MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION, MUMBAI

TEACHING AND EXAMINATION SCHEME FOR POST S.S.C. DIPLOMA COURSES

COURSE NAME : DIPLOMA IN ELECTRICAL ENGINEERING

COURSE CODE : EE

DURATION OF COURSE : SIX SEMESTERS **WITH EFFECT FROM 2012-13**

SEMESTER : SIXTH **DURATION : 16 WEEKS**

PATTERN : FULL TIME - SEMESTER **SCHEME : G**

SR. NO	SUBJECT TITLE	abbreviation	SUB CODE	TEACHING SCHEME			EXAMINATION SCHEME										SW (17600)
							PAPER HRS.	TH (1)		PR (4)		OR (8)		TW (9)			
				TH	TU	PR		Max	Min	Max	Min	Max	Min	Max	Min		
1	Management $	MAN	17601	03	--	--	1&½	50#*	20	--	--	--	--	--	--		
2	Testing & Maintenance of Electrical Equipments β	TME	17637	04	--	04	03	100	40	50#	20	--	--	25@	10		
3	Power Electronics β	PEL	17638	04	--	02	03	100	40	50#	20	--	--	25@	10		
4	Illumination Engineering	IEN	17639	04	--	02	03	100	40	--	--	--	--	25@	10		50
5	**Elective (Any One)**																
	Modern Electric Traction	MET	17640	04	--	02	03	100	40	--	--	--	--	25@	10		
	Elements of Industrial Automation	EIA	17641	04	--	02	03	100	40	--	--	--	--	25@	10		
6	Project β	PRO	17801	--	--	04	--	--	--	--	--	50#	20	50@	20		
			Total	**19**	**--**	**14**	**--**	**450**	**--**	**100**	**--**	**50**	**--**	**150**	**--**		**50**

Student Contact Hours Per Week: **33 Hrs.**

THEORY AND PRACTICAL PERIODS OF 60 MINUTES EACH.

Total Marks **: 800**

@ - Internal Assessment, # - External Assessment, No Theory Examination, $ - Common to all branches, #*- Online Examination, β - Common to EP

Abbreviations: TH-Theory, TU- Tutorial, PR-Practical, OR-Oral, TW- Term Work, SW- Sessional Work.

- Conduct two class tests each of 25 marks for each theory subject. Sum of the total test marks of all subjects is to be converted out of 50 marks as sessional work (SW).
- Progressive evaluation is to be done by subject teacher as per the prevailing curriculum implementation and assessment norms.
- Code number for TH, PR, OR, TW are to be given as suffix 1, 4, 8, 9 respectively to the subject code.

Course Name : All Branches of Diploma in Engineering / Technology

Course Code : EJ/EN/ET/EX/EV/IC/IE/IS/MU/DE/ME/PG/PT/AE/CE/CS/CR/CO/CM/IF/ CW/EE/EP/EU/CH/CT/PS/CD/ED/EI/CV/FE/IU/MH/MI/TX/TC/FG

Semester : Sixth for EJ/EN/ET/EX/EV/IC/IE/IS/MU/DE/ME/PG/PT/AE/CE/CS/CR/ CO/CM/IF/CW/EE/EP/EU/CH/CT/PS/TX/TC/FG and Seventh for MH/MI/CD/ED/EI/ CV/FE/IU

Subject Title : Management

Subject Code : 17601

Teaching and Examination Scheme:

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS	TH	PR	OR	TW	TOTAL
03	--	--	1&½	50#*	--	--	--	50

NOTE:

- **Two tests each of 25 marks to be conducted as per the schedule given by MSBTE.**
- **Total of tests marks for all theory subjects are to be converted out of 50 and to be entered in mark sheet under the head Sessional Work (SW).**

Rationale:

Management concepts are universal and it is a multidisciplinary subject. They are equally applicable to different types industries like Manufacturing, Service and Trade as well as different kind of business activities like industry, army, school, hospital, retail shops etc. Also, at the end of diploma course polytechnic students are expected to enter in to the Industrial Environment. This environment is altogether different and new to the students. A proper introduction and understanding of management fundamentals is therefore essential for all these students.

Contents of the this subject will enable the students to address various issues related to human resource, finance, materials, legislations etc. by use of basic principles of management. This will ensure that students will play their role effectively to enhance the quality of business output in total.

Objective:

The students will able to:

1. Get familiarized with environment related to business processes.
2. Know the management aspects of the organisations.
3. Understand Role & Responsibilities of a Diploma engineer.
4. Understand importance of quality improvement techniques.
5. Appreciate need and importance of safety in industries.
6. Understand process of Industrial finance and its management.
7. Know the latest trends in industrial management.

