     - 1.3.3 Hysteresis loop
   - 1.4 To define
     - 1.4.1 Permeability
     - 1.4.2 Permeance
     - 1.4.3 Reluctance
   - 1.5 Describe magnetic circuit and comparison with electric circuit
   - 1.6 To describe
     - 1.6.1 Series
     - 1.6.2 Parallel
     - 1.6.3 and composite magnetic circuit
   - 1.7 To enumerate the energy started in a magnetic field
   - 1.8 To determine the pulling force by an electromagnets
   - 1.9 To describe the magnetic circuit in relay
   - 1.10 To solve simple problems on magnetic circuit
2. Passive Circuit Elements
   - 2.1 Resistance
     - 2.1.1 To define resistance
     - 2.1.2 To write equation relating voltage current and resistance
     - 2.1.3 To state unit of resistance
     - 2.1.4 To write expression relating resistance, resistivity, length of conductor and area
     - 2.1.5 To write different expression for the energy dissipated in a resistance
     - 2.1.6 To write the specification of resistance
     - 2.1.7 To describe the colour code of resistance
     - 2.1.8 Solving simple problems on resistance
   - 2.2 Capacitor
     - 2.2.1 To define Capacitor

2.2.2 Types of Capacitors
2.2.3 To write simple equation relating.
(a) Capacitance
(b) Capacitance, charge and voltage
(c) Energy stored interms of capacitance and voltage
(d) Capacictance, Area of the plate and distance between plate
2.2.4 To describe the construction of capacitor
2.2.5 To write the specification of capacitor
2.2.6 To solve simple problems on capacitor

2.3 Inductor
2.3.1 To define inductor
2.3.2 To write simple equations relating to voltage, current and inductance
2.3.3 To describe instruction of inductor
2.3.4 To define and mutual inductance
2.3.5 To define co-efficient of coupling
2.3.6 To describe dot convention
2.3.7 To state the unit of inductance
2.3.8 To write the expression for energy stored in inductance
2.3.9 To name different type of inductors and their field of application
2.3.10 To write the equation of inductor relating to its physical dimensions
2.3.11 To solve simple problems on inductor

3 D.C. Circuits
3.1 To define voltage and current source
3.2 To represent graphically the ideal current and voltage source
3.3 To represent graphically the practical voltage and current source
3.4 To describe series parallel combination and determine the equivalent resistance
3.5 To deduce the conversion formulae for Delta to Star and vice-versa
3.6 To state
3.6.1 Kirchhofffs current law
3.6.2 Kirchhofffs voltage law
3.6.3 Superposition theorem
3.6.4 Norton's theorem and Thevenin's Theory
3.6.5 Maximum power transfer theorem
3.6.6 To solve the D.C network problems using above theorems and laws

4. Sinusoidally excited Circuits
4.1 To differentiate between A.C and D.C
4.2 To describe the principle of generation of sinusoidal voltage and its waveform
4.3 To define
(a) Cycles (b) Frequency (d) Time Period (d) amplitude (e) phase difference
4.4 To define Average and RMS value of simple waves
4.5 To write R.M.S. and average value of sinusoidal quantity
4.6 To define form factor and peak factor
4.7 To represent sinusoidal wave by phases
4.8 To represent sinusoidal quantities in
4.8.1 exponential form
4.8.2 Complex form
4.8.3 Polar form
4.9 To state the effect ofA.C. quantity through
4.9.1 Resistance
4.9.2 Inductance
4.9.3 Capacitance

4.10 To describe simple R-L, R-C, & R-L-C series circuit and to find relation between voltages and current

4.11 To write the expression for power and power factor

4.12 To describe impedance triangle, power triangle and state the concept of Active reactive and apparent power

5. Series and parallel Resonance

5.1 To state the condition for series Resonance

5.2 To determine the expression of frequency at resonance condition

5.3 To draw the frequency reopen curve

5.4 To define quality factor

5.5 To define band width

5.6 To state the condition for parallel resonance

5.7 Tp determine the resonance frequency for parallel L-C Circuit

5.8 To draw the frequency response curve for the parallel resonance

5.9 To solve problems on series and parallel resonance

6. Transient 5

6.1 Transient in RC circuits

6.1.1 To determine the voltage equation across the capacitor being charged through resistor

6.1.2 To, draw the curves for charging capacitor

6.1.3 To draw the curves for discharging capacitor

6.1.4 To define time constant

6.2 Transient in R-L circuit

6.2.1 To determine the current equation in R-L Circuit

6.2.2 To draw transient curves in R-L circuit

6.2.3 To define time constant m R-L circuit

6.2.4 To solve problems on series and parallel resonance

7 Analysis of Waveform 5

7.1 Analysis of waveform by Fourier Transform (Use standard formulae only)

8 Class Test 4

List of Experiments

1. Identification of Passive Components
2. Performing the good bad test of Passive Components
3. To verify Kirchhoffs Current Law and Voltage Law
4. To verify Superposition Theorem
5. To verify Thevenin's Theorem
6. To develop the charging and discharging curve of voltage across the capacitor connected m series with a resistor
7. To measure the voltages across R,L,C in a series RLC circuit. To develop phaser diagram.
8. To verify maximum power transfer theorem
9. To determine the resonance frequency and Q-factor in a series LC circuit
10. To determine the resonance frequency and Q-factor in a parallel LC circuit

Reference:

Electronics and Electrical Engineering
By Lionel Warnes (Macmillan)

ELECTRICAL MEASUREMENT AND MEASURING INSTRUMENTS

L	T	P	Curri. Ref. No.: E-403
3	0	2	

Total Contact hrs.:75 Total marks: 150 Theory:
Theory: 45 End Term Exam: 70
Practical: 30 I.A.: 30
Pre requisite: 205 Practical:
Credit: 4 End Term Exam: Nil
I.A: 50

Rationale

The subject Electrical Measurement and Measuring Instrument is an important subject in the field of Electrical Engineering. This subject deals with the technique of measuring. Voltage, current and wattage by the indicating type of instruments. The technique of measurement of Electrical power in single phase and three phase circuits will be studied here. Measurement of energy and calibration and adjustment of energy meters will be studied under this subject. Prior to above the working principle construction of all type of measuring instruments like indicating, integrating and recording type will also be studied here. Users of potentiometers and other resistance measuring instruments are included under this subject. It is noteworthy to mention that the modem industries are implementing digital instruments-for measuring electrical quantities but till date the conventional instruments are being used for this reason the importance of studying the subject i.e Electrical Measurement and Measuring Instruments75 still exists. However the provision for studying the construction and working principle of advanced electrical instruments (digital instrument) may be made in a sp crate subject.

AIM

1. To acquire the skill for selecting similar instruments for the measurement of voltage, current and wattage.
2. To learn the technique connecting different type of Electrical measuring instruments
3. To learn the technique of calibratres and adjustment of different type of electrical measuring instruments.
4. To explain the working principle and construction of different type of Electrical Measuring Instruments

Detailed Course Contents

Unit Topic/Sub Topic Total Hours

1. Introduction (3 Hours)

1.1 Systems of Units

- To describe base units with examples
- To describe derived units with examples
- To indicate the units and dimensions of the following: frequency, speed, acceleration, force, work, energy, power, charge, potential remittance, Conductance, capacitance, inductance, magnetic field, flux density, magnetic flux.

• To analyse the dimensions in : Electrostatic System, Electromagnetic System.

• To define the following: Newton, Joule, Newton meter, watt, Ampere, Coulomb, Ohm, Volt, Farad, Weber, Henry Self nductance, mutual inductance unit magnetic pole. Ampere turn,

Ampere turn per meter, Tesia

2. Types of Instruments: (3 Hours)

2.1 To classify different type of instruments e.g. indicating integrating, integrating and recording.

2.2 To describe type of

(a) deflectional system

(b) Controlling System and

(c) damping systems.

2.3 To describe the advantage and disadvantages of above mentioned systems.

2.4 To describe the constructional detail of pointer, control spring and Instrument bearings.

3. Construction and Working principles (6 Hours)

To describe the constructions, working principles for following instruments

3.1 moving coil instruments

3.2 moving iron instruments

3.3 Electrodynamic instruments (air cared and iron cared

3.4 induction instruments

3.5 Electrostatic Instruments

3.6 Thermal instruments

3.7 Describe the above principles in case of Ammeter, Voltmeter and Wattmeter (also describe PF wattmeter)

4. Extension of Range of instruments and conversion (3 Hours)

4.1 To describe the method of extensions of rage of ammeters and Voltmeters (D.C Meters) describe the concept of? And swamp ig resistor

4.2 To describe the method of range of ammeter and voltmeter (A.C meters) . Uses of C.T and P.T working principles ?

4.3 To describe the working principles of rectifier type instruments

4.4 To Solve of Problems on above concepts

5. Measurement of Resistance (6 Hours)

5.1 To classify the resistance according to the range values

5.2 To define the accuracy of measurements

5.3 To describe method of measurement of resistances

5.3.1 To state ammeter voltmeter method of measurement (Connection for ammeter for different ranges of resistance state the sources of error in different measurement techniques)

5.3.2 To state method of substitution for the measurement of resistance. Discuss the sources of error

5.3.3 To state what stone bridge principle of measurement of resistances with precautionary measures

5.3.4 To describe the concept of meter bridge and P.O box principles, discuss about the sources of error

5.3.5 To describe the Kelvin-Double bridge prmciple. Deduce the expression for calculation for the value of unknown resistance. Discuss the methods for eliminating the errors for measurements.

5.3.6 To describe the basic principles of series and shunt ohmmeter

5.3.7 To describe the principles of crossed coil or Rado ohmmeter. Describe for low resistance and high resistance measurement

5.3.8 To describe the construction working principles of Megger. State the type of maintains tester and their field of application. State the recommendation of Bureau of Indian Standard Specification for selection voltage of testing. State the effect of capacitance of cable regarding the selection of megger. State the effect of use of guard ring in megger.

5.3.9 To state the method of measuring the insulation resistance while the power is on.

5.3.10 To solve of problems on above topic/subtopic

5.4 Measurement of Earth resistance

5.4.1 Define- the term Earthing, describe the importance of earthing

5.4.2 Describe the earth testing equipment, describe the method and principles of earth testing

6 Measurement of Power (6 Hours)

6.1 To describe the method of single phase power by

(a) three ammeter and

(b) three voltmeter method

6.2 To describe the method of connecting a wattmeter for measurement of single-phase power

6.2.1 To describe the method of measurement of p.f bv using wattmeter, voltmeter and Ammeter in single-phase circuit.

6.3 To describe the method of three phase power by two wattmeter method, Deduce the expression for measurement of total power and the p.f of die circuit for the balanced load conditions. State the precaution should be taken for the measurement of Power in low p.f load condition

6.4 To describe the basic principles and method of measurement of reactive power

6.5 To solve problems on power measurement

7.0 Energy Meter (6 Hours)

7.1 To describe the construction and working principle of D.C Energy meters

7.2 To describe the construction and working principles of Induction Type Energy Meter State the construction and working principles of following Adjustment

7.2.1 To describe the method of testing on Energy meter

7.2.2 To describe the method of construction of three phase Energy meters

7. 3 Solve problems on Energy meter Testing

8. Bridges and Potentiometers (6 Hours)

To describe the principles ofA.C Bridges on the following

8.1 Capacitance comparison Bridge

8.2 Inductance comparison Bridge

8.3 Maxwell's Bridge

8.4 Hays Bridge

8.5 Schering Bridge

8.6 Wien's Bridge

8.7 Resonance Bridge

8.8 Describe the precautionary measure to be taken for light frequency measurement(Description of the method of Wagner's Earth Connection)

8.9 Solution of problems on above concepts

9. To describe the transformer oil testing set (4 Hours)

To state the Bureau of Indian standard specification regarding Testing voltage. To decide method of Delectric Strength Measurement of Transformer oil and Insulation of a motor

10. Class Test (2 Hours)

List of experiment

1. Dismantling and Assembly of indicating type instrument Pm.m.c type, identification and drawing the following
   (a) deflecting system
   (b) Controlling System
   (c) Damping System
2. Dismantling and assembly of indicating type instrument eg Electrodynamic Wattmeter, identification and drawing of (a) deflecting System (b) Controlling System (c) Damping System (d) current coil (e) potential coil (f) voltage multiplier
3. Dismantling and assembly of indicating type instrument e,g. Moving Iron Voltmeter and Ammeter, identification and drawing of (a) deflecting system (b) Controlling System and damping system.
4. Dismantling and assembly of rectifier type voltmeter
5. 5.1 Dismantling and assembly of Single phase energy meter, identification and drawing of (a)deflecting system (b) braking system (c) current coil(d)potential coil (e) creep adjustment (f) Pf adjustment (g) speed adjustment
   5.2 Calibration of single phase Energy Meter and Phantom loading and power factor
6. Measurement of power by three Voltmeter methods
7. Measurement of power and power factor by three-ammeter method
8. Measurement of three phase power & power factor by 2 wattmeter method
9. Extension of Range of a Pmmc voltmeter
10. Connection of CT and PT for measurement of high current and high voltage and determination oftrans ratio of current and potential transformer
11. Measurement of Armature resistance by Kelvin^ Double Bridge
12. Measurement of Medium. Value resistance by Ammeter Voltmeter method
13. Study of HV oil Testing set
14. Measurement of dielectric strength of transformer oil by oil testing set
15. Measurement of Earth resistance by Earth Testing Megger
16. Localization of cable fault by Murray loop test

Reference:

1. Electrical Measurement and Measuring Instruments
   By Goldmg
2. Electron Instrumentation
   By H.S. Kalsi, T.M.H
3. Electrical Measurements and Measuring Instruments
   By E.Handscombe(The Wykeham Technologies Sendee)
4. Electrical Measurement and Measuring Instruments
   By S.R. Paul (Rukamari Book House Calcutta
5. Electrical Measuring Instruments
   By S.R.Paul(Concept Publications 6/2/H D.Gupta Lane 700 050)

ELECTRICAL MACHINE -1

L	T	P		
3	0	2		Curri. Ref. No.: E-404
Total Contact hrs.:75			Total marks: 150	Theory:
Theory: 45				End Term Exam: 70
Practical: 30				I.A. :30

Pre requisite: 105,106 Practical:
Credit :4 End Term Exam: Nil
I.A : 50

Rationale:
The application of D.C. Machine in Modern Industries are sdll in practice. The Electrical Engineering Technicians has to look after the installation, operation and control of Machines. So the knowledge of Machine are very essential in this regard. As the filed of Electric al machine is very vast, this subject is divided into two parts Electrical Machine I and Electric al Machine II. The Electrical machine I deals with D.C. Machines, transformers and Different type of Batteries. Though modern industries are now-a-days uses ac. Motors and alternating mostly, the usage of DC Machines like D.C. Motors, Generators are still in practice. The usage of transformers and batteries are very wide far that reason these topics have been included in this subject. This subject deals with the working principles, operation of the machines. Special emphasis have been given on the maintenance, repair of the above machine also.

Aim:
1. To acquire knowledge on the construction and working principles of H.P.C. Machine 1.2 transformer 1.3 Batter}7 (Accumulating)
2. To describe the installation and maintenance procedure of 2.1 D.C.Machine 2.2 Transformers 2.3 Batteries
3. To describe the changing methods of the batteries

Detailed Course Content

Unit Topic/Sub-topic Total Hours

1. D.C. Machine (12 Hours)

1.1 To describe the constructional detail of a D.C.Machine
1.2 To describe the Magnetic Circuit in a D.C. Machine
1.2.1 To define geometrical axis and central axis.
1.2.2 To describe the brush positions
1.3 To describe Armature Winding
1.3 .1 To define lap and wave winding
1.3.2. To state the filed of application of Lap and Wave winding
1.3..3. To state the function of equalizing ring and dummy coils
1.4 To state the types ofD.C. machines
1.4.1 On the basis & connection of field Coil with armature
1.4.2 To define cumulative and differential compound
Fleming's Right hand & Left hand Rule
1.5 To describe the working principle of D.C. Generator
1.5.1. To write the emf. Equation of D.C. Generator
1.5.2 To state the method of determining O.C.C. curve of D.C. Generator (self excited)
1.5.3 To define critical resistance and critical speed
1.5.4 To describe the armature reaction
1.5.5 To state the method of reducing armature reaction
1.5.6 To describe the load characteristics of D.C. Generator
1.5.7 To state the application of D.C. Generator
1.5.8 To solve problems on D.C. Generator

2 D.C.Motor Generator (12 Hours)

2.1 To describe the working principle of D.C. Motor
2.1.1 To state the significance of back emf

2.1.2 To write the torque equation of D.C. Motor
2.1.3 To describe the characteristics of
a) Speed armature
b) Torque armature current
c) Speed torque characteristics.
d) Speed field current characteristics
2.1.4 To state the field of application of Different type of D.C .Motor
2.1.5 To state the basic principle of starting of D.C. Motors
2.1.6 To describe the speed control of D.C. Motor by
i) Varying flux ii) by varying armature current
2.1.7 To describe the speed reversal method of D.C. Motor solve the problems on D.C. Motor (specify the areas)

3. Transformer: (10 Hours)

3.1 To define a Transformer & state its basic principle
3.2 To state the classification of transformer based on
3.2.1 application
3.2.2 construction
3.3 To describe the construction of transformer
3.3.1 To prepare the list of components used
3.3.2 To describe the composition of the components
3.3.3 To state the type and nature of cooling of transformers
3.4 To describe the working principle of transformer
3.5 To describe transformer on (a) no-load (b) full load
3.6 To derive the emf equation of transformer
3.7 To state the effect of leakage flux and leakage reactance of transformer
3.8 To describe the phase ^diagram on no load (specify whether ideal or actual)
3.9 To describe the actual approximate equivalent circuit
3.10 To determine the equivalent resistance, reactance impedance referred to either side
3.11 To determine percentage resistance, reactance and impedance of transformer
3.12 To draw the phasor diagrams on load at different pfs
3.13 To describe different type of losses in transformer
3.14 To calculate the losses and efficiencies of transformer
3.15 To state the condition for maximum efficiency of transformer
3.16 To state the procedure for testing of transformer
3.17 To describe the open circuit test and short circuit test
3.18 To determine the voltage regulation of a transformer
3.19 To describe the construction of Auto transformer
3.20 To describe the working principle of Auto transformer

4. Storage Batteries : (8 Hours)

4.1 To state the types of storage batteries
4.2 To describe the construction of Lead Acid battery
4.3 To describe the working principle of Lead Acid Battery
4.4 To describe the special feature of maintenance free battery
4.5 To describe the features in Emergency light batteries
4.6 To state the defects in storage batteries
4.7 To describe the method of battery maintenance
4.8 To describe different method of battery charging
4.9 To describe different battery charging circuit for (a) constant voltage

(b) constant current charging

4.10 To describe the method of testing, fault diagnosis and repair of batteries

4.11 To describe the safety procedure for battery

4.12 To describe the method for prevention of environmental pollution

5. Class Test: (3 Hours)

List of Experiment

1. Study of the construction of D.C.Machine
2. Study of the construction ofA.C. Machine (Specify)
3. Determination of No load characteristics/Drawing ofOCC curve ofD .C. Machine
4. Adjustment of brash position of D.C. Shunt Motor
5. To determine the speed torque characteristics of a D.C. Motor (Shunt and Compound)
6. To determine the speed armature current characteristics of a D.C. Motor
7. To determine the torque armature current characteristics of a D.C. Motor.
8. To control the speed of a D.C. Shunt Motor by (a) armature voltage Variation (b) A field flux variation
9. To assemble and test the speed reversal circuit of a D.C. Shunt Motor
10. To study of transformer on No load and draw the no load phasor diagram
11. To determine the (a) no load loss (b) full load loss (c) efficiency And percentage regulation of a single phase transformer
12. To determine the phasor diagram of transformer on load at different pfs
13. To dismantle and assemble a I KVA, 230V: 110V -h 110V transformer And perform the test on the transformer (Specify Test)
14. To draw the equivalent circuit of a single phase transformer
15. To study the installation procedure of a three phase power transformer (mechanical and electrical work) and prepare the brief report on this.
16. To study the detail construction of a lead Acid Accumulator
17. To study the assembly procedure of a lead Acid accumulator and Prepare a brief report on it.
18. To study the initial installation procedure of a lead Acid battery And prepare a instructional manual on charging methods
19. To study the construction of Different battery chargers e.g.
    a) Taper charger/constant voltage charger
    b) Constant current charger
    c) Auto cut off battery charger
20. To study the construction of Maintenance free battery

Reference:

a) Batteries and Energy System by Mantell(McGraw Hill)

b) Storage Batteries by Vinal (John Willey & Sons)

ELECTRICAL POWER SYSTEM I
(POWER GENERATION AND SUBSTATION)

L	T	P		
3	0	2		Curri.Ref.No.:E-405
Total Contact hrs.:45			Total marks: 100	Theory:
Theory: 45				End Term Exam: 70
Practical: 30				I.A.: 30
Pre requisite: 105,106				Practical:
Credit :3				End Term Exam: Nil
				I.A: Nil

1. Rationale: -

The knowledge of power generation and the substations are very essential in the field of Electrical Engineering. The role of the technician in maintaining a generating station and substation is vital. Some emphasis have been given on the maintenance aspects of Power generating station and substation. As the power crisis in this country is increasing day by day with the increase in power demand the utilisation of Diesel-generating set is also increasing. Hence the detail study of diesel generating sets as a captive power-generating unit is to be studied here.