Learning Structure:

Application	• Use management functions & techniques. • Realize importance of management process in Business. • Describe Business scenario.	• Practice managerial traits. • Know supervisory responsibilities, time management & productivity
Procedure	• Exposure to world of work • Information collection regarding government functions, rules and regulations, regarding Business processes. • Case studies of management functions.	• Review of Supervisory responsibilities • Time Management functions • Learning to learn management functions
Concepts	• Globalization & WTO • Modern methods of management • Value addition by efficient management.	• Roll of supervisor • Managerial Traits • Government Rules & Regulations and their implications.
Facts	• Conventional Engineering & Business opportunities • Changing Role & nature of employment. • Developments in functions of Business Management.	• Role and Opportunity for technicians in Business world. • Responsibilities & Expectations from Technicians in Business Environment.

Contents: Theory

Topic and Contents	Hours	Marks
Topic 1: Overview of Business **Specific Objectives** ➢ State various business types and sectors ➢ Describe importance of globalisation 1.1. Types of Business • Service • Manufacturing • Trade 1.2. Industrial sectors Introduction to • Engineering industry • Process industry • Textile industry • Chemical industry • Agro industry • IT industry • Banking, Insurance, Retail, Hospitality, Health Care 1.3 Globalization • Introduction • Advantages & disadvantages with respect to India	02	04
Topic 2: Management Process **Specific Objectives** ➢ State various management principles ➢ Describe different management functions 2.1 What is Management? • Evolution • Various definitions of management • Concept of management • Levels of management • Administration & management • Scientific management by F.W.Taylor 2.2 Principles of Management (14 principles of Henry Fayol) 2.3 Functions of Management • Planning • Organizing • Directing • Controlling • Decision Making	08	08
Topic 3: Organisational Management **Specific Objectives** ➢ Compare different forms of organisation , ownership for a specific business ➢ Describe types of departmentation 3.1 Organization : • Definition	08	08

• Steps in organization 3.2 Types of organization • Line • Line & staff • Functional • Project 3.3 Departmentation • By product • By process • By function 3.4 Principles of Organisation • Authority & Responsibility • Span of Control • Effective Delegation • Balance ,stability and flexibility • Communication 3.5 Forms of ownership • Proprietorship • Partnership • Joint stock • Co-operative Society • Govt. Sector		
Topic 4: Industrial Safety and Legislative Acts **Specific Objectives** ➢ Describe types of accidents & safety measures ➢ State provisions of industrial acts. 4.1 Safety Management • Causes of accidents • Types of Industrial Accidents • Preventive measures • Safety procedures 4.2 Industrial Legislation - Necessity of Acts Important Definitions & Main Provisions of following acts: • Indian Factory Act • Workman Compensation Act • Minimum Wages Act	08	06
Topic 5: Financial Management (No Numerical) **Specific Objectives** ➢ Explain functions of financial management ➢ State the sources of finance & types of budgets. ➢ Describe concepts of direct & indirect taxes. 5.1 Financial Management- Objectives & Functions 5.2 Capital Generation & Management • Types of Capitals - Fixed & Working • Sources of raising Capital - Features of Short term, Medium Term & Long Term Sources 5.3 Budgets and accounts • Types of Budgets	08	08

• Fixed & Variable Budget - Concept • Production Budget - Sample format • Labour Budget - Sample format • Profit & Loss Account & Balance Sheet - Meaning, sample format, meaning of different terms involved. 5.4 Meaning & Examples of • Excise Tax • Service Tax • Income Tax • Value Added Tax • Custom Duty		
Topic 6: Materials Management (No Numerical) **Specific Objectives** ➢ Describe concept of inventory, ABC analysis & EOQ. ➢ Describe purchase functions & procedures ➢ State features of ERP & MRP 6.1 Inventory Concept, its classification, functions of inventory 6.2 ABC Analysis - Necessity & Steps 6.3 Economic Order Quantity Concept, graphical representation, determination of EOQ 6.4 Standard steps in Purchasing 6.5 Modern Techniques of Material Management • Material Resource Planning (MRP) - Functions of MRP, Input to MRP, Benefits of MRP • Enterprise Resource Planning (ERP) - Concept, list of modules, advantages & disadvantages of ERP	08	08
Topic 7 Quality Management **Specific Objectives** ➢ State Principles of Quality Management ➢ Describe Modern Technique & Systems of Quality Management 7.1 Meaning of Quality Quality Management System – Activities, Benefits Quality Control - Objectives, Functions, Advantages Quality Circle - Concept, Characteristics & Objectives Quality Assurance – Concept, Quality Assurance System 7.2 Meaning of Total Quality and TQM Components of TQM – Concept, Elements of TQM, Benefits 7.3 Modern Technique & Systems of Quality Management like Kaizen,5'S',6 Sigma 7.4 ISO 9001:2000 - Benefits, Main clauses.	06	08
Total	**48**	**50**