2. Aim : -

2.1 To develop the knowledge in detail layout of
a) Thermal Power Plants
b) Hydro Electric generation unit
c) Nuclear Power generating station
d) Diesel generating Unit
2.2 To furnish a list of generating station. Auxiliaries for above generating System
2.3 To develop the maintenance schedule for above generating stations
2.4 To prepare the layout of different types of sub station
2.5 To develop maintenance schedule of the substations

Detailed Course Content

Unit	**Topic/Sub topic**	**Total Hours**
1	Generation of Electrical Power	(15 Hours)

1.1 To state the name of the sources of Energy
1.2 To describe the factors on which the following generating systems are implemented
(a) Thermal Power station (b) Hydro Electric Power Station
(c) Atomic Power stations (d) Gas Turbine (e) Diesel generating systems
1.3 Thermal Power generation
1.3.1 To describe the detail layout of thermal power station
1.3.2 To state the factors for site selection and furnish the list of thermal power plants
1.3.3 To state the generating capacity of the thermal power station
1.3.4 To describe the working principle of the following(a) Coal

handling Plant (b) Alternators (c) condensing plant (d) Water treatment plant (d)Ash handling system (f) Station auxiliaries (g) pulverising system (h) steam generation system (i) turbine system

1.4 Hydro Electric Power generation

1.4.1 To state the reasons for developing a Hydro Electric reasons for developing a Hydro Electric Project

1.4.2 To describe different type of hydro electric project

1.4.3 To furnish a list of hydro electric projects and their capacities

1.4.4 To describe the detail layout of the hydro electric project

1.4.5 To describe the alternator, the computing system and turbine of the hydro electric projects

1.4.6 To describe the station auxiliaries of the hydro electric projects

1.5 Atomic Power Generation

1.5.1 To state the reasons for selecting Atomic Power Station as a power-generating unit

1.5.2 To state the factors on which the site is selected

1.5.3 To state different type of Atomic Power generating system

1.5.4 To describe the detail layout of the Atomic Power generating system

1.5.5 To describe the safety system needed for the running and maintenance of the Atomic Power generating system

1.5.6 To state the advantages and disadvantages of Atomic Power generating system

1.6 Diesel Generating Plants

1.6.1 To state the reason for selection of Diesel generating system as power generating unit

1.6.2 To state the capacities of the Diesel generating System

1.6.3 To describe the schematic layout of the Diesel generating System

1.6.4 To describe the starting procedure of a Diesel generating System

1.6.5 To furnish the list of materials and components required for the operation and maintenance of Diesel generating Set

1.6.6 To state the relevant IE rules for connecting the Diesel generating Set with the bus bar

1.6.7 To prepare the maintenance schedule

1.6.8 To prepare the testing schedule for the repair work during breakdown

1.7 Gas Turbine

1.7.1 To state the reason for selecting gas turbine

1.7.2 To prepare the layout of the gas turbine

1.7.3 To explain the workshop principle of the gas turbine

1.7.4 To state the advantages & disadvantages of gas turbine

1.8 To perform the comparative study of stream, Hydel, Atomic, Diesel generating and gas turbine plants

2. Power Planning Economic and Tariff (8 Hours)

2.1 To define

(a) Demand (b) Load Curve (c) Maximum Demand or Peak Load (d)Connected load (e) Demand factor (f) Load factor (g)Diversity factor (h) Plant Factor

2.2 To solve the problems on above

2.3 (a) To describe the factors involved for determining cost of generation

(b) To solve problems on 2.3 (a)

2.4 (a) To describe the method of determination of size of conductors and apply Kelvin's law (b) Solve the problem on 2.4(a)

2.5 (a) To describe the method of (i) load survey (ii) Planning (iii) calculation for Tariff (b) To solve problems on 2.5 (a)

2.6 (a) To describe the method of power factor improvement of a plant

(b) To solve problems on 2.6(a)

2.7 (a) To describe the factors involving the economic choice of Equipment

(b) To explain power auditing

3. Power Installations and Drives (7 Hours)

3.1 To define power installation

3.2 To list and explain the factors on which a power installation is designed

3.3 To prepare a layout of an Industrial Power Distribution System

3.4 To describe the methods for the selection of drive in an industrial system

3.5 To state and explain the factors on which the motor is selected

3.6 To prepare a table stating the properties and application of Different type of Motor

3.7 To describe the method for the choice of device tor specific Industrial Utility

3.8 To design and estimate for a 400 V, three phase 4 wire bus bar system (Power derived from 3 phase 11 KV system)

4. Sub Station (7 Hours)

4.1 To define substation

4.2 To prepare the list of equipment of a sub-station

4.3 To design the layout of a transmitting sub-station

4.4 To design the layout of (a)Primary distribution sub-station

(b) Secondary distribution sub-station

4.5 (a) To describe the method ofEarthlmg the Substation

(b) To describe the earthing systems as per Bureau of Indian Standard

(c) To state the relevant IE Rules for sub-starion earthing

4.6 (a) To distinguish between Earthed versus Isolated neutral power system

(b) To describe the reason for neutral point earthing

4.7.1 To describe the method of Inspection and Maintenance of (a)Switchgear (b)Trans former (c) Transformer oil (d) Bus bars (e) Power factor improvement devices

4.7.2 (a) To describe the method of transformer oil testing (b) Describe the effect of contamination (c) To describe the method of filtering and renovation of transformer oil (d) Properties and application of mineral oil (e) State the relevant code for the transformer oil testing

5. Battery Bank (5 Hours)

5.1 To describe the detail of connection and function of a battery bank

6. Class Test (3 Hours)

Reference:

1. Electrical Power by S.R.Chakraborty
(Venus Publishers 71/2B Bidhan sarani Kolkata 700006)

ELECTRICAL ENGINEERING DRAWING

L	T	P	Curr. Ref. No. : E-406
0	0	0	

Total Contact hrs.: Total marks: 100 Theory:

Theory : Nil End Term Exam : Nil

Practical: 60 I.A :Nil

Pre requisite: 203,204 Practical

Credit: 2 End Term Exam: 50
I.A: 50

1. Rationale:-

Drawing is the language of Engineers. Any job which is to be communicated for implementation is required to be done within an optimum time span and with efficacy. Since last century lot of change has taken place in Drawing for representing job specification. Standardised symbols as prescribed by Bureau of Indian specification are to be introduced while practicing the jobs on Drawing. The preparation of list of material along with the specification writing is also an important factor which is to be dealt in this subject.

2. Aim:

2.1 To acquire the skill in presenting the job specification using standardized symbols used in Electro technological field (as per the stipulation by Bureau of Indian Standard).

2.2 To acquire skill in using the norms and standards prescribed in Indian Electricity Rules and Bureau of Indian Standard regarding selection of components and circuit accessories and equipments.

2.3 To acquire skill in preparing the list of components with full specifications.

2.4 To acquire the skill in using handbooks and standards for developing the drawing

2.5 To acquire the skill in presenting an object (Electrical or mechanical) through the third angle projection system.

2.6 To acquire the skill in presenting an object (Electrical or mechanical) by free hand sketch.

2.7 To acquire the skill in using Computer Aided Drafting for the presentation of Electrical Drawing.

Detailed Course Content

Unit	Topic/Sub Topic	Hours
1	Construction of Assembly drawing of the Electrical& Mechanical Item 1.1 Preparing the list of Electrical Symbols as per IS 2032 (Part I to Part XI) 1.2 Prepara0tion of Drawing Sheet and selection of name plate using IS696-1972 1.3 Preparation of Isometric free hand sketch of Mechanical or electrical objects and their dimensioning as per Bureau of Indian Specification 1.4 Preparation of orthographic projection Drawing from the free hand sketch	5
2.	Drawings of Joints and Electrical Accessories Preparation of Drawing on 2.1 Different type of Cable Joint 2.2 Kit Kat fuse with its holder 2.3 Spst knife switch 2.4 Carbon brush holder 2.5 Cable lugs or Thumble	
3.	Drawing of Electrical Instruments Preparation of Drawing on 3.1 Front dial of (a) Moving Iron (b) Moving Coil (c) Dynamometer and (d) Induction Type Instruments 3.2 Diagrams on deflecting systems of (a) Moving Coil (b) Moving Iron(c) Dynamometer and (d) Induction Type Instruments 3.3 Diagrams on (a) Controlling system (b) Damping System 3.4 Diagrams on (a) reed type frequency meter (b) Weston Frequency Meter 3.5 Diagram on polyphase Energy Meter	6

4. Drawing on Electrical Machine
   - 4.1 Sectional Drawing of (a) D.C. Shunt Motor
   - 4.2 Assembly Drawing of three phase wound Rotor induction Motor
   - 4.3 Assembly Drawing of three phase transformer with tank and bushing

5. Drawing on Panels
   - 5.1 Schematic Diagram on Automatic Star Delta starter
   - 5.2 Control panel of a sub-station

6. Winding Diagram
   - 6.1 Developed lap winding diagram of a 4 pole D.C. Machine
   - 6.2 Schematic diagram of a 4 pole D.C. Machine
   - 6.3 Developed winding diagram of double layer, short chorded lap winding of a 3 phase 400 v, 4 Pole induction Motor

7. Transmission & Distribution Line Diagram
   - 7.1 Drawing of the diagram of a 3 phase 4 wire Power Distribution system showing die arrangements for service connection and safety device over road crossing safety guard
   - 7.2 Diagram for HT and LT insulation with detail of fittings
   - 7.3 Detail diagram of distribution pole with stay wire
   - 7.4 Detail diagram of Transmission Pole with arrangement of conductors and safety devices

8	Plant and substation layout Diagram 8.1 Preparation of diagram of Pole Mounted Sub-station 8.2 Preparation of the diagram of Foundation mounted outdoor substation 8.3 Preparation of the layout of 11KV substation	5
9	Uses of Auto CAD version 2000 (a) Selecting size of paper (b) Drawing border line and name plate (c) Drawing Electronic schematic Diagram (d) Drawing printed circuit Board (e) Preparing printed circuit assembly drawing (f) Mechanical Assembly drawing (usage of ELECTEMP.DRG. ELECOMP.DRG and other relevant files and commands) **N.B.** The job must include Activity Study of (g) graphic Area (b) Command Line/Prompt Area (c) Screen Menu Area (d) status line (e) pull down Menu and Menu Bar (f) Pull down Window and Dialogue Boxes (g) keyboard and function of each keys (h) Function keys (i)Hot Keys(j) usage of commands (A,C,CP,DV,E,L,LA,LT,M,MS,P,PL,PS,R,T,V,Z) (k)Input and plotting devices (1) command terminators and choice selection	10
10	Class Test	3

Reference:

(1) Electrical Engineering Drawing by Dr.S.K.Bhattacharya (Second Edition) New Age International Publishers
(2) I S 2032 (Part I to Part XI)

(3) IS 696-1972

ELECTRICAL ENGINEERING WORKSHOP

L T P .		Curr. Ref. No.: E407
0 0 4		
Total Contact hrs,:60	Total marks: 100	Theory:
Theory- Nil		End Term Exam: Nil
Practical: 60		I.A : Nil
Pre requisite: 203,204		Practical:
Credit : 2		End Term Exam: Nil
		I.A : 100

Rationale:

The role of the subject Electrical Engineering Workshop is very important in building up the career of a technician. It is necessary to learn the concepts, skill, process/technique and develop attitude to work. The concept can be learned in the lecture classes, but for developing skill, learning the process or technique or to develop the attitude to work can not be acquired by attending the workshop. In, this curriculum case has been taken to include such type fop the job which are encountered frequently in the day to day life of an electrical technician. The jobs are arranged in such a manner that the technicians will learn the technique of solving problems and important the IE rules and IS specification

Aim:

a) To develop skill on wiring practices
b) To develop skill in connecting different accessories
c) To learn the techniques of fixing and preparing the layout of electrical wiring
d) To learn the techniques of measuring insulation resistance and earth resistance /

Detailed Course Content

Unit	Topic/SubTopic	Total Hours
		60

1) To identify different type of tools and accessories used in electrical work shop and prepare a list with diagram
2) To study the safety practices in Electrical workshop and prepare a brief Instructional manual
3) To dismantle a ceiling fan using screw driver, wrenches, bearing puller etc and prepare a list of components
4) To dismantle and assemble single phase and three phase pump motor using screw drivers, wrenches, bearing puller and prepare the list of components .
5) To perform the preventive maintenance operation of a three phase induction motor along with the servicing of star/delta starter and single phase preventor circuit(Maintenance schedule and maintenance log book must be prepared as per bureau of Indian Standard
6) To perform the connection of a wiring installation for (a) incandescent lamp Controlled by a reed switch (b) 5 amp. 230v. 3 pin socket controlled by a Reed switch "(c) a ceiling fan controlled from a reed switch through a miniature Circuit breaker with neon indicator must be used.

7) To perform the wiring connection of twin fluorescent lamp (Stroboscopic effect elimination and power factor improvement methods must be practiced
8) To perform the wiring connection of three fluorescent lamps using three phase 4-wire supply (To state the reason and field of application of such connection
9) To assemble a Semi Automatic star Delta starter using contactors and time delay and thermal over load unit
10) Assemble a Direct on line starter using contactor, thermal over load and Single phase preventer circuit.
11) To practice the winding of coils for small transformers, and assemble It in stamping of cares finally perform the testing.
12) To perform the Megger testing of a wiring installation and fill in the test report form of the ElectricSupply authorities.
(The conventions stipulated in IE Rules and IS specifications must be practiced)
13) To perform the resistance measurement of an earth installation using earth Megger testing equipment (The convention stipulated in IE Rules and IS Specification must be practiced)
14) To assemble the coils of stator Rotor of an induction motor after using different type of insulating materials and locking wedges
15) Perform the testing of insulation resistance of the stator and Rotor of 3 phase 400v.
wound rotor induction motor
16) To perform the good and bad test of (a) Diode (b) transistor (c) resistor (d)inductor (e) capacitor by digital Multimeter
17) To solder the joints of (a) 12 SWG solid copper conductor using 65 watt 230 V. soldering Iron (b) Six numbers of 10 amp. 1000 V. Diode with heat sink and connecting lugs by 35 watt 230 V. soldering iron.(c) a 8 pin DIP base on printed circuit vero board by 18 watt 230V. leakage free soldering iron using of tweeters, nippers, pliers are to be practiced. De-soldering of above job.
18) To perform the installation work of a 5 KW 400 v. motor. The work Should be completed with (a) foundation detail (b)layout of the system (c)list of connection (d) testing method
19) To study and trace wiring installation of building and prepare the single layout diagram with full specification of the accessories and control gears used.
20) To practice the fixing of porcelain insulators, safety devices on the arm Steel pole (uses of the specification of Bureau of Indian Standard Specification)
21) To assemble the string insulator
22) To assemble a 400 V. Distribution panel using (a)Miniature circuit Breakers (b) MCCB (c) CT with ammeter and selecting switch (d) Voltmeter with selecting switch.

Reference:
1) Electrical Installation Work
by TG Francis (Sixth Edition) ELBS
2) Electrical Equipment Testing & Maintenance
by AS Gill (Rusteen Publishing Company, PHC)

ELECTRONIC DEVICES AND CIRCUITS -I

L	T	P		
3	0	2		Cum. Ref. No.: E408
Total Contact hrs :75			Total marks: 150	Theory:
Theory: 45				End Term Exam: 70
Practical: 30				I.A.: 30
Pre requisite: 105,106				Practical:
Credit: 4				End Term Exam:: Nil
				I.A:50

Rationale:

Electrical Engineering can not stand alone without the study of Electronic Devices & Circuits. The modern Electrical Equipments are mostly controlled by electronic circuits where both the circuits are mostly designed on the basis of linear and binary operation of the solid state devices. This subject provides the facility for the study of basic knowledge of the solid state devices and their application. Care has been taken so that the study of the practical circuits are included m this subject rather than theoretical approach. Some problems on designing of simple electronic circuits have also been included here.