Learning Resources:
Books:

Sr. No	Author	Name of Book	Publisher
01	Dr. O.P. Khanna	Industrial Engineering & Management	Dhanpat Rai & Sons New Delhi
02	Banga & Sharma	Industrial Engineering & Management	Khanna Publication
03	Dr. S.C. Saksena	Business Administration & Management	Sahitya Bhavan Agra
04	W.H. Newman E. Kirby Warren Andrew R. McGill	The process of Management	Prentice- Hall

E Source:

nptel.iitm.ac.in
http://iete-elan.ac.in/subjects/amIndustrialMgmt.htm

Course Name : Electrical Engineering Group

Course Code : EE / EP

Semester : Sixth

Subject Title : Testing and Maintenance of Electrical Machines

Subject Code : 17637

Teaching and Examination Scheme

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS	TH	PR	OR	TW	TOTAL
04	--	04	03	100	50#	--	25@	175

NOTE:

- **Two tests each of 25 marks to be conducted as per the schedule given by MSBTE.**
- **Total of tests marks for all theory subjects are to be converted out of 50 and to be entered in mark sheet under the head Sessional Work (SW).**

Rationale:

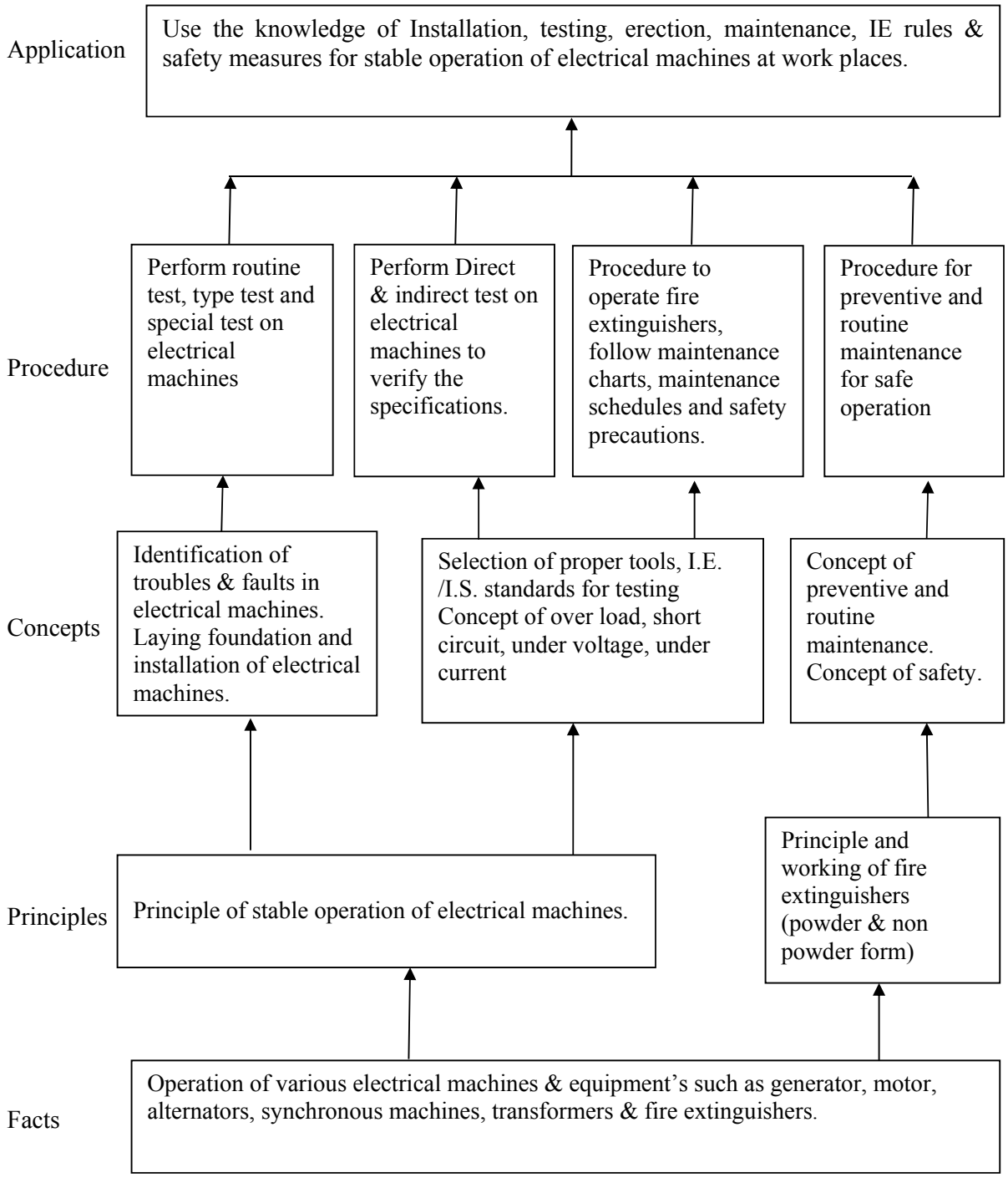
This course is under applied technology courses. Most of the diploma electrical engineers are working either in industries, power plants or in state electricity board as a supervisor / technician/procurement engineer. They have to understand instructions from superiors and pass on the same to the skilled workers working under them. The knowledge of testing, maintenance, erection and installation of electrical equipment's in industries, power plants and state electricity board is essential. This subject provides the detailed guidelines as per I.S. codes/I.E. Rules for testing, maintenance, erection and installation of electrical equipment's. As scope of business/Industry is at global level it is also essential that the student should be well conversed about international codes. They should be made aware about importance of preventive maintenance for efficient and effective functioning of electrical machines.