Aim:

To develop knowledge on the characteristics of
- a. different type of diodes
- b. transistor

To describe the working principles of transistor amplifiers
To describe the effect of feedback on amplifier
To develop different application circuit on diode and transistors

Detailed Course Contents

Unit	Topic / Sub Topic	Total Hours
1.	Electrical components and their specification	(6Hours)

1.1 Resistors: To state
- 1.1.1 the types of resistor
- 1.1.2 characteristics of resistor
- 1.1.3 field of application of resistor
- 1.1.4 troubles in resistor
- 1.1.5 good bad test of resistor
- 1.1.6 full specification of resistor

1.2 Capacitor: To state or describe
- 1.2.1 the types of capacitor
- 1.2.2 characteristics of capacitor
- 1.2.3 field of application of capacitor
- 1.2.4 troubles in capacitor
- 1.2.5 good bad test of capacitor
- 1.2.6 full specification of capacitor

1.3 Inductor : To state or describe
- 1.3.1 the types of inductor
- 1.3.2characteristics of inductor
- 1.3.3 field of application of inductor
- 1.3.4 troubles in inductor
- 1.3.5 good bad test of inductor

1.3.6 full specification of inductor

2. Semiconductor Diodes (6 hours)

2.1 Semiconductor Physics

To describe

2.1.1 the properties of semiconductor
2.1.2 the principle of conduction in crystal
2.1.3 doping
2.1.4 unbiased diode
2.1.5 forward and reverse biased diode

2.2 Characteristics and application of diodes

2.2.1 To describe the volt amps. characteristics of diode
2.2.2 To explain the property of ideal diode
2.2.3 To define the resistance of diode and describe the method of measurements
2.2.4 To describe practical diode
2.2.5 To state the important specifications of semiconductor diode
2.2.6 To describe the half wave and full wave rectifier circuits
2.2.7 To calculate the efficiency of rectifier circuit
2.2.8 To write the formulae of calculating the parameters of filter circuit

2.3 Special purpose diodes

2.3.1 To describe the characteristics and field of application of (a) zener diode (b) capacitive diode (c) Light emitting diode (d) photo diode (e) schottky diode (f)constant current diode (g) step recovery diode (h) tunnel diode (I) PIN diode (j) gun diode

3.0 Transistor (20 hours)

3.1 To describe the construction of transistor
3.2 To describe the working principle of transistor

3.3 To state the types of transistor
3.4 To describe the characteristics of transistor and method of drawing characteristic curves
3.5 To describe the amplifying characteristics
3.6 To describe the amplifying characteristics in (a) common base (b) common emitter (c) common collector configuration
3.7 To define (a) current amplification factor (b) collector current (c) emitter current (d) leakage current (e) input resistance (f) output resistance (g) base current amplification factor
3.8 To establish the relation between a and P
3.9 To describe the method of drawing the (a)input characteristics curve (b) output characteristics curve
3.10 To compare the characteristics of three different configurations e.g. CB, CE, CC.
3.11 To analyse the load line of a transistor (both for dc and ac)
3.12 To describe the function of the heat sink of a transistor
3.13 To write the specification of a transistor
3.14 To state the conditions for faithful amplification
3.15 To define transistor biasing
3.16 To describe the effect of selection of different operating point on the load line

3.17 To state the essential requirements of a transistor biasing circuit
3.18 To define stability factor
3.19 To describe (a)base resistor biasing (b) feedback resistor biasing (c) voltage divider biasing (d) emitter biasing
3.20 To describe the function of a small signal single stage amplifier
3.21 To calculate the voltage and power gain of amplifier
3.22 To describe the classification of amplifiers
3.23 To define the multi stage amplifier
3.24 To state and describe different types of coupling used in amplifiers
3.25 To describe the band width of (a) R.C coupled (b) Transformer coupled (c) direct coupled amplifier
3.26 To describe different type of Transistor power Amplifier (push pull & complementary symmetry)
3.27 To determine the collector efficiency for different classes of power amplifier
3.28 To describe the collector dissipation curve an its importance
3.29 To describe and draw different stages of an Amplifier used in PA system.
3.30 Feedback Amplifier (To define concept of feed back, gain in feedback, advantage and disadvantage in feedback amplifiers)

4.0 Sinusoidal Oscillators (5 hours)

4.1 To state types of Electrical Oscillation
- 4.1.1 To describe damped and un-damped oscillation
- 4.1.2 To state the condition for oscillation

4.2 To describe different type of Oscillators
- 4.2.1 Tuned collector Oscillator
- 4.2.2 Hardey Oscillator
- 4.2.3 Colpitfs Oscillator
- 4.2.4 Phase shift Oscillator
- 4.2.5 Wein Bridge Oscillator
- 4.2.6 Crystal Oscillator

4.3 To state the applications of above Oscillators

5. Wave-Shaping Circuit (5 hours)

5.1 To describe the function of diode-clipping circuit
5.2 To describe the function Of transistorised — chipping circuit
5.3 To explain the function of (a) clamping circuit (b) synchronising clamping
5.4 To explain the working principle of integrating and differentiating and feedback circuits

6. Class Test (3 hours)

List of Experiments:
1. To identify the active and passive components
2. To determine the forward and reverse characteristics of PN junction diode
3. To determine the input and output characteristics of Junction transistor
4. To determine the forward and reverse characteristics of a zener diode
5. To connect the (a) common base (b) common emitter (c) common collector Amplifiers and to compare their gain
6. To assemble (a) two stage R.C. coupled (b) transformer coupled (c) Direct coupled amplifier and check the amplification of the input signal
7. To connect a single stage amplifier and check the cut off, saturation and normal biasing conditions on input signal by varying the biasing.
8. To determine the frequency response curue of a two stage R.C. coupled amplifier
9. To determine the (a) current amplification factor in common base configuration (b) base current amplification factor in common emitter configuration

10. To determine the input and output characteristics of transistor, (a) draw the D.C. load line (b) draw the collector dissipation curve
11. To construct a multistage amplifier with (a) power Amplifier and check the amplification of input signal with and without negative feedback
12. (l)Construct Hardey Oscillator and adjust (a) gain to obtain sinusoidal wave output and (b) L-C to vary. the frequency (2)Determine the resonance frequency and amplitude of oscillation
13. Construct a phase shift Oscillator and adjust its gain to obtain sinusoidal output. Determine (a) gain and (b) frequency of oscillation during Oscillation
14. Construct the diode clipping and clamping circuit and observe the clipping level with change in biasing voltage
15. Construct a differentiating and integrating circuit by using R-C network.

Reference:
1. Electronic Principles by Sahdev (Dhanpat Rai & Sons)
2. Electronic Devices and circuits — Mothershead (TMH)
3. Electronic Devices (Floyd)
4. Electronic Principles (Malvino) (TMH)

ELECTRONIC DEVICES AND CIRCUITS -II

Curr. Ref. No.: E409

L	T	P
3	0	2

Total Contact hrs.:75
Theory: 45
Practical: 30
Pre requisite: E408
Credit: 4

Total marks: 150

Theory:
End Term Exam: 70
I.A: 30
Practical:
End Term Exam:: Nil
I.A: 50

Rationale:
The application of Electronic Devices is increasing, not only in the field of electronics communication and instrumentation but it is also used in the field of electrical Engineering. In fact the field electronics is being amalgamated with the field of Electrical Engineering. So the study of Electronic Devices and circuits are very essential for the students of the Diploma course in Electrical Engineering. The part of this subject deals with the characteristics of basic devices like diode transistors and their circuits. The second part is dealing with the special devices e.g. UJT,

FET, MOSFET, OPAMP, 555 timers and three terminal regulator chips. The study of CRO, Digital Multimeter and signal generators have also been included in this subject.

Aim:

To acquire the knowledge of application and working principles of
(a) UJT, FET, MOSFET, OPAMP, three timing regulators.

To acquire the knowledge for specifying and indenting of the components as stated in Sl No 1.

To acquire knowledge on the working principles and applications of (a) CRO (both analog and Digital (b) Digital Multimeter (c) Signal generator

Detailed course content

Unit	**Topic / Sub-Topic**	**Hours**

1. Unijunction Transistor. (3 hours)
   - 1.1 To describe the construction, working principle and characteristics of Unijunction Transistor.
   - 1.2 To define (a) Intrinsic stand off ratio (b) emitter voltage (c) emitter diode voltage (d) emitter current (e) negative resistance region (f) saturation region.
   - 1.3 To describe the UJT relaxation Oscillator circuit and write expression for the time period of the oscillator.
   - 1.4 To state some application of UJT relaxation oscillator.
2. Field Effect transistor (3 hours)
   - 1.1 To describe the construction, operation and characteristics of Junction Field Effect Transistor.
   - 2.2 To define (a) channel ohmic region (b) Pinch off region (c) Drain resistance (d) Trans conductance (e) Zero-gate-voltage Drain Current (f) dissipation (g) gate out off current.
   - 2.3 To describe the effect of temperature on FET parameters
   - 2.4 To describe the common source AC amplifier circuit and define (a) voltage gain (b) output resistance (c) Input resistance (d) input capacitance
   - 2.5 To describe (a) fixed bias with self bias circuit (b) the common drain or source follower circuit (c) the common gate FET amplifier.
   - 2.6 To explain the frequency response of FET amplifier.
3. MOSFET (Metal Oxide Semiconductor Field Effect Transistor. (4hours)
   - 3.1 To describe (a) Depletion MOSFET (b) Enhancement MOSFET.
   - 3.2 To differentiate the characteristics ofJFET and MOSFET.
   - 3.3 To describe (a) the handling precautions of MOSFET, (b) dual gate MOSFET (C) Integral gate protection.
   - 3.4 To describe the testing procedure of field effect Transistor
   - 3.5 To describe the application of a dual gate MOSFET m automatic gate control amplifier.
   - 3.6 To Describe the function of a field effect diode
   - 3.7 To describe the application of FET in oscillators
4. Opto electronic Devices (4 Hours)
   - 4.1 To describe the Electromagnetic spectrum of Light.
   - 4.2 To list the application of photo Electronic Devices.
   - 4.3 To describe (a) the spectral response (b) Illumination and Irradiance of Optoelectronic Devices.
   - 4.4 To describe the photoconductive sensors e.g. (a) Bulk-type photoconductive cells (b) PN photodiode (c) PIN Photodiode (d) Avalanche Photodiode (e) NPN Photodiode (f) NPN

Phototransistor (g) Photo Darlington Transistor

4.5 To describe the applications of Photodiodes and phototransistors

4.6 To describe the function of light Emitters e.g. (a) LED's (b) Infrared Emitters (c) laser diode.

4.7 To describe the functions of (a) Photo-couplers (b) application of the photo coupler circuit

5. Differential amplifier. (4 Hours)

5.1 To define a differential amplifier and explain its significance

5.2 To describe four different configuration of the differential amplifier.

5.3 To draw the dc and ac equivalent circuit for a differential amplifier configuration

5.4 To deference the voltage gain, differential input and output resistance

5.5 To Define and explain (a) common mode rejection ratio

5.6 To explain the importance of FET differential amplifier.

5.7 To describe the constant current bias circuit, current mirror circuit in amplifier and explain its importance

5.8 To determine the overall voltage gain, the input resistance and the output for the cascade arrangement of several amplifier stages.

6. Operational Amplifier (10 hours)

6.1 To define operational amplifier

6.2 To draw the block diagram representation of a typical Op-amp

6.3 To analysis a typical Op-amp equivalent circuit

6.4 To describe the manufacturers designation for integrated circuits

6.5 To define SSI, MSI, LSI and VLSI packages

6.6 To draw the circuit symbol for a 741 Op-amp and show7 die pin number for each terminal

6.7 To furnish the ordering information of Op-Amp

6.8 To describe the power supplies required for Op-amp circuits

6.9 To define (a) input off set voltage (b) input off set current (c) common mode rejection ratio (d) large signal voltage gain (e) slew rate (f) output resistance (g) output short circuit current of operational amplifier

6.10 To state the seven important properties of the Ideal Op-Amp

6.11 To draw the equivalent circuit of Op-Amp

6.12 To define (a) open loop Op-Amp configuration (b) differential amplifier amplifier (d) non-inverting amplifier

6.13 To define (a) ground terminal (b) virtual ground

6.14 To draw the (a) inverting and non-inverting amplifier circuit

6.15 To calculate the close loop gain of (a) inverting and non-inverting

6.16 To develop mathematical expression and state the applications of (a) subtracter (c) integrator (d) differentiator circuit (e) voltage follower

6.17 To define comparator and show the output waveform for sinusoidal input and the reference voltages of (a) zero voltage (b) Positive voltage (c) negative voltage

6.18 Describe (a) zero crossing detector with hysterisis (b) voltage to current (c) currents to voltage converter

6.19 To State some application of Op-Amp, (a) basic voltage measurement (b) resistance voltmeter (c) Zener diode tester (d) diode tester (e) LED tester constant high current source (g) 4-20 ma current loop(h) Tone control converter (i) Temperature to voltage converter (use of AD 590)

6.20 To explain the operation of a multi vibrator circuit and sketch its output voltage waveform and calculate the frequency of Oscillation

6.21 To make a monostable or one shot multi-vibrator

6.22 To develop a square / triangular wave generation using Op-Amp, resistors and capacitor and determine frequency of osicillation

6.23 To develop basic differential amplifier using op-amp

6.24 To develop an adjustable gain instrumentation amplifier using common mode rejection circuits

6.25 To describe the (a) low pass (b) high pass and (c) Band pass filter

7. Integrated circuit tuner (4 hours)

7.1 To describe the internal block diagram and pin connection of a 555 timer chip

7.2 To describe the function of (a) output (b) reset (c) discharge (d) Control voltage (e) trigger (f) threshold terminals of a 555 rimer

7.3 To describe the circuits and working principle of 555 rimer used as (a)Astable Mulri- vibrator (b) Monostable Multi-vibrator (c) pulse width modulator (d) pulse position modulator

8. Power supply and linear Regulated power supply (5 hours)

8.1 To design a full wave bridge rectifier circuit by choosing the proper size of transformer, diode and capacitors

8.2 To measure the percent regulation, percent ripple

8.3 To Design a bipolar unregulated power supply

8.4 To develop a fixed dual voltage power supply using 7800 and 7900n series of IC three terminal regulator

8.5 To develop an adjustable dual voltage regulated power supply using LM317 and LM337 chips

9. C.R.O. , Multimeters and signal generator (6 hours)

9.1 To describe the construction and working principle of cathode ray tube

9.2 To describe the block diagram and field of application of a (a) Linear C.R.O. (b) Digital storage Oscilloscope and describe functions of important controls on the front panel

9.3 To explain the significance of the ferun 31/2 digit and 3 V4 digit display system

9.4 To state die important specification of a Digital Multimeter

9.5 To draw the block diagram and state the field of application of the digital Multimeter.

9.6 To define signal generation

9.7 To write the specification of a signal generator

9.8 To describe the working principle of a signal generator using 1C 8038

10 Class Test (2 hours)

List of Experiments

1. To draw the Emitter characteristics curue of the Injunction Transistor and identify cutoff, negative resistance region and saturation region of the device

2. Construct a UJT Relaxation Oscillator circuit and (a) measure the peak value of (a)Curiffer voltage (b) output voltage (c) frequency of oscillation at different value of R.C.

3 To draw the (a) Drain currents for different values of V^g (b) Transconductance curve ofJEFT

4 Construct the (a) common source (b) common drain (c) common gate amplifier ofJFET and compare their gains

5 To construct the inverting amplifier and verify the gain of amplifier with various ratio of R1 and R2 Also check the gain of input, output signals (use 1C 741)

6 To construct the non — inverting amplifier and verify the gain of amplifier with various ratio of R, and R^. Also check the polarity of input output signals (use IC741)

7 Construct the adder and subtracter circuit using 1C 741 and verify the output voltage with various input voltages

8 Construct an integrator circuit and note the output waveform for a square wave input

9 Construct a differentiation circuit and note the output wave form for a triangular input voltage.
10 To develop a comparator circuit and note the output waveform with sinusoidal input and (a) zero volt (b) positive voltage and (c) negative voltage inputs as the reference input at the non-inverting input terminals.
11 To Develop a square wave / triangular wave generator circuit by using 1C 741 as square wave generator and integrator
12 To develop (a) voltage to current and (b) current to voltage converter circuit and check and adjust its linearity
13 To use a 1C 741 in differential mode and check its common mode rejection capability
14 To develop an instrumentation amplifier by using three 1C 741
15 To establish an astable multi vibrator circuit by using 1C 555
16 To establish a Monostable multi-vibrator circuit by using 1C 555
17 To develop a pulse width modulator circuit by using a 555 timer
18 To develop a regulated power supply unit using (a) step down transformer (b) Four arm bridge rectifier (c) Filter and (d) three terminal 7800 group 1C regulator
19 Perform die test for different load current and input voltage and determine percent regulation
20 Develop an adjustable d.c. Voltage regulator using LM 317
21 Use a 3 V2 digit digital Multi meter for measurement of (a) D.C. voltages (B) A.C. voltages (c) frequency of a signal (d) Value of resistor (e) value of inductors (f) value of capacitor
22 Use a 3 Vz digit digital Multimeter to perform the good bad test of (a) diode (b) transistor (c)SCR.
23 Use a 3 V* digit digital Multimeter to measure (a) true RMS (B) Average and (c) peak value 24 of a rectified sine wave and find its form factor and peak factor
25 Use a dual trace CRO along with a signal generator to note (a) different type of wave forms of the output of signal generator (b) The amplitude and frequency of wave form (c) phase relation between two phase shifted wave forms

References :-

a) Electronic Devices and circuits by Allen Mother shed (PHI)
b) Operational Amplifier and Linear Integrated circuit by robert conghlin (fourth edition Frederick F. Drescolt (PHI)
c) Op-Amp and Linear integrated circuits (3rd Edition) by Ramakant A. Gayakwad (PHI)

ELECTRICAL MACHINE II

L	T	P		Curri. Ref. No.: E 501
3	0	2		
Total Contact hrs.:75			Total marks: 150	Theory:
Theory: 45				End Term Exam: 70
Practical: 30				I.A :30
Pre requisite: E404				Practical:
Credit: 4				End Term Exam: Nil
				I.A: 50

Rationale:-

The subject Machine II is a subject, which deals with the Induction Machine, synchronous Machine and fractional Horse Power Motors. In this subject the construction, working principles, starting principles are to be studied. The testing of the machines and the brief design ideas have also been included here. In addition to the theoretical study of the topics as mentioned above care has been taken for including the practical aspects of the topics. A few problems have also been included here, so that die student can develop the problem solving attitude during their service career.

Aim :

a. To describe the construction and working principles of induction motor
b. To describe the construction and working principles of synchronous machines
c. To describe the construction and design principles of fractional horse power motors
d. To describe the construction and working principles of special type of motors eg D.C.brushless Motor and stepper motor
e. To describe the method of starting of induction motor
f. To describe the testing and installation procedure of induction motor and synchronous machines

Detail of course content

Unit	**Topic/Sub Topic**	**hour**
1.	Induction Motor	15
	1.1 To explain the constructional features of three phase induction Motor	
	1.2 To explain the method of the production of rotating magnetic field produced in a three phase stator winding when three phase supply is applied in it.	
	1.3 To define slip, synchronous speed	
	1.4 To describe the working principle of an three phase induction motor	
	1.5 To develop an expression for torque in three phase induction Motor	
	1.6 To draw the torque speed characteristics of a three phase induction motor	
	1.7 To explain (a) the effect of variation of applied voltage of torque speed characteristics (b) the effect5 of variation of rotor resistance on torque speed characteristics	
	1.8 To explain the method of achieving high starting torque of an three phase induction motor	
	1.9 To explain various methods for starting induction Motor	
	1.10 To explain the modern techniques of starting different type of induction Motor	
	1.11 Explain different method of speed control in three phase induction motor (conventional Method)	
	1.12 Explain the modern method of speed control of three phase induction motor	
	1.13 State and enumerate different losses in three phase induction motor	
	1.14 To determine the efficiency of three phase induction motor considering the losses in the motor	
	1.15 To develop the Electrical equivalent circuit of three phase induction motor	
	1.16 To calculate the torque developed, current drawn, power factor, motor speed of three phase induction motor (usage of standard equation) and data	
	1.17 To describe the testing procedure of three phase induction motor for determining the performance characteristics	
	1.18 To compare the performance of three phase induction motor with other motors	
	1.19 To state the factors on which the suitability of employing three phase induction motor for specific purpose is judged	
	1.20 To state the various methods for testing of Induction Motor	
	1.21 To state the various components in Test Report	
	1.22 State various factors involved in installation of a three phase induction Motor	
	1.23 To state various steps for the maintenance of induction motor	
	1.24 To state the various faults and testing methods for remedial measures	
	1.25 To explain the working principle of single and three phase induction regulator	
2.	Three Phase Synchronous Machine	10
	2.1 To explain the constructional detail of three phase synchronous Machine	
	2.2 To explain the method of inducing poly phase voltage in a synchronous generator	
	2.3 To describe the advantages of a rotating magnetic field system in a synchronous machine over a rotating armature system	
	2.4 To explain the basic principle of developing three phase armature windings	

2.5 To derive the emf Equation and explain the need for (a) distribution winding (b) making a short pitched winding

2.6 To explain the armature reaction and its effect an different load of different power factor

2.7 To determine voltage regulation by synchronous impedance method

2.8 To describe the method of synchronise the incoming alternator with three phase bus bar

2.9 To state the conditions for load sharing between two alternators in synchronised mode

2.10 To explain why synchronous motor is not self-starting

2.11 To explain the effect of change in excitation of a synchronous motor on armature current

2.12 To state application of synchronous machine

2.13 To state the condition/factors for the application of synchronous machine

2.14 To describe the methods of testing the synchronous machines and to determine their performance characteristics

3. Single Phase Motors 10

3.1 To list various type of single phase motors

3.2 To explain the construction of various type of inductor motor (split phase type)

3.3 To explain the construction and working principles of single phase synchronous motor

3.4 To explain the construction and working principles of single phase commutator motor

3.5 To explain the construction and working principle of shaded pole type single phase induction motor

3.6 To draw the performance characteristics of all above type of single phase motors

3.7 To describe the testing procedure of single phase induction motor measurement of (1) speed (2) power consumption (3) torque

3.8 To state the reasons for selecting a specific type of single phase induction motor for a particular purpose.

4. Special Machines 6

To explain the construction and working principle of

4.1 Moving coil Manchine

4.2 Disc Machines

4.3 Linear D.C Motor

4.4 Brush less D.C.Motor

4.5 Stepper Motor

4.6 A.C. Drag cup type servomotor

4.7 D.C.Servomotor

5. Class Test 4

List of Experiments

1. To determine the slip of an induction motor
2. To perform the insulation resistance test of three phase induction motor
3. To perform the high voltage test of the three-phase induction motor
4. To perform the open circuit test of the three phase induction motor
5. To perform the blocked rotor test of a three phase induction motor
6. To perform the Dynamometer method of testing the speed current and speed torque characteristics
7. To perform the pony brake method of the speed current and speed torque characteristics
8.
9. To perform No load test and Blocked Rotor tool to draw circle diagram for determining
   a) The true current and power factor at rated voltage
   b) The maximum output
   c) The maximum torque

d) The full load efficiency
e) Full load rotor speed

10. To determine the effect of rotor resistance on the torque speed curves of an induction motor
11. Determination of Magnetisation characteristics of an alternator (a) at no load rated speed (b) at no load half rated speed (c) at full load (non-induction) rated speed
12. Determination of excitation required to maintain constant voltage in an alternator
13. Determination of the relationship between terminal voltage and load current of an alternator, keeping excitation and speed comfort
14. Determination of regulation and efficiency of an alternator from open circuit and short circuit
15. Determination of the relationship between terminal voltage and load current of an alternator for varying power factor load, the speed and excilation remaining constant
16. Parallel operation of three-phase alternator and load sharing
17. To determine the performance test of ceiling fan and preparation of test report as per Bureau of Indian Standard

Reference:-

a) Electrical Machines by Dr. S.K.Bhattacharya (T.M.H)
b) Electrical Machines by J.D.Edwards (Mackmillan)

ELECTRICAL POWERS SYSTEM II

L T P — Curri. Ref. No,: E502

Total Contact hrs.:45 — Total marks: 100 — Theory:

Theory: 45 — End Term Exam: 70

Practical: Nil — I.A : 30

Pre requisite: E405 — Practical:

End Term Exam: Nil

I.A : Nil

Rationale :

The subject power system has different parts like power generation, Transmission & Distribution of switch gear and protection. Since the topics in the above sections covers very vast areas, it is required to devide the subjects into three different major parts e.g., (i) Power generation (b) Power transmission & Distribution (c) Switch Gear & protection. As the subject power Transmission and Distribution is more or less descriptive and based on the study of structures of transmission line, construction of lines, overhead safety devices, service connections, estimating work, these topics are included in power system. Some care has been taken to include the study of die equipment,

accessories and systems which have been developed very recently. The related IE rules and Bureau of Indian Standard Specifications have also been included here.

Aim :
To acquire knowledge on
(a) Principles of Distribution System
(b) Materials of Overhead Lines
(c) Concept on Line Design
(d) Concept on Line Construction
(e) Concept on Lighting Arrestors
(f) Detail of Service Connection
(g) Construction Detail of underground cables
(h) Maintenance of Transmission & Distribution Lines
(i) HVDC transmission lines
(j) IE Rules .

Detaied Course Content

Unit	**Topic/Sub Topic**	**Hour**
1.	Principles of Transmission and Distribution	3
	1.1 To describe die transmission System and Distribution System	
	1.2 To determine the variation of Transmission efficiency with the variation of System Voltage	
	1.1.2 To state the principle of choice of voltages in generation,Transmission and Distribution	
	1.3 To compare the overhead and underground Distribution	
	1.4 To describe the distribution systems eg	
	a) Radial system	
	b) ring main system	
	1.5 To describe	
	(a) 2-Wire D.C.System	
	(b) 3-Wire D.C.System	
	(c) Single phase A.C	
	(d) Three phase A.C.System	
	1.6 To determine the copper efficiency of	
	a) D.C. 2-wire system	
	b) 3 wire D.C.System	
	c) single phase A.C	
	d) Two phase A.C	
	e) three phase 3 wire.System	
	f) Three phase 4 Wire system	
	1.7 To determine the current loading in three phase 4 wire feeder system	
	1.8 To determine the voltage drop in A.C Feeder (Single phase	
	1.9 To determine the voltage drop in three phase AC Feeder	
	1.10 To describe the A.C distributor and determining the sending end voltage	
2.	Materials of Overhead Line	3
	2.1 To describe the construction characteristics and their applications of	
	a) Poles and Wood Poles	
	b) Treatment of wood Poles	
	c) Concrete Poles	

d) Steel tubular poles
e) Rail Poles
f) Steel towers with cross arms brackets
g) Stays, struts and other line accessories like Arcing Horns etc. suspension clamp, strain clamp, snail clamp, tubular compression dead end, etc and binding wires dampers etc

2.2 To describe the construction, characteristics and field of application of
a) Shackle Insulators
b) Pin Insulators
c) Post Insulators
d) Disulators
e) String Insulators

3. Concepts on line Design 3

3.1 To describe the rules and practices on
a) Selection of phases
b) Selection of conductor size
c) arrangement and spacing of conductor
d) selection of height of poles or Towers
e) Clearances between power lines
f) selection of span
g) Calculation of Sag
h) maintaining the clearance from building (Vertical & Horizontal)
i) maintaining the clearance between powerlines& telelines, railway crossing, River crossing
j) earthing and counterpoise of transmission and distribution line

4. Line Construction 2

To describe different steps in line construction

4.1 Using Poles e.g.
a) Methods of line survey
b) Installation procedure of poles
c) fixing of fittings and fixtures

4.2 Using Towers
a) construction of Towers
b) Method of Tower Earthing
c) Method of installing insulator string, dampers
d) paying out & stringing of conductors
e) Preparing different type of conductor joints

5. Lighting Arresters 3

To describe the construction and functions of the following

5.1 Ground wire
5.2 Horn gap arresters
5.3 Pellet type oxide film arrestors
5.4 thyrite arrestor
5.5 Auto valve arrestor
5.6 Location of the connection of lighting arrestors from transformer

6. Service Connection & Tests 5

To describe

6.1 Layout of the low and Medium voltage Distribution system

6.2 To describe the detail of service connection of overhead line (low and Medium voltage)
6.3 To describe the detail of service connection of underground system
6.4 To describe the detail of service connection of high Tension supply system
6.5 To state the relevant IE Rules and IS specification regarding the tests before giving service connections
6.6 Insulation Testing & EarthTesting

7. Underground cables 7
7.1 To describe the types of cables
7.2 To describe lonisation cables
7.3 To describe the construction of Extra High cables
7.4 To state the standard size of cables and their field of applications
7.4.1 To write the specification of underground cable
7.5 To describe the construction of (a) PILC Cable (b) XLPE Cable (c) PVC Cable
7.6 Describe the testing of cables (as per IS Specification)
7.7 To describe the methods of cable laying
7.8 To describe the method of Cable joints for (a) PILC Cable (b) XLPE Cable (c) PVC Cable
7.9 To describe Cable end Boxes
7.10 To state the type of Tests for commissioning of cables

8. Maintenance and Repair of Transmission and Distribution Line 6
8.1 To describe the method inspection
8.2 To describe the method of repairing of line and snapped conductor
8.3 To describe the rules for safety precautions

9. HVDC Transmission line
10.1 To describe the HVDC Transmission system
10.2 To compare the HVDC Transmission system with HVAC Transmission system

10. IE Rules 1956
11.1 To state the IE Rules related to
a) Overhead lines
b) Conductors at different voltages on same supports
c) Erection of or alteration to building structure, flood banks and elevation of roads
d) Clearance
e) Routes
f) Maximum intervals between supports
g) same structure carrying the Telecommunication lines
h) Lines crossing or approaching each other
i) Guarding
j) Service from OH Line
k) Earthing
l) Metallic bearer wire used for supporting insulated cables
m) Protection against lighting
n) Unused overhead lines

11. Class test 3

Bibliography

a) Power Installation (Overhead lines)
By S.R Chakravorty

(Venus publication 7 jaganath Sur Lane Kolkata 6)

b) Electrical Power
By S.R Chakravorty
(Venus publication 71/2B bidhan Sarani Kolkata 6)

c) IE Rule

d) Relevant B.I.S Specifications

POWER ELECTRONICS

L	T	P		
3	0	2		
Total Contact hrs.:75			Total marks: 150	Theory:
Theory: 45				End Term Exam: 70
Practical: 30				I.A. : 30
Pre requisite: E408,E409				Practical:
Credit :4				End Term Exam: Nil
				I.A.: 50

Curri. Ref. No.: E503

Rationale:

Power Electronics is an interdisciplinary area using the members of Thyristor family control electronics to control the switch ON and switch OFF processes of the devices and principles of control theory. The filed of control electronics also had a great change from discrete and log system to the digital integrated and microprocessor control. T he area power electronics had a two sided development (a) the semiconductor devices of improved performance^) control circuit of these devices. Thus the care has been taken to include the study of the characteristics of the power devices which are being used and also their control circuits star6dng from their rudimentary level to the block diagram study of the sophisticated computer control system.

Aim:

To acquire knowledge in

a) The characteristics of power devices like thyristors and power diodes
b) Field of application of the power diode and thyristors
c) The construction and working principles of speed control circuits of d.c. and a.c. machines
d) The construction and working principles of a.c. power conditioners.
e) The construction and working principles of inverters, switch Mode power supplies and uninterrupted power supplies.

Detailed Course Content

Unit	Topic/Subtopic	Hours
1	The Thyristor and their characteristics 1.1 To describe the construction, working principle, characteristics and rating of a) Power diode b) Silicon controlled rectifier c) Power Transistor d) Gate turn off Thyristor (G.T.C.) e) Triac f) Diac	(4 hours)

1.2 To classify Thyristors
1.3 To state the available range of following
a) power diode (general power diode, fast recovery diode, schotdng diode
b) Thyristor (SCR) c) Power Transistor d) Gate Turn off Thyristors (GTO)
c) Power MOSFET;s f) Triac g) Diac.
1.4 To explain the basic principle of selection ofThyrsitors
a) Overloads and fault current b) Voltage ratings c) Diode behavior of thyristor
d) Snubber e) Series parallel operation f) Current sharing during switching
g) Forward break over voltage h) Anode current i) Collector current
j) Gate current and gate voltage k) Turn on and Turn off time
l) Break down voltage

2 Power Diodes & Power Transistors (2 hours)
2.1 To classify power diodes and state their characteristics and field of application
2.2 To describe a) forward recovery b) reverse recovery characteristics of power diode
2.3 To describe a) the static characteristics of transistor b) Turn-on and Turn off times of transistors c) Second break down in transistor d) Breakdown voltage of transistor e) Base drive circuit of transistor
2.4 To describe the properties, type and construction of Metal Oxide semiconductor field effect transistors (MOSFET)
2.5 To describe the static characteristics of MOSFET
2.6 To describe the properties, construction of metal Oxide Semiconductor insultate gate transistor
2.7 To describe the dv/dt and di/dt protections of transistors.
2.8 To describe the properties and construction of Static Induction Transistors.

3. Line Cumulated Converters (2 hours)
3.1 To define a) Converter b) Inverter
3.2 To classify and explain line cumulated converter in terms of quadrant of conversion
3.2.1 Describe single phase converter applicable to a) purely resistance b) combined resistance and inductive load with compensation by free wheeling diode d) a resistance in senes with back. emf d) a resistance, inductance e back emf and free wheeling diode
3.2.2 To describe the following with the equation for output voltage
a) three phase half w^ve converter b) three phase semiconverters
c) three phase full converters d) three phase dual converter
3.2.3 To describe the methods of power factor improvement for phase controlled converters
3.2.4 To state the basic considerations for designing converter circuits.
3.2.5 To describe the gating circuits of thyristor converter

4 A. C. Voltage Controllers (3 hours)
4.1 To explain the principle of A. C. voltage control
4.2 To describe the principle of a) ON OFF Control and b) Phase control for single phase and three phase toads (Star/Delta connected loads
4.3 Describe the single phase tap changer circuits
4.4 Describe the a) single phase b) three phase cycloconverters
4.5 Describe AC Voltage controller circuit with PWM control
4.6 To state the basic consideration for the design of AC voltage controller circuit
4.7 To describe the effects of source and load inductances

5. Thyristor Commutation Techniques (3 hours)
5.1 To describe the methods of

a) Natural commutation b) Forced Commutation c) Self Commutation
e) impulse commutation e) Resonant pulse commutation f) Complementary commutation g) External pulse commutation h) Load side commutation
j) Line side commutation

5.2 To state the basic considerations for the commutation circuit Design

6. D.C. Chopper and Switch Mode Power Supply . (3 hours)

6.1 To define the D,C. Choppers and their field of application
6.2 To describe the principle of step down and step up operation
6.3 To classify the choppers and explain the operation principle of each class
6.4 To describe the block diagram of switch Mode regulator
6.5 To describe the basic principle of thyristor chopper circuits
6.6 To describe the basic principle for Pulse Width Modulated Inverter circuit for single phase and three phase output.
6.7 To describe the principle of voltage control in single phase inverters
6.8 To describe the principle of forced coumulated Inverters
6.9 To describe the principle of parallel resonant inverter

7. Static Switches (Using thyristors) (3 hours)

7.1 To describe the principle of operation of a) single phase A.C. switches
b) three phase A.C. switches c) three phase reversing switches
c) A.C. switches for bus transfer e) single pole thynstor D.C. switch
f) solid state relays for (1) D.C. (2) A.C.circuits

8. Power supplies (5 hours)

8.1 To explain the purpose for developing A.C. and D.C. Power supply (in industries)
8.2 To describe he principle of operation of
a) switched mode D.C. power supply
b) Resonant power supply
c) Bidirectional D.C. power supply
d) A.C. power supplies and VPS configuration
e) Power Factor conditioning system

9. D.C. Drives (5 hours)

9.1 To classify different type of drives
9.2 To describe a) Basic characteristics of D.C motors b) operating modes of D.C. Motors
9.3 To describe the circuits and operating principles of
a) single phase (al) half wave converter drive (a2) semi converter drive
b) (a3) full converter drive (a4) dual converter drive
c) three phase (bl) half converter drive (b2) semi converter drive
(b3) full converter drive (b4) dual converter drive.
9.4 To describe the closed loop control system of D.C. Drive
9.4.1 To deduce (a) the open loop transfer function of the system (b) the closed Loop transfer function of the system
9.4.2 To describe (block diagram representation) of closed loop speed control with inner current loop and field weakening
9.4.3 To describe (a) the phase locked loop control system (b) Microcontrol of D.C. Drive

10. A.C. Drives (4 hours)

10.1 To list different method of A.C. motor control
10.2 To draw the schematic diagram of (a) stator voltage control
(b) Rotor voltage control (c) frequency control (d) stator voltage and frequency control (e) stator current control (f) voltage current and frequency control

11. Protection of devices and circuits (4 hrs)
    11.1 To describe the design consideration for cooling system ofthyristors
    11.2 To describe different type of snuber circuits
        11.2.1 To describe the method of suppression for (a) reverse recovery Transcents (b) supply and load side transcents
        11.2.2 To describe the method of voltage and current protection circuits.
12. Triggering Circuit (3 hours)
    12.1 To describe the (a) phase shift triggering (b) pubed triggering (c) gated pulsed triggering (d) optocoupled triggering system for SCR's and triacs
    12.2 To describe the pulse transformer operation and state the design Considerations
    12.3 To describe the soft start method of starting of large Inductor Motor
13. A. C. Voltage Control (2 hours)
    13.1 Describe the operating principle of (a) constant voltage transformer (b) Servo controlled voltage stabiliser
    13.2 Describe the working principles of different type of Electro Magnetic Interference suppressor
    13.3 Dielectric and induction heating
14 Class Test (2 hours)

List of Experiments

1. To draw the characteristics curve ofS.C.R.
2. To assemble the turn ON and turn OFF circuit of SCR and check the performance
3. To assemble and run push pull inverter circuit (Transistorized)
4. To assemble and run push pull inverter circuit (SCR version)
5. To assemble and control the current through DC load (360° control) by Phase Shift Method
6. To develop the circuit for current regulation through heater by phase shift Control of triac
7. To control the speed of a D.C. motor through full wave rectifier bridge and SCR (phase shift control)
8. To regulate the speed of a D.C. motor by using of zero crossing detector And UJT Oscillator .
9. To regulate the speed a D.C. motor by pulsed triggering through optocoupler
10. To regulate the speed of a D.C. motor by gated pulsed triggering and Through pulsed transformer
11. To regulate the speed of an A.C. load by PWM Circuit
12. To develop the back and boost converter circuit for D.C. to D.C. conversion And check its performance
13. To run and study of a closed loop D.C. Motor control system
14. To trace the circuit of constant voltage transformer
15. To trace the circuit of a servo controlled voltage stabilizer.
16. To develop and assemble the Electro Magnetic Interference suppressor Circuits and check the performance
17. To assemble and run the soft start method of starting of induction Motor (Wring triacs)
18. To assemble, run and check the performance of a SCR controlled Automatic battery Charger
19. To develop forced commutation circuits for (a) resistive load and (b) Inductive loads

Bibliography :

1. Power Electronics - Md. H. Rashid (PHI)
2. Power Electronics - vdedam Subrahmanium (New Age International Publisher)
3. G.E Manual
4. Power Electronics - P.C Sen (T.M.C)

ELECTRICAL ESTIMATING AND ILLUMINATION DESIGN

L	T	P		
3	0	0		Curri. Ref. No.: E504
Total Contact hrs.:45			Total marks: 100	Theory:
Theory: 45				End Term Exam: 70
Practical: Nil				I.A: 30
Pre requisite: E405,E406				Practical:
Credit: 3				End Term Exam: Nil
				I.A:Nil

Rationale:
Electrical Engineering Diploma holders are very often faces the problems of estimation of the Electrical distillation work and the design aspects of die illumination system. The basic idea of electrical installations detail of electrical components and accessories and luminaries and design procedure of illumination system is discussed here. The study of borrow of Indian standard specifications are also to be discussed in this subjects

Aim :
1. To describe the steps of design procedure
2. To describe the steps of estimating procedure
3. To design the circuits of motor controllers
4. To estimate the quantity and cost of components
5. To prepare the list of components with full specification
6. To select correct size of components
7. To design and estimate the illumination system for domestic, office, street light courtyard and factors installation

Detail course content

Unit	Topic / sub Topic	Total Hours
1.0	Electrical symbols and standards	(2 Hours)
	1.1 To state the need of electrical system	
	1.2 To prepare the list of symbols	
	1.3 To illustrate different electrical diagram	
	1.4 To state the mediods of representatives for wiring diagrams	
2.0	Lighting Installation	(6 Hours)
	2.1 To calculate the following of a domestic building	
	a) Total load of the installation	
	b) Size of Feeder and main switches	
	c) Number of sub circuits	
	d) Size of sub circuit components	
	e) Length and number of components	
	f) Total cost of the installation	
	2.2 (a) To show the layout of the installation on building plan	
	(b)Prepare the single line and multiline Diagram showing the size of components	

3.0 To estimate the detail connection of a service line from (6 Hours)
a three phase four wire over head system
(3 phase 4 wire 400 V, 50Hz 20KW load)

3.1 To calculate the following for an industrial installation
- a) Total load of the installation
- b) Size of Feeder and main switches
- c) Number of three phase sub circuit
- d) Number of single phase sub circuit as per Bureau of Indian standard
- e) Size of components
- f) Length and number of components

3.2 To Prepare layout of the system

3.3 To show the single line diagram

3.4 To estimate the cost of the installation

4.0 To estimate the cost of a pole mounted substation (6 Hours)
(11 KV/400 three phase 4 wire secondary 150 KVA distribution load)
- a) Show detail diagram of the accessiories mounted
- b) Prepare list of equipment with full specification
- c) Indicate the quantity and cost of components.