General Objectives:

After completing this course students will be able to-

1. Know I.S. codes/I.E. Rules & safety measures related to electrical machines.
2. Identify / Locate common troubles in electrical machines.
3. Plan & carry out routine & preventive maintenance
4. Prepare trouble-shooting charts for electrical machines.
5. Ascertain the condition of insulation & revarnishing if necessary.
6. Initiate total productive maintenance.

Learning Structure:



Theory:

Topic and Contents	Hours	Marks
Topic 1: Safety Measures & Prevention of Accidents Specific Objectives: ➢ To follow electrical safety measures ➢ To rescue electrocuted person and follow artificial respiration methods ➢ To use fire extinguisher for fire due electrical causes Contents: 1.1 Concept of electrical safety, electrical accidents, its causes & preventions. 1.2 Safety signs and symbols used in industry. 1.3 Electrical shocks and factors affecting the severity of it, method of rescuing electrocuted person & different methods of artificial respiration. 1.4 Electrical safety as per I.E. Rules 1956. 1.5 Do's & don'ts regarding safety while working on electrical installations. 1.6 Concept of Permit system, its preparation & regulation for attending to electrical work. 1.7 Precautions to be taken to avoid fire due to electrical reasons, operation of fire extinguishers, types of fire extinguishers.	08	12

Topic 2: Testing of Electrical Machines
Specific Objectives:
➢ To perform tests on various electrical machines as per Indian Standards
 	
Contents:
2.1 Objectives of testing.
2.2 Roles of Bureau of Indian Standards (BIS) in testing of electrical equipment's.
2.3 Types of tests: Routine, type, supplementary & special tests.
2.4 Methods of testing - Direct/ Indirect/ Regenerative testing.
2.5 Concepts of tolerances.
• Tolerances for rotating machines as per IS 4722-2001
• Tolerances for power transformers as per IS 2026 (part-I) - 2011
2.6 Testing of transformer as per IS 2026 (Part-I)-2011
• Routine tests, Type tests and Special tests.
2.7 Testing of three-phase Induction motor as per IS 4029 - 2010 and IS 325 - 1996.
• I.M. as a generalized transformer with vector diagram
• Equivalent circuit of 3-phase IM (No numerical)
• performance of open circuit test and short circuit (blocked rotor) test to find various quantities by drawing circle diagram with various conditions such as
  • at full load
  • maximum torque
  • maximum output
  • maximum input
2.8 Numericals on 2.6 & 2.7.
2.9 Testing of single-phase induction motor as per IS 7572-2009.
2.10 Testing of synchronous machines as per IS 7132-1973.
	22	32

Topic 3: Maintenance of Electrical Machines Specific Objectives: ➢ To plan routine and preventive maintenance schedule ➢ To prepare maintenance schedules for electrical equipments as per IS ➢ To identify different faults developed due to poor maintenance of electrical machines Contents: 3.1 Concept of maintenance, types of maintenance, Routine, preventive & breakdown maintenance. 3.2 Causes of failure of electrical machines. 3.3 Preventive maintenance • Advantages • Procedure for developing preventive maintenance schedules for electrical machines 3.4 Factors affecting preventive maintenance schedules. 3.5 Identification of different types of faults developed such as mechanical, electrical and magnetic faults due to poor maintenance. 3.6 Maintenance schedules of the following as per I.S.S. • Distribution transformer and Power transformer as per IS 10028 (Part-III)-1981 • Single phase & three phase Induction motors as per IS 900-1992 • Synchronous machines • Batteries IS 14782-2000	10	12
Topic 4: Testing and Reconditioning of Insulating Materials Specific Objectives: ➢ To follow the methods of reconditioning of insulation ➢ To test insulating oil as per IS ➢ To measure insulation resistance by different methods Contents: 4.1 Factors affecting life of insulating materials, classifications of insulating materials as per IS 1271-1985. 4.2 Measuring insulation resistance by different methods such as i) Polarization, ii) Dielectric absorption, iii) Megger • To predict the condition of insulation • Meaning of infinity and zero reading 4.3 Reconditioning of insulation • Cleaning and drying the insulation • Re-varnishing • Construction and working of vacuum impregnation plant 4.4 Insulating oil • Properties of insulating oil • Causes of deterioration of oil • Testing of transformer oil as per IS 1866-2000 • Method of purification and filtration of insulating oil	08	16
Topic 5: Fault Finding and Troubleshooting of Electrical Machines Specific Objectives: ➢ To use various tools for fault finding in electrical machines ➢ To locate faults in electrical machines ➢ To prepare trouble shooting charts for rotating machines and	08	12

transformers Contents: 5.1 Limits of voltage, current, frequency & speed for safe working of electrical machines. 5.2 Internal & external causes for failure and abnormal operation of equipments. 5.3 List of mechanical faults, electrical faults & magnetic faults in the electrical equipments. 5.4 Use of tools like bearing puller, filler gauges, dial test indicator, spirit level, megger, earth tester, and growler. 5.5 Common troubles in electrical equipments and machines. Preparation of trouble shooting charts for • D.C. Machines • AC Machines • Transformers [IS 10028 (Part-III) - 1981]		
Topic 6: Installation and Earthing of Electrical Machines Specific Objectives: ➢ To install static and rotating electrical machines ➢ To use the devices and tools for handling of electrical equipments ➢ To level and align different coupled drives ➢ To reduce the resistance of earth electrode by different methods Contents: 6.1 Concept of foundation for machinery installation. Requirements of foundation for static & rotating electrical machinery. 6.2 Concept and procedure of leveling & aligning. • Alignment of direct coupled drive • Effects of misalignment 6.3 Installation of transformer as per IS 10028 (part-II) -1981. 6.4 Requirements of installation of pole mounted transformer. 6.5 Requirements of installation of rotating electrical machines as per IS 900 - 1965 6.6 Devices and tools required for loading, unloading, lifting, and carrying heavy electrical equipment's & precautions to be taken while handling them. 6.7 Earthing • Importance of earthing • Difference between installation earthing & system grounding • Types of earthing as per IS 3043 - 1987 • Earthing resistance values for different types of installations • Factors affecting earth resistance • Methods of reducing earth resistance • Provision of earthing as per I.E. rule-61 & I.E.rule-90	08	16
Total	**64**	**100**

Practical:
Skills to be developed:

Intellectual Skills: 1. Select appropriate meters and equipment.
2. Recollect testing and maintenance procedures.

Motor Skills: 1. Accuracy of measurement.
2. Proper connections.
3. Draw characteristics.

List of Practicals:

Sr. No.	Title of Practical/Lab.Work/Assignments
1	Measure Impedance, Voltage and Load losses of Three phase Transformer.
2	Perform reduced voltage running up test on Three Phase Induction Motor as per IS 325:1967.
3	Perform No Load and Blocked Rotor Test on Three Phase Induction Motor as per IS 325:1967. And Draw Circle diagram and Calculate performance Indicator.
4	Calculate Regulation and Efficiency bye Back to Back connection of single phase Transformer.
5	Determine Breakdown Strength of Transformer Oil by using Oil Testing Kit.
6	Measure Insulation resistance of Transformer winding , Stator and Rotor of A.C. Rotating Machines using Megger.
7	Measure the Resistance of Earth Electrode using Earth Tester.
8	Understand the operation of Fire Extinguisher by giving Demonstration.
9	Prepare Troubleshooting Charts for Single Phase and Three Phase Induction Motor
10	Use different maintenance tools such as Bearing Puller, Growler, Dial-Test Indicators, Filler Gauge, Spirit Level, etc.