5.0 Automatic Starter Design (4 Hours)
- a) To design and estimate the automatic star / Delta starter using contractors and time delay unit
- b) To show the connection Diagram
- c) Prepare list of components with full specifications
- d) Estimate the total cost

6.0 Distribution Panel Design (4 Hours)
- a) To design and estimate distribution panel including the bus bar and metering system
- b) To prepare the detail diagram
- c) To prepare the list of equipment with detail specification
- d) To estimate the cost

7.0 Transformer Design (7 Hours)
- a) To design and estimate the small 100 VA 230V /15-0-15, 50Hz transformer
- b) To show design steps
- c) To write the notes on selection of materials
- d) To estimate the size, quantity and cost

8.0 Design of illuminadon scheme (7 Hours)

8.1 To define the important terminology's related to illuminadon

8.2 To state the laws of illuminadon

8.3 To use the standard formulae for determining the required lumen output

8.4 To determine the number of luminaries

8.5 To state different illuminadon levels for different purpose

8.6 To define, state and describe different type of luminaries like fluorescent lamp, Incandescent lamp. Sodium vapour lamp etc.

8.7 To Design a practical lighting scheme for
- a) Domestic installations b) Drawing office
- c) courtyard lighting d) street lighting

9.0 Class Test (3 Hours)

Reference :-

a) Electrical design, Estimating and costing by Raina and Bhattacharya (Willey)
b) Electrical Installation work by T.G. Frames (ELBS)

SWITCH GEAR AND PROTECTION

L	T	P		
3	0	0		Curri. Ref. No.: E505
Total Contact hrs.:45			Total marks: 100	Theory:
Theory: 45				End Term Exam: 70
Practical: Nil				I.A.: 30
Pre requisite: E405,E502				Practical:
Credit: 3				End Term Exam: Nil
				I.A :Nil

Rationale :

Switch gear and Protection plays an important role in the Electrical power system. Since the demand of Electrical power is increasing the job of generation, transmission and Distribution of Electrical Energy is becoming very complicated. To the modern technique of efficient generation, transmission and distribution is coming of regularly. The uses of inter connected bus National power grid is increasing day by day. For the job of operation, maintenance and repair work the service of electrical technicians care very essential. In this subject lot of information are provided so that the updated knowledge can be given to the student of Diploma in Electrical Engineering.

Aim :
To acquire the knowledge of
(a) The basic principles of protection of feeders, and electrical devices like trans former and Machine
(b) The devices used for protection circuit
(c) Fundamental principles of construction operation and Maintenance of circuit breakers inclusive of vacuum circuit breaker
(d) Testing of protective systems and switch gears

Detailed course content

Unit	Topic / Sub Topic	Total Hours
1	Protective Relays	(4 Hours)
	1.1 To describe the following (a) causes of faults (b) consequences of faults (c) relay protection (d) zones of protections (e) essential qualities of protection (f) primary and back up protection (g) basic principle of operation of protective system (h) economic considerations	
	1.2 Basic principles and components of protection	

1.2.1 To explain methods of discrimination

1.2.2 To explain the method of derivation of a single -phase quantity from three phase quantities

1.2.3 To describe the components of protection

1.3 Operating principles and constructional Features of Relay

1.3.1 To state (a) the classification (b) principal types of electromagnetic relays

1.3.2 Explain (a) the theory of induction relay torque

(b) the theory of rely design and construction

2. Relay Application and characteristics (4 Hours)

2.1 To describe the functions and operating principle of

(a) over current relays (b) instantaneous over current relay

(c) application of time current relays

(d) time-graded protection with over current relays

(e) directional relays (f) directional over current relays and their connections (g) distance relays (h) Impedance relay

(i) Ohm rely (j) differential relays

3. Feeder Protection (6 Hours)

3.1 To describe the protection and their selection

3.2 To explain the principle of over current protection in respect of

(a) non-directional time and current grading

(b) directional time and current grading

(c) over current earth fault protection

(d) directional earth fault relays

(e) Earth-fault detection in systems earth through A.C. suppression oil

3.3 To explain the principle of distance protection in respect of

(a) effect of the ratio source Impedance to line impedance (Zs / Zv)

(b) time grading of distance relays

(c) requirements of definite distance schemes (d) fault resistance

(e) reach of distance relay (f) scheme of distance protection

(g) distance protection by impedance relays

(I) distance protection by reactance relays (j) MHO distance protection

(k) over loads and power sharing (1) current and voltage connection

(m) selection of distance scheme (n) application of three-phase system.

3.4 To explain pilot protection in respect of (a) wire pilot protection

(b) carrier and Microwave pilot protections

3.5 Apparatus protection

3.5.1 Transformer protection

3.5.2 To describe (a) the nature of transformer faults

(b) Faults in Auxiliary equipment (c) winding faults

(d) overloads and external start-circuits

(e) differential protection of transformers

(f) problems encountered in differential protection of transformers,

(g) percentage or biased differential relays

(h) methods for preventing operation on Inrush currents

(I) Influence of winding connections and

earthling on earth fault current (j) star-winding with

resistance earthed neutral (k) star-winding neutral solidly earthed

(1) delta winding (m) over current and earth-fault

(n) earth leakage protection (o) restricted earth-fault protection

(p) Gas actuated relays (g) transformer feeder protection

4.0 Generator Protection (3 Hours)

4.1 To describe type of generator faults e.g.
(a) stator fault (b) Rotor fault (c) Abnormal running conditions
4.2 To describe (a) the stator protection systems
(b) the rotor protection systems
(c) the field feature protection
(d) unbalanced load up protection
(e) over load protection (f) prime mover protection
(g) over speed protection (h) over voltage protection
4.3 To describe the protective scheme for a direct connected generator
4.4 To describe (a) the protection of generator transformer unit (b) relay tripping functions

5.0 Motor protection (3 Hours)
5.1 To describe different type of motor faults
5.2 To describe the protection systems of (a) stator
(b) Rotor (c) over load (d) unbalance and single phasing
(e) under — voltage (f) Reverse phase protection (g) loss of synchronism

6.0 Bus Zone protection (3 Hours)
6.1 To describe different type of Bus Zone faults
6.2 To explain (a) Bus backup protection
(b) differential scheme of Bus Bar protection
(c) frame leakage protection

7. Auto re-closing (4 Hours)
7.1 To define (a) Operating time of protective relay
(b) operating line of circuit breaker
(c) dead line of circuit breaker or system
(d) dead time of Auto re-close relay
(e) closing impulse time of auto-re-close relay
(f) reclaim time of auto re-close relay
(g) re-closing line (h) Lockout of circuit breaker
(I) lockout of auto re-close relay (j) anti-pumping
(k) number of shots (1) spring winding Zonal
(m) operating counter (n) counting relay
7.2 Describe the auto re-close system of
(a) Medium voltage auto re-close
(b) High voltage auto re-close

8. Testing and maintenance of Protective gear (4 Hours)
8.1 To explain the basic principle of relay testing
8.2 To describe (a) factory tests of relays
(b) the installation or commissioning test
(c) period maintenance tests
8.3 To describe (a) Test benches (b) heavy current test plant
(c) general methods of testing protective gear
(d) current transformer test (e) potential transformer test
(f) phasing check
8.4 To describe features of design which assist maintenance.

9. Static Relays (3 Hours)
9.1 To describe the basic principle for the development of static Relay
9.2 To describe the principle of operation of
(a) Electronic relay (b) transductor relay
(c) Rectifier bridge relays (d) transistor relays
(e) Hall — effect relays (f) gauss effect relays

10. Basic static Relays used in protective schemes. (3 Hours)
    10.1 To describe die basic elements of a static Relay e.g.
        (a) Input element (b) Measuring element
        (c) output element (d) Feed element
    10.2 To describe the working principle of over current Relays e.g.
        (a) static time- current relay and time-current characteristics
        (b) directional over current relays
    10.3 To explain (a) differential protection (b) static distance protection
11. Circuit breakers (6 Hours)
    11.1 Theory of circuit interruption
    11.2 To state the rating of a circuit breaker
    11.3 To define the effect of re-striking voltage transients
    11.4 To describe this interaction between the breaker and circuit
    11.5 To classify (a) current dropping (b) duties of switch gear
    11.6 To describe (a) automatic switch (b) air circuit breakers
        (c)Oil circuit breakers (single break and multi-break construction)
        (d) Air-blast circuit breaker (e) performance of circuit breakers and system requirements (f) terminal start air unit and R.R.R.V.
        (g) interruption of small inductive and capacitive currents (h) Modification of circuit breaker duty by shunt resistors
    11.7 To state the recent developments in circuit breakers

Reference :

(a) Power System Protection and switch gear
    By B.ravindranath E-M-Chamber (New Age Pvt. Ltd Publisher)
(b) Switch Gear and protection
    By Sawhney
(c) Switch Gear and protection
    By Dr. R.S Jha

REPAIRING OF ELECTRICAL MACHINES

L T P
Total Contact hrs.:45
Theory: 15
Practical: 30
Pre requisite: E405,E409
Credit: 2

Total marks: 100

Curri. Ref. No.: E506
Theory:
End Term Exam: 50
I.A :Nil
End Term Exam: Nil
Practical:
I.A: 50

Rationale :

It is needed that the shop floor experience on dismantling and assembly of Electrical machines within the curriculum of Diploma in Electrical Engineering. The learning of the procedure may be possible within a few lecture classes, but the practice should also be arranged in the workshop. This subject is designed to provide the scope of acquiring knowledge both theoretically and practically.

Aim :
To acquire skill and knowledge in
(a) dismantle and assemble of Electrical machines like motor, transformer, switch units and starter
(b) repairing techniques of the above machines

Detail Course Content

SLNo	Topic/Sub Topic	Hour
1	Repair of Electrical Machines 1.1 To describe the construction and list the troubles of Electrical Machines 1.2 To state the method of inspection and determination of defects in an Assembled Machine 1.3 To describe the dismantling process and determine the defects in a disassemble machine 1.4 To describe the machine assembly procedure 1.5 To describe the Endshield Repairing Procedure 1.6 To describe the ship ring and commutator repairing procedure 1.7 To describe the repair of slip ring Mechanism and brush repair 1.8 To describe die method of shaft repair 1.9 To describe the method of terminal and lead repair 1.10 To describe the method of core- steel repair 1.11 To describe die method of rotor or armature balancing 1.12 To describe the method of winding repair 1.13 To describe the winding insulation and joining techniques 1.14 To perforce the test as per Bureau of Indian Standard	5
2	To apply binding to Rotors and armature	5
3	To describe the impregnation and drying process of winding	5
4	To describe the tools and machines used for machine repair	3
5	To state the relevant Bureau of Indian Standard for testing of equipment after repair	3
6	Transformer Repairing 6.1 To describe the repair of low and medium rating Power Transformer 6.2 To list the factors for inspection before the repair of faults 6.3 To describe the method of inspection of core and winding 6.4 To describe the method of core repairs 6.6 To describe the method of repair, preparation and drying of windings 6.6 To describe the method of repair of top changer 6.7 To describe the method of bushing repair 6.8 To describe the method of repair of tanks, conservators and fillings 6.9 To describe the method of transformer assembly 6.10 To	6

	describe the different testing and measurement procedure as per Bureau of Indian Standard Specification	
7	To describe the periodic maintenance of Switch Fuse Unit changeover and bus bar and different type starters	5
8	To prepare the maintenance schedule of a high power transformer	4
9	To prepare the operation and maintenance schedule of a Diesel Generating Set	4
10	To describe the commissioning procedure of a Power Transformer	5

NB : Some visit are to be arranged for observing repair procedure in Workshops and manufacturing unit

Reference:

(a) Repair shop Electrician
By G.Vartanov, V.Verner, V. Serebryakov (Peace Publishers, Moscow)

DIGITAL ELECTRONICS & MICROPROCESSOR-1

L T P
3 02

Curri. Ref. No.: E507

Total Contact hrs.:75
Theory: 45
Practical: 30

Total marks: 150 .

Theory:
End Term Exam: 70
I.A: 30
Practical:
End Term Exam: Nil
I.A : 50

Pre requisite:E408,E409
Credit: 4

Rationale:

A lot of MSI, LSI, VLSI and Microprocessors have been developed and are being widely used in the Industrial Applications. To understand the functions of the above- mentioned chips it is required to learn the basic principles. So different topics of digital electronics have been included in this subject. As The field of Digital Electronics and Microprocessor is very vast the subject is divided into two parts. In the first part the study of fundamental principles have been included visa vis the study of combinational and sequential logic application of different 1C chips have also been included here. The knowledge of digital to Analog and Analog to Digital converters are very essential for interfacing the analog to Digital System. So these topic have also been included

Aim:

1. To acquire knowledge on the operation of basic building blocks e.g. AND, OR, NOT
2. To develop the (a) combinational logic circuits (b) Sequential logic circuits
3. To acquire knowledge on the operation of DAC and ADC modules
4. To develop application circuits by using available standard 1C Chips

Detailed Course Content

Unit	**Topic/Sub-Topic**	**Hour**
1	Number system. Radix conversion and Binary Codes	(5 Hours)

1.1 To define (a) binary (b) bit (c) base or radix (d) Numeric coding

1.2 To write the generalised equation for the conversion of a number from other systems to the decimal systems

1.3 To convert a number from other systems to the decimal system by using the generalised equation

1.4 To convert(a) decimal number to binary number (b) octal to binary (c) Binary to Octal (d) Hexadecimal to Binary (e) Binary to Hexadecimal (f) Octal to Hexadecimal (g) hexadecimal to octal number

1.5 To classify the numeric codes

1.6 To define

a) Weighted code al) BCD Code

b) Non weighted code bl) Non-error detecting code

(c) R^g counter code (d) excess three code (e) gray code

(f) self checking code (g)parity checking code (h) error checking code

(i) simple error correcting code (j) self correcting code (k)learning code

(l) alphanumeric code (m) display code (n) seven segment display (o) dot matrix display

1.7 To perform

(i) Binary addition

(ii) Binary subtraction

(iii) Binary multiplication

(iv) Binary division

1.8 To perform the (a) 1's complement operation of binary number (b) binary subtraction by using 1's complement operation (c) 2's complement operation (d) binary subtraction using 2's complement

2. Digital Logic Circuit and Boolean algebra (5 Hours)

2.1 To describe (a) switching circuits (b) Logic gates (c) Symbols for logic gates (d) truth table for different type of gates

2.2 To realise exclusive-OR in terms of basic building blocks

2.3 To define universal building blocks and realisation of basic logic gates in terms of universal logic gates

2.4 To use diode, transistor, FET, MOSFET as logic gates (or switches)

2.5 To be familiarised with RTL,DTL,TTL, ECL. IIL, MOS Circuits

2.6 To define SSI, LSI,MSI, Microprocessor, Fan in. Fan out, Noise level in TTL circuits, totempol configuration

2.7 To use Boolean Algebra for the verification De-Morgan's theorem and other Boolean Functions

2.8 To describe (a) sum of product (b) NAND gate realisation (c) Product of Sum (d) NOR gate realisation

2.9 To define (a) Minterm (b) Maxterm (c) canonical

2.10 To use Karnaugh Map for simplification of Boolean equation (Karnaugh map utilising Minterms and Maxterms)

3. Combinational and arithmetic Logic Circuits (2 Hours)

3.1 To develop and explain (a) Half Adder(b) Full Adder (c)Binary parallel Adder (d)Subtractor (e) Full & half subtracter (f) Adder/Subtractor in Ps complement and 2's complement system (g) BCD addition and subtraction in 9's complement system (h) excess 3 adder and subtracter

3.2 To develop and explain following circuits (a) comparators (b) Encoder (c) decoder, (d) muldplexing(e) demultiplexing (f) priority encoder (g) BCD to seven segment display decoder

3.3 State the application of above circuit

4. Sequential Circuits (2 Hours)

4.1 To develop and explain the following circuits
(a)Flip Flop using NAND or NOR gate (b)RS-FUp Flop (c) clocked RS Flip Flop (d) D Flip-Flop (e) Triggering of Flip-Flop (f) J-K Flip-Flop (g) T Flip-Flop (h) Master slave Flip- Flop

4.2 To state the application of the above circuits

4.3 To develop and explain following circuits
a)\ Asynchronous or ripple counter (b) Modulo counter
(c) synchronous counter (d) Divide by N counter (e)Decade counter (f) up-down counter (g) ring counter (h) Jhonson Counter

4.4 To state the application of above counters

5. Shift Register (2 Hours)

5.1 To develop and explain following circuits
(a)Shift Register (b) Buffer Register (c) Serial in serial out register (SISO) (d) Parallel in serial out shift Register (PISO)
(e) Parallel in Parallel out shift Register (PIPO)
(f) Bi-directional shift Registers (h) Universal Shift Register

5.2 To describe the connection diagram and application of 1C Shift Registers.

6. Digital Memories (2 Hours)

6.1 To describe the functions and applications of Digital memories like
(a)RAM (b)ROM (c)PROM (d)PLA
(e)FIFO (f)Magnedc core memories
(g)Magnedc Surface storage devices (h)Magnedctape
(i)Magnedc Disc Storage device

6.2 To describe the following operation with the help of digital circuits
a) Serial adding
b)Parallel adding
c) Parallel subtracting
d)Combined adder subtracter
e) Multiplication circuit
f) Division circuit

7. DA and AD converter (4 Hours)

7.1 To explain the working principles of
a) D/A Converter with binary weighted register
b) D/A converter with R and 2 R resistors
c) Monolithic/hybrid D/A Converter e.g. (1) MC 1408 (2)NE/SE5018

7.2 To describe a practical circuit for using D/A converter in instrumentation and control circuit

7.3 To explain the working principle of
a) Successive approximation A/D converters
b) Monolithic/hybrid A/D converter
c) Single and dual slope integration ADC
d) Counter and servo type ADC
e) Parallel type ADC

7.4 To describe a practical circuit for using ADC in instrumentation and control circuit

8. Popular 1C Chips used in practical circuits (6 Hours)

8.1 To develop a parallel Full adder circuit using TTL chip 7483

8.2 To develop a 3 to 8 decoder circuit using 7420 chips

8.3 To set up a BCD to 7 secget Display decoder circuit

8.4 To develop a 4 digit counter system using 7490 (Decade counters)
8.5 To develop a 4 bit serial in parallel out shift register using 1C 7476
8.6 To develop dive by 'N' counter using 1C 7473
8.7 To develop a multiplexed display decoder cum counter by using MM 925
8.8 To design a digital system for controlling the elevator by using sequential logic.

List of Experiments

A. Experiments by using Digital Trainer Kit

1. Verification of Truth Tables for AND, OR,NOT, Exclusive-OR gates
2. To develop exclusive-OR gate using basic building block
3. To develop the half adder and full adder circuit and verify the truth table
4. To connect a 4-bit parallel full adder circuit and verify the Truth Table
5. To connect four Flip Flop circuit to develop a four bit ripple counter
6. To connect aJ.K. Flip Flop circuit and verify the truth table for various input ofJ and K
7. To connect 4 Flip Flop with "Pro" and "CLR" input terminal for developing different type of shift registers
8. To connect the 7492 counter chip to develop different module counter
9. To connect the 7490 decade counter with display decoder system for showing the counting operation
10. Connect the XOR circuit to develop parity bit checker

b. Experiments by using bread board and 1C chips

1. To develop a 3 to 8 decoder circuit
2. To develop a set-reset Flip Flop by using 7400 (NAND Gate) chip
3. To develop a divide by *N1 counter by using 7473 chip
4. To develop a two digit counter by using 7490, 7448 and seven segment Display
5. Develop a 4 to 1 multiplexer circuit by using discrete chips
6. To develop a 4 digit multiplexed display counter by using MM 925 and other relevant components
7. To develop a up down counter circuit by using Flip Flops and AOI (And OR Invert) circuits
8. . To connect the DAC chip MC1408 L or 0800 in the circuit to check the conversion process
9. To connect the ADC 7109 on the circuit to check the conversion process

References :

1. Digital Electronics and Microcomputers - R.K.Gaur (Dhanpur Rai)
2. Fundamental Engineering - Lionard S. Bobrow(Oxford)
3. Digital Principles and application - Malvino & Leach (TMH)
4. Digital Electronics and Microprocessor (Problems and solution) - R.P.Jain (TMH)
5. Elements of Computer Science by S.Srinivasan (New Central Book Agency (Pvt) Ltd)

DIGITAL ELECTRONICS& MICROPROCESSOR -II

L	T	P	Curri. Ref. No.: E508
3	0	2	

Total Contact hrs.:75 Total marks: 150 Theory:
Theory: 45 End Term Exam: 70
Practical: 30 I.A :30
Pre requisite: E507 Practical:
Credit: 4 End Term Exam: Nil
I.A:50

Rationale: -
Digital Electronics & Microprocessor is not a new subject. Though the progress and advancement in this area is very fast, the study of the basic principles e.g. the study of digital building blocks and 8085A system is still continuing. As the field is very vast, The whole subject is divided into two parts. The study of Microprocessor its peripheral devices, advance level microprocessor and microcontrollers are included in the second part. A lot of emphasis has been given to do some exercise on design aspects for the better understanding. A lot of lab exercises have been included for better understand of the subject.

Aim: -
1) To appreciate the importance of microprocessors in flexible system design
2) To acquire thorough knowledge about the architecture, memory organisation, instruction set, interrupt control and programming methodology of 8085A system
3) To acquire thorough knowledge of using the peripheral and interfacing devices e.g. 8251,8255,8253,8257,8279
4) To acquire the first hand knowledge of system design
5) To acquire knowledge on fault diagnosis and maintenance of Microprocessors Based system
6) To acquire knowledge on 16 Bit Microprocessor
7) To acquire knowledge on 8251 Microcontroller

Detail Course Content

Unit	Topic/sub topic	Hours
1	Microcomputer system and Hardware 1.1 To describe the architecture of a microcomputer 1.2 Define (a) programmable (b) memory (c) Input/output (d) CPU 1.3 To describe the microcomputer organisation and the function of the microprocessor 1.4 To describe the principle of operation of a microprocessor 1.5 To describe the generic architecture of a microprocessor with its functional components (e.g. registers ALU, timing & control unit and control signals) 1.5.1 To describe (a) various registers (general purpose register and special purpose register) (b) general capability of ALU (c) various control signals (d) functions of internal and external buses 1.6 To explain with sketch various functional components of 8085A Microprocessor	2

2. Memory and Memory Organisation 2

2.1 To describe memory organization with reference to microprocessor

2.2 To define static and dynamic RAM

2.3 To compare advantages and disadvantages of static and dynamic RAM

2.4 To describe (a) ROM, PROM, EPROM (b) important memory timing parameters (c) memory address decoding (d) various forms of storage in microprocessor

3. Elements of Programming 2

3.1 To use Binary and Hexadecimal number systems

3.2 To explain (a) instruction code (b) die need for assembly language (c) role of assembler

3.3 To state the merit and demerit of instruction length

3.4 To identify the field of instruction

3.5 To differentiate execution efficiency of various types of instructions

3.6 . To describe the role of flags

3.7 To explain opcode fetching modes

3.8 To describe time requirements of instructions

3.9 To identify the blocks of a flow chart

4. Instruction Set 4

4.1 Data Transfer & Arithmetic group of Instruction of 8085A

4.1.1 To identify and use the data transfer and arithmetic group of instructions

4.1.2 (a) To recognise the number of states, machine cycles, addressing modes associated with each instruction

(b) To describe the effect of the instruction on flags if any

4.1.3 To write small programmes using these instructions

4.2 Logical group & Branch group of Introduction for 8085A

4.2.1 To identify and explain the logic and branch group of restriction

4.2.2 (a) To recognise the number ofT states, machine cycles, addressing modes associated with each instruction

(b) To recognise the effect of execution of instructions, on the various flags

4.2.3 To write sets of instruction to illustrate logic and branch operations

4.2.4 To explain the use of logic instruction masking or resetting of individual bus

5. Slack, I/o & M/C Control group of instructions for 8085A 3

5.1 (a) To define stack and stack pointer

(b) To describe their uses

5.2 To explain the method of storing and retrieving from stack (use ofPUSPl and POP instruction)

5.3 To explain the sequence of program execution when a subroutine is called and executed

5.4 To explain the process of information exchange between program counter and stack

5.5 To write short programmes exploring the use of these instructions

5.6 To use the instruction IN and OUT for developing simple program

5.7 To explain the function of machine control instruction

6. Interfacing of INPUT/OUTPUT Devices 2

6.1 To decode the address assigned to an Input/Output part

6.2 To explain the process of interfacing an I/O device with microprocessor for a specified device address

6.3 To explain the process of interfacing non- multiplexed and multiplexed display output port with microprocessor

6.4 To compare the software/hardware overheads of interfacing multiple ports using decoders microprocessor

6.5 To compare I/O mapped I/O and memory mapped I/O interfacing with microprocessor

7. Memory Interfacing with Microprocessor 2

7.1 To explain absolute, linear, foldback address decoding of memories

7.2 To draw the internal functional diagram of memory device

7.3 To explain the process of interfacing memory for a given memory map

7.4 To explain read and write timings and signal waveforms of microprocessors and memory (RAM & ROM)

7.5 To explain bus contention

7.6 To explain the techniques to overcome bus contention

7.7 To explain the function of wait states and interfacing slow memories

8. Analog Signal Interfacing 2

8.1 To explain the need of Analog Interfacing

8.2 To explain interfacing techniques of 8 bit or higher word length Digital to Analog converters (DAC) with microprocessor

8.3 To explain interfacing techniques of 8 bits or higher word length Analog to Digital Converters (ADC) with microprocessors

8.4 To explain the need and use of Opto-isolator

8.5 To explain with examples of interfacing of 8 bit ADC/DAC with microprocessor

9. Interrupts 2

9.1 To describe basic techniques of data transfer between CPU and I/O devices

9.2 To explain (a) an interrupt driven I/O scheme (b) vectored and polled interrupts (c) priondsadon of interrupts (d) the 8085A interrupt system

9.3 To describe (a) the various methods of handling muldple interrupts (b) the operation of a programmable interrupt controller (PIC) chip 8259A (c) the control commands and programming of PIC 8259A

10. Serial Communication in 8085 and 1C 8251 2

10.1 To explain serial communication formats, standards and MODEM

10.2 To explain the serial communication using SOD and SID pins of 8085 microprocessor

10.3 To describe die internal architecture of 1C 8251

10.4 To explain the method of transferring asynchronous data transfer by 1C 8251

11. Programmable Peripheral Interface 8255 and applications 2

11.1 To explain the internal structure of 8255A. To describe (a) the programming methodology ofthe8255A (b) method of interfacing 8255A I/O devices in simple mode (c) method of interfacing 8255A devices in hand shake technique

12. Programmable interval Timer/Counter 8253 2

12.1 To describe (a) the internal architecture of 8253 (b) programming technique of 8253 Timer/Counter (c)the application of 8253 timer

13 Direct Memory Access and DMA Controller 8257 13.1 To describe (a) Direct Memory Access operation (b) the internal structure of 8251 (c) method of use of DMA Controller 8257 2

14 Programmable Keyboard and Display Interface - 8279 14.1 To describe (a) the internal structure of 8279 (b) the programming methodology of 8279 (c) the use of 8279 for keyboard and display interface 2

15 System Design - general considerations 15.1 To describe the steps for design of a Microprocessor based system 15.2 To list the required features of the system 15.3 To draw up the performance specifications for the system to be designed 15.4 To list all the user interface properties 15.5 To list all the design 3

	constraints 15.6 To draw the block diagram and flow diagram of a Microprocessor based system 15.7 To break-up the system into interconnecting modular sub systems 15.8 To list various design alternatives 15.9 To select the appropriate design alternatives to meet the systems performance specifications and constraints 15.10 To compare the hardware/software trade- offs . for the system design	
16	Microcontroller 16.1 To define Microcontroller 16.2 To compare the Microcontroller 8051 with 8bit microprocessor 16.3 To describe the 8051 Microcontroller hardware 16.4 To describe (a) the Input/Output Pins, Ports and Circuits (b) external memory (c) counters and Timers (d) Serial Data Input/Output (e) Interrupts	4
17	16 -bit Microprocessor and Current Trends 17.1 To describe basic features of 16 bit microprocessor 17.2 To describe architecture and main feature of 8086 17.3 To explain the concepts of multiprocessing and co-processing 17.4 To describe scale uptrends and special feature in 16 bit microprocessors 17.5 To describe basic feature of RISC microprocessor 17.6 To describe (a) Pentium family (b) Architecture (c)block diagram (d)addressing modes (e) data type 17.7 To describe the operating principle of stepper motor	4
18	Class Test	3

List of Experiments:

1) To examine the 8085A training Kit, identify the microprocessor. Keyboard interface chip. Input Output Interface Chip, Programmable dmer/counter chip, serial communication chip, interrupt controller chip, RAM and ROM area.

2) To move a data (a) by immediate addressing (b)from register to register (c) register to memory(d)memory to registers

3) To add two hexadecimal numbers

4) To subtract one hexadecimal number from other

5) To add five hexadecimal numbers winch are stored in 5 successive memory location

6) To arrange five random hexadecimal numbers in memory locations in a sequential order (Starting from highest to lowest)

7) To divide two hexadecimal numbers and convert the result from hexadecimal to decimal value

8) (a) To develop a time delay subroutine

(b) To convert 5 hexadecimal (number into its corresponding Analog Value and display it on CRO screen using the dme delay subroutine as per Sl No. 8 (a)

9) To convert the analog values into its corresponding digital value and display it in the address and data field

10) To develop a programme for driving a stepper motor

11) To develop a programme for a Running display of HELP US in Address and Data field

12) To develop a programme for Traffic Control System

13) To develop a programme to display the second and Minute of a clock

14) To develop a programme to control a Coffee Vending Machine

15) To develop a programme for the operation of a counter

Reference:

1. Microprocessor, Architecture, Programming and Application with the 8085/8080A by Rames S.Gaonkar (PHI)
2. Introduction to Microprocessor - A.P. Mathur (TMH)
3. Microprocessor by Rafiquazzaman
4. Microprocessor & Microcomputer by Malvino

INSTRUMENTATION AND CONTROL

L	T	P		
3	0	2		Cum. Ref. No.: E509
Total Contact hrs.: 75			Total Marks : 150	Theory:
Theory: 45				End Term Exam: 70
Practical: 30				I.A: 30
Pre requisite: E 408,E409				Practical: Nil
Credit: 4				End Term Exam: Nil
				I.A: 50

Rationale:

Due to widespread automation in Industry, the study of instrumentation and control has become very essential. Since the whole system is a combination of analog and digital system, so the topics on both die systems have been included as the course of studies. Along with the topics of sensors and its characteristics its interfacing techniques with both analog and digital system will be discussed under this subjects. The first hand knowledge on data Acquisition system PLC have also been included in a nutshell.

Aim: -

To acquire knowledge on

a) The construction characteristics and method of usage of sensors and transducer
b) The interfacing technique of sensors with both analog and digital system
c) The first hand knowledge of control system with a brief study of controllers and their usage
d) The first hand knowledge on Data Acquisition system and programmable logic controller

Detail Course Content

Unit	Topic/Sub Topic	Hour
1.	Overview of Instrumentation and control system 1.1 To list the basic components of Instrumentation system such as (a) measurement system (b) Information signals and systems (c) Intelligent versus dumb instrumentation 1.2 To discuss the basic idea of the control systems such as (a) Automatic Control systems, (b) Types of control system (c) definition of controller	4
2.	Temperature Measurements 2.1 To explain the concept of temperature and its scale 2.2 To state the practical scales of temperature measurement 2.3 To describe different method of temperature measurement eg (a) expansion thermometers (b) liquid in glass thermometer (c) other expansion thermometers (d) thermoelectric thermometers (e) thermocouple in practice (f) thermistors (g) resistance temperature detector and its method of measurements (h) radiation thermometer (Optical pyrometer. Practical Pyrometery	4

3. Force and weight 4

3.1 To define (a) force (b) mass

3.2 To describe the (a) method of weight measurement
(b) force measurement by elastic transducers

3.3 To describe the methods of Force Measurement

3.4 To describe the construction, working principles and usage of strain gauges

3.5 To describe the construction, working principles and usage of piezo electric Transducers

3.6 To describe the construction, working principles and usage of Linear variable Transformer (LVDT)

3.7 To describe the dynamometer method of torque measurement

4. Pressure Measurement 4

4.1 To describe the concepts of pressure measurement
in (a) mechanics (b) Hydraulics (c) kinetics (d) thermodynamics

4.2 To explain different method of pressure measurement such as (a) direct pressure measurement (b) indirect pressure measurement (tubes, bellows, diaphragm) (c) electrical pressure transducers (capacidve type, inductive type,
resistive type)

4.3 To describe the working principles of (a) Force balance system (b) differential pressure cell (c) piezo electric transducer

5. Flow Measurement 4

5.1 To describe fundamental principles of flow measurement of fluids such as (a) Flow velocity (b) gross volume flow (c) gross mass flow

5.2 To define (a) viscosity (b) Reynolds number (c)
kinematic viscosity

5.3.1 To describe the measurement of paint velocity by (a) pilot static probe (b) hot wire anemometer (c) transit time velocimeters

5.3.2 To describe the measurement of gross volume flow by (a)constant area, variable pressure drop flowmeter (b) constant pressure drop, variable area flow meter
(c) Turbine meters (d) positive displacement flowmeter

5.3.3 To describe the measurement of gross mass flow by (a) moment type flow meter (b) thermal type flowmeter (c) inferential methods

6. Measurement of other physical Quantities 4

6.1 To describe the principle of measurement of (a) humidity (b) acidity/alkativity (PH) (c) density (d) sound (e) liquid levels (f) motion (g) rotational displacement (h) velocity (i) acceleration (j) chemical composition (by spectroscopy, chromatography

7. Transducers 4

7.1 To describe the characteristics of Electrical Transducers

7.2 To describe the criterion for the selection of Transducers

7.3 To describe the principles of different type of resistive transducer (b) different type of inductive transducer (c) capacitive transducer (d) photoelectric transducers (e) thermoelectric transducers (f) ultrasonic temperature Transducers (g) magnetic flow meters (i) measurement of thickness by Beta gauge

8. Signal Conditioning 4

8.1 To describe the basic principle (a) D.C (b) A..C signal conditioning (c) Data Acquisition and conversion system

8.2 To describe the basic instrumentation Amplifier

8.3 To describe the instrumentation Amplifier with Microprocessor system

8.4 To describe the block diagram of an instrumentation system

8.5 To explain the instrumentation Amplifier circuit used on Transducers Bridge

9. Control System Engineering 8

9.1 To define control system Engineering

9.2 To define Transfer Function

9.3 To use lap lace transform relations for developing
Transfer Functions of different Electrical
Mechanical and Electro mechanical systems

9.4 To define Block diagrams

9.5 (a) To develop block diagram from the transfer function (b) to reduce a block diagram to its final form by using different rules of block reduction (c) To determine the overall transfer function from block diagrams

9.6 (a) To define signal flow graphs (b) to determine the ratio between output and thermocouple in practice (f) thermistors (g) resistance temperature detector and its method of measurements (h) radiation thermometer (Optical pyrometer. Practical Pyrometery input from signal flow graphs

9.7 (a) To define the steady state and transient response (b) To determine the steady state and Transient response of a system from the lap lace inverse

Reference :

1. Intelligent Instrumentation – Gearge C. Barney (PHI)
2. Electronic Instrumentation by H.S Kalsi (TMH)
3. Principles of Industrial Instrumentation by D. Paranobis (TMH)

REPARING OF HOUSEHOLD EQUIPMENT

L	T	P		
1	0	2		Cum. Ref. No.: E510
Total Contact hrs.:45			Total marks: 100	Theory:
Theory: 15				End Term Exam: 50
Practical: 30				I.A.: Nil
Pre requisite: E 501				Practical:
Credit:				End Term Exam.: Nil
				I.A: 50

Rationale:-

The modem house are highly mechanised. The modern house wife prefers electrical and electronically controlled gadgets rather than the conventional systems. In most cases there is no proper scope of repairing these gadget when malfunctioning starts. Our technicians also been embarrassed when they are asked to attend the fault and suggest the remedy. Since the construction and working principles are not properly exposed to the Electrical Diploma Holder so they are scared to open those gadget. This subject will describe the constructional detail of those gadgets and the probable causes of failure, so that the necessary repair work can be carried out either by himself or by any workmen under the guidance of the Electrical Diploma Holders.

Aim:-

(a) To describe the principle of household domestic gadgets such as (i) Ceiling fan (ii) Exhaust fan (iii) fluorescent lamp (iv) electrical wiring (v) electric iron (vi) Electric Oven (vii) Vacuum Cleaner (viii) Refrigerator (ix) air conditioner (x) Water heater

(b) To describe the dismantling technique of the equipment as stated above

(c) To describe the list of tools required for the trouble shooting procedure

(d) To list the materials/ components required for troubleshooting procedure.
(e) To list the materials/ components required for trouble shooting procedure.

Detail Course Content (Combined theory and Practice):

Unit	Topic/Sub Topic	Hours
1.	Ceiling fan/Exhaust Fan	4
	1.1 To describe and draw the diagram of a ceiling/exhaust fan	
	1.2 To describe the electrical circuits of ceiling/exhaust fan	
	1.3 To describe the fastnedng of the components of ceiling /exhaust fan	
	1.4 To describe the dismantling procedure of a ceiling /Exhaust fan	
	1.5 To stat the precautions required to dismantle the ceiling/Exhaust fan	
	1.6 To state the method of the fault detecting procedure of the ceiling/Exhaust fan	
	1.7 To state the procedure for repair of the ceiling/Exhaust fan	
	1.8 To describe the method of testing of ceiling/Exhaust fan	
	1.9 To describe the process of preventive maintenance	
2.	Fluorescent Lamp/Sodium Vapour Lamp	4
	2.1 To draw and describe the circuit of the lamp filling	
	2.2 To explain the function of each components	
	2.3 To state the procedure for dismantling	
	2.4 To enlist the probable faults in the fitting	
	2.5 To state the procedure for repair of the circuit	
	2.6 To perform the repair work	
	2.7 To state the assembly procedure	
	2.8 To suggest testing procedure	
3.	Electric iron	3
	3.1 To describe the detail construction of the electric iron	
	3.2 To describe the dismantling procedure with some guidance for precautionary measure	
	3.3 To perform tests for fault finding and repairing	
	3.4 To assemble and perform the test for use (to describe the standard commissioning procedure)	
4.	OTG/Oven	3
	4.1 To describe the construction and operational hints for the equipment	
	4.2 To describe the process of dismantling procedure	
	4.3 To perform tests for fault finding and repair	
	4.4 To assemble the unit, test after repair	
	4.5 To describe the Standard Commissioning Procedure	
5.	Water heater/Geyser	3
	5.1 To describe the principle of operation and construction	
	5.2 To describe the process of dismantling	
	5.3 To perform the tests for fault finding repair	
	5.4 To assemble the unit, list after repair	
	5.5 To describe the standard commissioning procedure	
6.	Vacuum Cleaner	5
	6.1 To describe the construction and principle of operation	
	6.2 To consult the operating manual for the study of operation	
	6.3 To describe the process of dismantling	
	6.4 To describe the process of preventive maintenance	
	6.5 To describe the process for testing and repair	
	6.6 To describe the process of commissioning after repair	
7.	Split type/Window Air-conditioning	10
	7.1 To describe the function of control terminals on the remote control unit	

7.2 To describe the electrical Circuit (in some cases block diagram/functional diagram) for checking the operation

7.3 To describe the procedure for testing without dismantling for detecting or isolating the fault

7.4 To describe the procedure for testing after dismantling for detecting or isolating the fault

7.5 To describe the procedure for the repair replacement of defective components

7.6 To describe the testing procedure for the compressor or costing unit/without dismantling

7.7 To describe the procedure for commissioning of the Air Conditioner of the repair

8. Basic Refrigerator - Freezer Combination 10

8.1 To describe the operating principle of the refrigeration -Freezer Combination

8.2 To describe the electrical circuit (in some cases the block diagram/functional diagram) for checking the operation

8.3 To describe the method of testing of components without dismantling the refrigerator

8.4 To describe the method of testing of components after dismantling the refrigerator

8.5 To describe the method of listing the compressor

8.6 To describe the method of repairing of all the components and compressor

8.7 To describe the method of assembly of all components

8.8 To describe the method of preparing tests and commissioning of the refrigerator

8.9 To describe the precautionary names for the equipment and persons to be taken during repairing

9. Class Test 3

Reference:

(a) Electricity for Air Conditioning and Refrigeration Technician
by Edward F.Maohoney

PROJECTS ON ELECTRICAL ENGINEERING

L	T	P	Curri. Ref. No.: E512
0	0	6	

Total Contact hrs :90 Total marks: 150 Theory:
Theory: Nil End Term Exam: Nil
Practical: 90 I.A: Nil
Pre requisite: All subjects of Practical:
Group 4 & 5 End Term Exam:: Nil
I.A :150

Rationale:

The project work is a par of teaching learning process. In this activity the role of teachers is a facilitator or co-coordinator. The students will select the topic, perform design work, place the indent, procure or purchase the material either from departmental store or from the local market. The leadership quality, co-ordination of job and maintaining good communal harmony is an important factor of this type of activity. It is the process, which is to be evaluated .The success of the project, is not the ultimate goal. The group, who is successful in obtaining the good output, should definitely be credited but they must be evaluated for the other components of the activity.

Aim: To develop skill in

a) Selecting suitable topic
b) Designing of the job
c) Scheduling the job

d) Indenting
e) Procuring of material
f) Maintaining good relation amongst peer group
g) Developing leadership quality
h) Developing cost awareness
i) Effective utilisation of dme

Suggested of project activities (any two):
1. Load survey of an area
2. Prepare the maintenance schedule of an Electrical Plant
   a) Sub stadon b) Diesel generadon stadon
3. Develop a constant current transformer
4. Develop a constant voltage transformer
5. Develop an automadc battery charger
6. Develop a auto cut voltage stabiliser
7. Develop over voltage protecdon circuit
8. Develop single phase preventive circuit
9. Develop a linear regulated power supply

COMPUTER BASED INDUSTRIAL CONTROL

L T P — Curri. Ref. No.: E 601
3 0 2
Total Contact hrs: 75 — Total marks: 150 — Theory :
Theory: 45 — End Term Exam: 70
Practical: 30 — I.A: 30
Pre requisite: E508, E509 — Practical:
Credit: 4 — End Term Exam: NIL
I.A :50

Rationale:

There is a rapid growth of Computer Application in the field of Industrial Control. It is found that in most cases the transducers and output devices are analog in nature while for the easy control of many devices the software programming are used. The software programs are executed by digital computers. It may further be noted that the process control industries employ multi-access input and output devices, for this reason also the single processor and multiprocessor sys tems are used. Tills subject deals with die study of various features and components of computer based Industrial Control.

Aim:
To acquire the knowledge on
(a) The characteristics of basic building blocks of industrial control
(b) Fundamental principle of Digital Control
(c) Direct Digital Control
(d) Programmable Logic Control
(e) Distributed Digital Control
(!) Display System
(g) Final Control Elements

(h) Personal Computer in Real dme Environment

Detail Course Content

Unit	Topic/Sub Topic	Hour
Introduction		2
	1.1 To state (a) the expectation from Automation (b) Basic function of Automatic Control (c)The history of development of Industrial Control (d) About the current trend in computer control of process plants	
	1.2 Write brief notes on (a) Central Computer Control System (b) Distributed Control System(c) Hierarchical Control Systems (d) Process model (e) Intelligent Control	
2.	Fundamentals of Automatic Process Control	3
	2.1 To explain (a) Process definition (b) Feedback Control (c) basic principles of a single control loop (d) different principles of control e.g. two position control, Multiposidon control, PID control, rado control, cascade control	
3.	Transducer	3
	3.1 To state the basic requirement of transducer 3.2 To state the classification of transducer 3.3 Describe the function of modern transducers eg silicon transducers,fibre optic transducers LVDT, Capacitance gauges, silicon displacement 3.4 Fibre optic Displacement Transducers. Thermistors, Radiation Pyrometers, Silicon Temperature Transducers, Fibre-Optic Temperature Transducers, Piezoelectric Transducers, Silicon pressure transducers, Fibre optic pressure Transducers, intelligent sensors, on-chip signal processors, different type of biosensor	
4.	Building Blocks of Automation System	3
	(a) Processing systems (b) Microcomputers and Microcontrollers (c) The transputer (d) Multiprocessors System (e) Local Area Networks (f) Analog and Digital I/O Modules (g) Timer/counter Module (h) Display Control Module (i) Channel Scanning (j) Conversion to Engineering Units (k) Data processing (1) Distributed SCADA System (m) Remote Terminal Units (n) Terrestrial UHF/VHF radio with store and forward capability	
5.	Direct Digital Control	4
	5.1 To defme Direct Digital Control 5.2 To describe the structure of Direct Digital Control 5.3 To describe the DDC software function and algorithm 5.4 To define (a) position algorithm (b) velocity algorithm (c) Integral overshoot (d) reference position (e) reset wind up (f) auto manual switching (g) Cascade control (h) ratio control (i) multivariable control (j) Computer instrumentation (k) feed forward control	

6. Programmable Controllers 4

6.1 (a) To state the advantage ofPLC
(b) To state the name of popular PLC manufactures
6.2 To describe the principle of operation of PLC
6.3 To descnber the architecture of programmable controllers
6.4 To describe (a) Diagnostics (b) Input/Output system (c) Programming devices
6.5 To describe the programming of programmable controller
6.6 To describe (a) Ladder diagram instruction (b) Data transfer and data manipulation operation (c) Arithmetic operation (d) Flow control operation (e) Boolean Mnemonics (f) Functional Blocks (g) Data transfer operation (h) Arithmetic and logic operation (c) PID Control
6.7 To describe the software of PLC system
6.7.1 To define (a) system program (b) Application programme (c) Communication programme
6.8 To describe the application of PLC in the field of (a) Tyre manufacture (b) Tyre Curing (c) Plastic injection moulding (d) Chemical batching (e) material handling and others.

7 Distributed Digital Control 5

7.1 To describe the concept of Dedicated Computer System
7.2 To compare the distributed vs. Centralised Computer System
7.3 To state the functional requirements of distributed process control system
7.4 To describe(a) Plant operator's requirements (b) Maintenance Engineer's requirements (c) Design/Development Engineers requirement.
(d)Manager/Supervisorts Requirements (e) Distributed Control systems Evolution
7.5 To describe the System Architecture
7.6 To describe the function of the building blocks of Distributed Control System (To describe block diagram structure of a popular system)
To describe the (a) Process level (b) Unit Control level (c) group control level (d) process control level (e) Operation Control level
7.7 To describe the (a) Distributed Control sub system (b) Local Field station (c) Library of functions (d) Presentation and monitoring Devices (dl) Batch sequence operation display (d2) Process upset displays (d3)

control system mal function display.
7.8 To describe the communication option in Distributed Control Systems
7.9 To describe the confinguradon options in Distributed Control Systems
7.10 To describe the architecture of Popular Distributed Control Systems

8 Real time programming 5

8.1 Ti describe the information flow mechanism in real-dme systems
8.2 To describe (a) input sub-system (b) Processing sub-system (c)0utput sub-system (d) Information Processing (e) Interrupts (f) real time programming
8.3 To describe (a) Multi-Tasking Principle
8.4 To describe the State Transition diagram and its components
8.5 To describe Task Management principles and its function
8.6 To describe Inter-Task Communication Systems
8.7 To describe the avail types of Real-timeProgramming Language

9. Personal Computer in Real Time Environment 5

9.1 To describe the Personal Computer System and its facilities
9.2 To describe (a) P.C Bus and Signals (b) PC-AT ISA Bus Signal (c) EISA bus signals (d) Interrupts (e) PC-AT Interrupts (f) EISA Interrupts (g) InterruptController (programming and interfacing 8259
9.3 To describe the interfacing technique of PC to outside world.
9.4 To describe the function of Personal Computer in Real-Time Environment

10. Industrial Control on Applications 6

10.1 To describe (a) Cement Manufacturing Plant(b) Water Treatment Plant

11. Data Acquisition System 2

11.1 To describe the aims and objective of the Data Acquisition System
11.2 To describe different architecture of Data Acquisition System
11.3 To describe the functions of the Blocks of data Acquisition system

12 Class Test 3

List of Experiment:

1. To work with STEP -5 Software 15

Proramme of PCL Trainer based SIMATICS5-135 (a) Study of Hardware System (b) To practice the Digital Control Software (c) To practice PID Control Software

2. To work with GENIE Data. Acquisition & Software
   a. To study the hardware system
   b. To hardness hardware modules
   c. To utilized the software for connecting the analog and digital data input module for storing retrieving, displaying and control purpose

3. To work on Micro Controller Training kit

Reference :

Computer Based Industrial Control - by Krishna Kant (PHI)

PRINCIPLES OF ELECTRONIC COMMUNICATION

L T P Curri. Ref. No.: E 602
3 0 0
Total Contact hrs: 45 Total marks: 100 Theory :
Theory: 45 End Term Exam: 70
Practical: Nil I.A: 30
Pre requisite: Practical:
Credit: 4 End Term Exam: NIL
I.A :Nil

Rationale:

The knowledge of the Electronic Communication is very essential for transmitting the information for one place to other. As the type of messages and information are different for different field of application different type if communication media are used. The type of modulation, transmission frequencies and media also changes. For this reason the study of analogue and digital communications have been included in this subject. In addition o above the study of Antenna, Microwave, Facsimile, Television and Fiber optic system have also been included n this subject.

Aim:-
To acquire knowledge on
1. Modulation and Demodulation systems on Amplitude Modulation, Frequency Modulation, Pulse Modulation
2. To describe digital communication transmission lines and cables, wave guides, Radio wave propagation, Antennas, television system, satellite communication system and Fiber optic communication system

Course Content

Unit	Topic/Sub Topic	Hours
1.	Receivers	3
	1.1 To describe the construction and working principles of superheterodyne Receivers	
	1.2 To define a) tuning range b)Tracking c) Sensitivity and gain d)image rejection e)Superiors responses f)adjacent channel selectivity g) auto made gain control	
	1.3 To describe the a) double conversion superheterodynes receiver b) Electronically Tuned Receiver c) Integrated Circuit Receivers	
2.	Amplitude Modulation	3
	2.1 To define a) Amplitude modulation b) amplitude Modulation Index c) Modulation for sinusoidal Amplitude Modulation	

d) Frequency spectrum for sinusoidal Amplitude Modulation
e) Average power for sinusoidal Amplitude f) Effective voltage and current for sinusoidal Amplitude Modulation g) Non- sinusoidal modulation h) double sideband suppressed carrier modulation

2.2 To describe (a) Amplitude modulation circuits (b) Diagonal peak clipper (c) negative peak clipper (d) the amplitude modulated transmitter (e) Amplitude Modulated Broadcast transmitter (f) Practical circuit of amplitude modulated Receivers (g)Amplitude Modulated Receiver using phase locked loop (PLL) (h) noise in Amplitude Modulated Systems

3. Single Sideband Modulation 3

3.1 To describe the

(a) Single sideband principles (b)balanced modulation (c) clonbly balanced diode ring modulator (d) method of single sideband generation (dl) balanced modulator filter method (d2) phasing method (d3) third method (e) single sideband reception f) Pilot carrier single side band (g) independent sideband (h) frequency division multiplexing (i) Signal-to-noise ratio for single sideband (j) companded single sideband

4. Angle Modulation 3

4.1 To describe

(a) Frequency Modulation (b) Sinusoidal frequency Modulation (c) frequency spectrum for Sinusoidal frequency Modulation (d) average power in Sinusoidal frequency Modulation (e) Non-Sinusoidal frequency Modulation (Determination of deviation ratio) (f) the method of measurement of modulation index for Sinusoidal frequency Modulation (g) Phase Modulation

4.2 To establish the Equivalence between phase Modulation and Frequency Modulation

4.3 To explain (a) Sinusoidal phase Modulation (b) Digital phase Modulation

4.4 To describe Angle modulator circuits (a) varactor diode modulators (b)Transistors modulators

4.5 To describe the working principles of (a) FM Transistors (b) FM Broadcast transmitter

4.6 To describe the working principle of Angle Modulation Detectors

(a) Basic Detection of FM Signals (b) Foster see ley Discrimination (c) Ratio detection (d) Quadrature detector (e) phase locked loop detector (f) Automatic Frequency Control System (g) Amplitude limiter Frequency Control System (h) Amplitude limiter (h) Noise in frequency modulation system

4.7 Explain the term Pre-emphasis and De-emphasis

4.8 To describe the FM Broadcast Receivers

5. Pulse Modulation 3

To explain

5.1 Pulse Amplitude Modulation (PAM)

5.2 Pulse Code Modulation (PCM)

(a) Quantization (b) Compression (c) PCM Receiver (d) Differential PCM (e) sigma-delta A/D Conversion

5.3 Pulse Frequency Modulation

5.4 Pulse Time Modulation

5.5 Pulse Position Modulation

5.6 Pulse width Modulation

6. Digital Communication 4

6.1 To des cribe (a) Basic Digital Communication system (b) Synchronization (c) Asynchronization Transmission (d) Probability of Bit Error in Base band Transmission (e) Matched Filter (f) optimum Terminal Filter (g) Bit timing recovery (h) Eye diagram (i) Digital Carrier System (j) Amplitude shift keying (k) Frequency Shift Keying (1) Carriers Recovery Circuits (m) Differential phase shift keying (n) Hard and soft Decision Decoders

6.2 Error Central Coding (a) Block codes (b) Completion encoding (c) Parity encoding (d) Bit-etror Probability with forward error correction (c) Coding gain (f) convolution encoding

7. Transmission lines and cables 3

7.1 To define (a) the transverse electromagnetic wave (b) Balance Transmission Line (c) Unbalanced Transmission Line

7.2 To describe the Line constants of a transmission line

7.3 To define (a) Phase velocity (b) Wave length (c) Characteristics impedance (d) Propagation Co-efficient (e) Phase and group velocity (f) standing wave (g) loss less lines at radio frequencies (h) Voltage standing Wave Ratio

7.4 To describe (a) slotted line measurements at Radio Frequencies (b) Transmission line as Circuit Elements (c) Smith Chart (d) Time domain Reflectionometry (e) Telephone lines and cables at is characteristics (g) Microscope Transmission Lines

8. Wave Guides 3

8.1 To state the frequency range for usage of wave guide

8.2 To describe the construction and working principles of (a) Rectangular Wave guides (TE^mode, standing waves. Waveguide Terminations, Alternators, Contacts and joints, Reactive stubs and other modes)

9. Radio Waves 3

9.1 To start the range of frequencies for Radio Wave propagation

9.2 To describe propagation in Free Space (a) Microwave Systems (b) Troposhpheric propagation (mode of propagation. Radio horizon, contour maps, super and sub refractions, attenuation in the atmosphere, VHF/UHF radio systems)

9.3 To describe Ionospheric propagation (a) Ionospheric layers (b) Plasma frequency and critical frequency (c) optimum working frequency (d) virtual height (e) effect of earth's magnetic field (f) sendee range (g) ionospheric irregularities ionic disturbances and fading, summery F^ F^ layer) (i) H.F Radio systems

9.4 To describe surface wave (a) Mode of Propagation (b) ground wave (c) Broadcast Fading Zone

9.5 To describe low frequency propagation and very low frequency propagation. Extreme low frequency propagation

10. Antennas 3

10.1 To describe (a) antenna equivalent Circuits (b) Co-ordinate systems (c) Radiation Fields (d) polarization (e) isotropic radiator (f) power gain of an antenna (g) effective area of an antenna (h)

effective length of an antenna (i) hertizian Dipole (j) half wave dipole

10.2 To describe vertical antenna (a) ground reflections (b) grounded vertical antenna

10.3 To describe (a) folded elements (b) loop and ferrite-rod receiving antennas (c) Non resonant antennas (d) Driver arrays (e) broadside array (f) end -fire array (g) turnstile antenna (h) parasitic antenna (parade reflector. Parasitic directors, Yagi-Uda Array, Plane reflector array)

10.4 To describe VHF-UHF Antennas (a) Dicome Qunni (b) Helical Antenna (c) Log periodic antenna

10.5 To describe Microwave Antenna (Hams, paraboloidal, reflector antenna, dielectric lens antennas start antennas

11. Telephone systems 3

11.1 To describe wire telephones and its circuits

11.2 To describe (a) electronic telephone and its circuits (b) Electronic subscriber line interface circuit (c) subscriber loop lines (d) Transmission

11.3 To describe the public telephone network systems

11.4 To describe the (a) digital switching system (b) Trunk Circuits (c) Private Telephone network

12. Facsimile and Television 3

12.1 To explain facsimile Transmission

12.2 To describe the (a) facsimile Transmitter system (Transmitter and Receiver) (b) Transmission of Facsimile Telegraph signals (c) Digital For Transmission system

12.3 To state different Television Transmission system:

12.4 To describe (a) Television Camera System (b) Television Display system (Black and White and colour) (c) CRT projection display (d) Flat Panel displays (e) Interlacing and vertical synchronization Frequency (f) picture definition (g) Horizontal synchronization Frequency (h) Television Signal

12.5 To describe Television Receiver (Black 2 White 2 Colour Receivers)

12.6 To describe television Transmitters (colour Transmitters)

12.7 To describe High definition Television (Definition and aspect ratio for HDTV)

13. Satellite communications 3

13.1 To state and explain (a) Kepler's first law (b) Kepler's second law (c) Kepler's Third law

13.2 Describe (a) orbit (b) geostationary orbit (c) power systems (d) altitude control (e) Satellite station keeping (f) limits of visibility (g) Frequency plane and polarization (h) transponders (i) uplink power Budget calculations (j) Downlink Power Budget Calculation (k) Overall link budget calculation (l) multiple access methods

14. Fiber Optic Communications 3

14.1 To describe the principle of (a) Light Transmission in a Fiber (b) Fiber Index Profiles (c) modes of propagation (d) Single mode propagation in step index fibres (e) losses in fibers

14.2 To define (a) absorption losses (b) leaky modes (c) mode compiling losses (d) Bending losses (e) combined Fiber

14.3 To describe dispersion and effect of dispersion on pulse transmission
14.4 To define (a) Internodal dispersion (b) waveguide dispersion
14.5 To describe the light sources for fiber optics e.g. (a) Light emitting diode (b) Semiconductor Laser Diode
14.6 To describe the function of photo detectors e.g. (a) pin photodiode (b) pin photodiode (c) Avalanche photodiode (d) optical receiver circuit
14.7 To describe the methods of connections and splices
14.8 To describe the Fiber optic Communication Link systems

15. Class Test 3

1. Electronic Communication (4th Edition)
Dennis Roddy andJhon Coolen (PHI)

MICROWAVE

L	T	P		
3	0	0		Curri. Ref. No.: E 603
Total Contact hrs: 45			Total marks: 100	Theory :
Theory: 45				End Term Exam: 70
Practical: Nil				I.A: 30
Pre requisite: E602				Practical:
Credit: 4				End Term Exam: NIL
				I.A :Nil

Rationale

The application of Microwave is increasing rapidly. This is not only used in communication system, are also it is applied in Industry and household appliances. So the study of this subject both in the Electronic Communication and Electrical Engineering has become inevitable. Starting from die definition of Microwave, the topics on its working principles and field of applications have been included in this subject.

Aim
To acquire knowledge on
(a) Microwave transmitter structure and resonator
(b) Generation technique of Microwave
(c) Measurement of Microwave
(d) Microwave characteristics
(e) Different applications of Microwave in (1) Communication (2) Industry

Detail Course Content

Unit	Topic/Sub Topic	Hour
1	Transmission Structures and Resonators 1.1 To describe (a) transmission lines (b) Smith Chart (c) Waveguides (d) Resonators (e) Electromagnetic spectrum	4
2	Microwave Generation To describe the method Generation of Microwave in different method (Klystron, Magnetrons, Travelling Wave Tubes) Bipolar transistor, gunn oscillator. Avalanche diode oscillator.	4

Trapped Avalanche Transmit Time mode)

3 Microwave Measurement 3.1 To describe the principle of Microwave detection 3.2 To describe the method of Microwave Power Measurement 3.3 To describe the method of Microwave Impedance measurement 3.4 To describe the method of Microwave Frequency measurement 4

4 Satellite Communication 6

4.1 To define (a) Satellite Communication
(b) Geocentric Orbit
4.2 To describe (a) minimum range between earth station and satellite (b) path loss
4.3 To state reason for selecting elliptical path of oribitting of satellite

5. Microwave Radio Link 7

5.1 To define (a) microwave link (b) receiver power
5.2 To enumerate receiver power in terms of
(a) Waveguide and antenna losses.
(b) Transmitter antenna gain
(c) Path loss
(d) Receiver antenna gain
(e) Receiver waveguide and antenna losses
5.3 To describe the working principles of broadcasting and mobile telephones (to define co-channel interference and describe the method suppression)
5.4 To describe the mobile communication system.

6. RADAR 8

6.1 To define RADAR
6.2 To write the RADAR equation
6.3 To describe (a) Pulse RADAR (b) FMCWRADAR (c) Doppler RADAR
6.4 To describe the block diagram of RADAR system
6.5 To state different application of RADAR in
(a) Ship and Ship Position Control
(b) Air Traffic Control
(c) Altimetry
(d) Position fixing
(e) Mapping
(f) Tracking
(g) Guidance and homing for weapon
(h) Obstacle avoidance
(i) Distance Measurement
(j) Speed detector
(k) Burglar detection

7. Application of Microwave 9

To write notes on application of Microwave in following areas
(a) Optical Astronomy
(b) Radio Astronomy
(c) Infrared heat detection
(d) Imaging(Laud and human)
(c) Military sensing (arms control verification)
(f) Meteorology

(g) Geographical and Geological monitoring
(h) Monitoring agriculture
(i) Pollution Control
(j) Security Surveillance
(k) Microwave heating and cooking
(l) Medical hyperthermia
(m) Laser Cutter and Laser Surgery
(n) Solar Powered Satellite
(o) Control and Recording

8. Class Test 3

Reference:

(1) Microwaves by K.C.Gupta (New Age International Publisher)
(2) Microwaves Technique by A. Kumar (New Age International Publisher)
(3) Microwaves and Optical Transmission by A. David Oliver (John Willey & Sons)

NON-CONVENTIONAL SOURCES OF ENERGY

L T P Curri. Ref. No.: E 604
3 0 0
Total Contact hrs: 45 Total marks: 100 Theory :
Theory: 45 End Term Exam: 70
Practical: Nil I.A: 30
Pre requisite: 105,106 Practical:
Credit: 4 End Term Exam: NIL
I.A :Nil

Rationale: -

It is an era of power crisis. The treasure of national fuel like coal and oil being empty day by day. As a solution people are running after atomic energy. But the deadly problems of nuclear radiation made this system unusable. The people are in search of alternate energy source. This subject is an humble effort for searching the alternate source of deriving energy. The power of solar energy and its application along with wind power, wave power and solar cell have been included in this subject.

Aim: -
To acquire the knowledge on

(a) Assessing the solar power
(b) Technique on utilising the solar power
(c) Considering the application of solar power
(d) Assessing the wind power and wave power
(e) Technique on utilising the wind and wave power
(f) Considering the usage and application of wind and wave power
(g) Construction and fabrication of solar cell
(h) Technique on utilising solar cells

Detailed course content

Unit	Topic / sub-topic	Hours
1	Solar energy 1.1 Solar radiation I.I.I To describe (a) Global, direct and	10

diffused radiation. (b) Spectral distribution of direct solar radiation through four types of curves. (c) Radiation measuring Instruments (d) Data from a radiation measurement network. 1.2 Water and air heating application
1.2.1 To describe the construction and uses of water heating system through
(a) flat plate collector
(b)..spiral or "sea shell" collector
(c) heat pipe collector
(d) cylindrical heater / storage system
1.2.2 To describe three types of air heaters used to dry crop in lower latitude or space heating in higher latitude.
1.2.3 To describe the integration of an air collector into a heating and cooling system
1.2.4 To know some storage units
1.3 Space heating application:
To describe the utilization of air heater and thermal energy storage in space heating application.
1.4 Thermal Power and other applications (a) Head Engine (b) Large scale power Generation (c) Furnaces (d) cookers (e) refrigeration and cooling (f) Heat pumps (g) .solar ponds (h) distillation (I) industrial application of process heat and transport.
1.5 Photovoltaic Technology
(a) Principle of solar cells
(b) Solar cells and modules
(c) Applications of photovoltaic systems
(d) Photovoltaic Power Generation

2. Bio-Energy and other form of Energy 10

2.1 To define Bio-Energy
- 2.1.1 To describe the sources of Bio-Energy
- 2.1.2 To describe the renewal system of Bio-Energy
- 2.1.3 To describe the following processes
  - (a)Pyrolysis of wood
  - (b) Gasification of wood
  - (c)Producer gas preparation
  - (d) Briquetting
  - (e)Hydrolysis of wood ethanol
  - (f) Liquification of wood to oil
  - (g) Energy plantation and power programme
  - (h) Biological conversion

2.2 Animal Energy
- 2.2.1 To define the Animal Energy
- 2.2.2 To describe the method of utilisation of Animal Energy.

2.3 Energy from the Ocean
- 2.3.1 To describe the basic process of Ocean Thermal Energy Conversion (To state (a) the location of OTEC plants (b) Application of OTEC and (c) Economic Consideration)
- 2.3.2 To describe (a) the method of utilisation of wave Energy (b) the method of obtaining power from salinity gradients (c) utilisation of Tidal power

2.4 Hydrogen Energy

2.4.1 To describe the method of production of mass-scale hydrogen preparation

2.4.2 To describe the method of utilisation of hydrogen as alternative Energy source.

2.4.3 To state the advantages and disadvantages of Hydrogen Energy.

3 Wind Energy 8

3.1 To state the historical development of wind generated Electricity in the following countries (a) Denmark (b) USA (c) Russia (d) united kingdom

3.2 To enumerate the wind energy potential

3.2.1 To state the annual velocity and power duration curves.

3.2.2 To describe the windmill

3.2.3 To describe the use of wind energy as (a) power generation (b) water pumping system

3.2.4 To describe the method of wind Energy conservation, distribution and utilisation system.

4 Solar Cell 14

4.1 Standard silicon solar cell Technology (single crystal wafers to solar cells, solar cell to solar cell modules, module construction, cell operating temperature, module durability, module circuit design. Energy accounting)

4.2 Improved silicon cell Technology

4.2.1 To explain the properties of solar grade silicon

4.2.2 To describe the method of preparation of solar sheet and specify (a) Solar sheet requirement (b) Ingot Technologies (c) Ribbon Silicon.

4.2.3 To describe the cell fabrication and Interconnection techniques.

4.3 Concentric systems

4.3.1 To describe the principle of ideal concentrators

4.3.2 To describe the principle of (a) stationary and periodically adjusted concentrator (b) tracking concentrator (c) concentrator cell design.

4.3.3 Ultra-high efficiency systems

4.3.4 To describe the basic principle for developing ultra high efficiency system (muld gap cell concepts, thermo photo voltaic conversion)

4.4 Photo Voltaic systems components and Application

4.4.1 To describe the principle of Energy storage system

4.4.2 To describe the principle of power conditioning system

4.4.3 To state the photo voltaic applications

4.5 Design of stand Alone system

4.5.1 To describe (a) the solar module performance (b) Battery Performance (performance of lead Acid Battery, Nickel cadmium Batteries) (c) Power control system (d) the method of regulation and system sizing (e) to state the application in water pumping.

4.6 Residential and Centralised Photo voltaic power systems

4.6.I To describe the (a) detail layout of the residential systems (b) module mounting technique (c) thermal generation system (d) system configuration

4.6.2 To describe the design principle of central power plant of solar cell system (general considerations, operating modes)

4.6.3 To describe the working principle of satellite solar power stations

5. Class test 3

References:

1. Sun power
byJ.C. Me Veigh (Pergaman press)

2. Solar Cells

by Martina A. Green (Prentice series in solid state physical Electronics)

3. Energy Today and Tomorrow - Dr. Mahesh Dayal (Publication Division Ministry of I and B Govt. of India)

HIGH VOLTAGE ENGINEERING

L	T	P	Curri. Ref. No.: E 605
3	0	0	

Total Contact hrs: 45 Total marks: 100 Theory :
Theory: 45 End Term Exam: 70
Practical: Nil I.A: 30
Pre requisite:E405,E502,E505 Practical:
Credit: 4 End Term Exam: NIL
I.A :Nil

Rationale :-

High Voltage Engineering is highly essential in the field of Electrical Power generation. Distribution and protection. As the cables, Insulators conductors and other Electrical devices are badly exposed to the high voltage and extra High Voltage circuits, the technology of learning the testing procedure and detail of construction of the testing equipment's are very important. This subject deals with the technique of high voltage generation for testing, technique of high voltage measurement, non - destructive Insulation test techniques, and the technique for over voltages and insulation co-ordination

Aim :-

To acquire the knowledge in

(a) Techniques for generation of high voltage for testing
(b) Techniques for high voltage measurement
(c) Techniques for non-destructive insulation testing
(d) Techniques for over voltage and insulation Co-ordination

Detail course content

Unit	Topic/Sub Topic	Hours
1.	Over view of the power generation, transmission and Distribution	6
	1.1 To describe the generation and Transmission of Electrical Energy	
	1.2 To define (a) voltage stresses (b) Testing voltages.	
	1.3 To explain (a) Testing with power frequency voltages. (b) Testing with lightning impulse voltages (c) Testing with switching impulses (d) The need for high voltage D.C. sources	
2.	Generation of High Voltages	7
	1.4 To describe the method of	
	(a) Generation of Direct Voltages	
	(b) Conversion of AC to DC	
	(c) Electrostatic Generator	
	(d) Generation of Alternating voltages	
	(e) Construction and working principle of testing transformer	
	(f) Uses of services resonance circuit and its advantages	
	(g) The uses of impulse voltage	
	(h) Generation technique for impulse voltage	
	(i) Operation, design and construction of impulse generators	
3.	Measurement of High Voltages	10

3.1 To state the types of voltages to be measured and their wave shapes
3.2 To describe the measurement of (a) peak voltage by spark gap (b) state the effect of nearby earthed objects (c) state the effect of humidity (d) effect of irradiation and of polarity (e) influence of dust particles (f) effect of rod gaps
3.3 To describe the working principle of Electrostatic Voltmeters
3.4 To describe the method of high voltage measurement by ammeter in series with high resistance method
3.5 To describe the generating or rotating voltmeters
3.6 To describe the method of peak voltage measurement by (a) Chubb - Fortescue methods
3.7 To describe (a) passive rectifier circuits and voltage devides (b) crest voltmeter for AC measurement (c) two way booster circuit (d) impulse voltages (e) active or amplifying circuit of crest voltmeter, high voltage capacitor for measuring circuits (g) single capacitance units (h) Stacked capacitor Units
3.8 Voltage Dividing system and Impulse Voltage measurements
3.8.1 To describe (a) Generalised voltage generation and Measuring circuits (b) demands upon transfer characteristics of the measuring systems (c) Fundamentals for the computation of the measuring systems
3.8.2 To describe the principles of voltage dividers
3.8.3 To describe the interaction between voltage divider and measuring circuit
3.8.4 To describe the L.V. arm of the Measuring systems

4. Non — destructive Insulation Test Techniques 10
1.0 To describe the method of measurement of High voltage
Dielectric loss and capacitance Measurements (schearing Bridge)
1.1 To describe the function of" Wagner Earth"
1.2 To describe the method of measurement of large capacitance.
1.3 To describe the Transformer Ratio arm Bridge
1.4 To describe the method of loss Measurement on complete Equipment
1.5 To describe the Null Detector with band pars filter
1.6 To describe the partial - discharge Measurement Technique and explain the function of (a) Partial Discharge equivalent circuit (b) Partial Discharge currents (c) the partial Discharge measuring circuits for Apparent charge (wide Band Partial Discharge detection and narrow - band partial Discharge detection)
1.7 To describe the method of suppression of disturbances
1.8 To describe the method of calibration ofPD - Detectors in a Test Arrangement

5.0 Over voltage 9
5.1 To describe the Lightning mechanism
5.2 To state the (a) Energy in Lightning (b) Nature of Danger
5.3 To describe the simulated lightning surges for testing
5.2 To describe the switching surge test voltage characteristics

6.0 Class Test 3

NB: Visit to high voltage testing lab should be arranged (Vacational training)

Reference :-
(a) High Voltage Engineering Fundamentals By Kuftel, Zaengi (Pergaman Press)

Resource Persons

1.	Pritish Bhatacharya	Webel Power Electronic, Calcutta
2.	S.M Banerjee	Webel Power Electronic, Calcutta
3.	Rahul Maity	Philips, Culcutta.
4.	Sumit Guha	Seimens PCN Ltd. Calcutta
5.	Prof. M.K Roy	Jadavpur University, Calcutta
6.	Prof. D.Roy	TTTI, Calcutta
7.	Prof. A Mitra	TTTI, Calcutta
8.	Prof. N.De	TTTI, Calcutta
9.	Prof. S.Blah	Shillong Polytechnic, Meghalaya
10.	Prof. Moses Kyndiah	Shillong Polytechnic, Meghalaya
11.	Prof. Sunirmal Bhattacharya	Shillong Polytechnic, Meghalaya
12.	Prof. Tridib Chakravorty	Polytechnic Institute, Narasingarh, Tripura

LIST OF EQUIPMNET
ELECTRICAL ENGINEERING LABORATORIES

Sl.No.	Items
1.	Moving Iron Voltmeter (portable)
2.	Moving Iron Ammeter portable)
3.	Wattmeter (single phase dynamo meter type)
4.	Megger (D.C.)
5.	Earth Testing Set
6.	Single phase energy meter
7.	Three phase energy meter
8.	Digital Ammeter DC.
9.	Digital Ammeter AC.
10.	Digital Voltmeter(D.C)
11.	Digital Voltameter[A.Cl
12.	Wattmeter
13.	Single phase Auto transformer (variac)
14.	Power Capacitor
15.	Variable Inductor (Iron cored)
16.	Fixed Value resistors
17.	Wire Wound Rheostat
18.	Digital LCR Meter Auto ranging
19.	Auto Cut off Battery Charger
20.	Lead Acid Battery
21.	Tachometer
22.	Electronic Stroboscope (Digital)
23.	Digital Multimeter
24.	DC. machine for dismantling and assemble practice
25.	Tool Kit
26.	DC. Shunt motor for direct loading test
27.	Wound Rotor Induction motor (slipring induction motor)
28.	Three phase induction Motor (squirrel cage type)
29.	DC. machine with separately excited equipped with Tacho Generator
30.	DC. Compound Machine
31.	Slip ring synchronous/ Asynchronous Machine

32. Universal Motor
33. I-Phase Induction Motor with start and run capacitor
34. I-Phase Induction Motor with start capacitor
35. Split-phase Motor
36. Two speed Induction Motor Squirrel Cage
37. Dissectable Machines: Tutor
38. Microprocessor Training Kit
39. High Voltage oil testing set
40. Automatic winding m/c
41. Hand operator winding m/c
42. Solid state converter
43. Capacitor load
44. Inductive Load

45. Digital Storage Oscilloscope
46. Dual Trace Oscilloscope
47. Function Generators
48. Induction Heating Apparatus
49. Dielectric heating
50. Digital Tongue Tester
51. Digital insulation tester
52. Distance relay
53. Electronic Trivector meter
54. Electronic Energy meter
55. CT&PT Test set
56. Single phase and 3 phase power analyser
57. D.G. Set
58. P.C. based P.I.D. Temp controller
59. Electronic Component Trainer
60. Analog Trainer
61. Network Theorem Training Board
62. AC fundamentals training board
63. Digital Component Trainer
64. Thyristor Power Control Circuit
65. Digital Circuit Study Board
66. Electrical Machine Testing System
67. Instrumentation Trainer
68. Study of Control System Kit
69. Decade resistance box
70. Decade capacitance box
71. Decade inductor box
72. Shackle insulator box
73. Pin Insulator
74. Disc Insulator
75. Complete set of a overhead power distribution pole with arms insulators and safety devices
76. Over head service connection system complete set
77. Miniature circuit breaker single pole of different current rating (230V, SP and N0.5 - 2.5A)
78. Miniature circuit breaker four pole 650V, 6A
79. Single phase distribution board with box and miniature circuit breaker, 250V,

6 Amp, 8 way (for wiring practice) with 650V, 20A moulded case breaker

80. Three phase with Neutral (3 phase 4 wire) distribution board with box, miniature circuit breaker, connectors and master control MCB (4 pole) (for wiring practice)
81. Standard wire gauge BSW and M.M.
82. Laminated cores (Transformer assembly practice) Type: 30, 6, 33; Grade: 51
83. Super enameled copper SWG-30,32,36,40
84. Leatheroid (10 mil and 20 mil thick)
85. Prepahan thick (10 mil and 20 mil)
86. Air drying varnish (Dr Brick's)
87. PVC insulated cable a) Single core single strand 230V, 18 SWG b) Single

core Multi strand 230V, 7/200

88. PVC conduit 6mm, 12mm, 18mm
89. PVC casing 6mm, 12mm, 18mm
90. Current transformer
91. Potential Transformer
92. Decade capacitor box
93. Air cored Inductor
94. Decade Resistor box
95. Static speed control of AC motor (3cp inductor)
96. Electric power system simulator
97. Single phase and three phase power analyser
98. Microprocessor based temperature controller
99. Virtual instrumentation simulator
100. Electronic energy meter
101. Distance relay
102. CT PT test set
103. Machine tutor
104. Electric machine test unit
105. Digital insulation tester
106. High Voltage Insulation Tester
107. Flux Meters
108. Sound Level Meter
109. Digital Tonque Tester
110. Micro controller trainer kit
111. Starter kit for digital signal processing