List of Assignments:

1. To demonstrate artificial respiration methods for shock affected persons.
2. To visit transformer repairing workshop/ electrical machine workshop.

Learning Resources:

1. **Books:**

Sr. No.	Author	Title	Publisher
1.	B.V.S. Rao	Operation & Maintenance of Electrical Equipments Vol-I & II	Media promoters and publisher Ltd. Mumbai
2.	M.V. Deshpande	Design & Testing of Electrical Machines	PHI learning private Ltd. New Delhi
3.	Sunil S. Rao	Switchgear & Protection	Dhanpat Rai and Sons, New Delhi
4.	Bhattacharya	Electrical Machines	Tata McGraw Hill
5.	V.K. Mehata & Rohit Mehata	Principles of Electrical Machines	S. Chand & Company Ltd.
6.	Tarnekar & Kharbanda	Laboratory Experiments in Electrical Engineering.	S. Chand & Company Ltd.
7.	B. L.Theraja	A Textbook of Electrical Technology Vol.-II	S. Chand & Company Ltd.
8.	Edward Hughes	Electrical and Electronics Technology	ELBS publications
9.	Kothari & Nagrath	Electrical Machines	Tata McGraw Hill

2. **CDs, PPTs, Models, Charts etc. :**

PPTs:

- www.lanl.gov/safety/electrical/docs/skilled_worker_module_6.ppt
- www.sandia.gov/.../Electrical/Sand_2009_1947_P_Non-Electrical

3. IS Codes and I.E Rules:

I.E. Rules 1956	: Safety
IS 4722-2001	: Rotating Electrical Machines – Specification
IS 2026 (part-I) -2011	: Power transformers: Part 1 General
IS 2026 (Part-II)-2010	: Power transformers: Part 2 Temperature-rise
IS 2026 (Part-III)-2009	: Power Transformers: Part 3 Insulation Level, Dielectric Tests and External Clearances in Air
IS 2026 (Part-IV)-1977	: Power transformers: Part 4 Terminal marking, tappings and Connections
IS 4029 – 2010	: Guide for testing three-phase induction motors
IS 325-1996	: Three phase Induction motors- specifications
IS 7572-1974	: Guide for testing single-phase ac and universal electric motors
IS 7132-1973	: Guide for testing synchronous machines
IS 10028 (Part-III)-1981	: Code of practice for selection, installation and maintenance of transformers: Part 3 Maintenance
IS 900-1992	: Code of practice for installation and maintenance of induction motors (first revision)
IS 1271-1985	: Thermal evaluation and classification of electrical insulations
IS 1866-2000	: Code of practice for electrical maintenance and supervision of mineral insulating oil in equipment
IS 3043 – 1987	: Code of practice for earthing
IS 15429-2004	: Storage installation and maintenance of dc motors-code of Practice
IS 9320-1979	: Guide for testing d.c. machines
IS 14782-2000	: Code of Practice for Maintenance and Testing of Large Lead acid Batteries for Generating Stations and Substations
I.E. rule-61	: Earthing
I.E.rule-90	: Earthing

4. Websites:

- www.bis.org.in
- www.standardsbis.in
- www.civilengineer.co.in

Course Name : Electrical Engineering Group

Course Code : EE/EP

Semester : Sixth

Subject Title : Power Electronics

Subject Code : 17638

Teaching and Examination Scheme:

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS	TH	PR	OR	TW	TOTAL
04	--	02	03	100	50#	--	25@	175

NOTE:

- **Two tests each of 25 marks to be conducted as per the schedule given by MSBTE.**
- **Total of tests marks for all theory subjects are to be converted out of 50 and to be entered in mark sheet under the head Sessional Work (SW).**

Rationale:

Power electronics is a branch of engineering that combines the fields of electrical power, electronics and control. As an electrical engineer it is necessary to exercise control on power given to the machines to control its speed, voltage and current to suit its load.

The invention of thyristor as a power device led to development of compact, reliable and maintenance free drive circuits. The utility of power devices spread to industrial applications such as UPS, induction heating, high voltage DC transmission, Electrical welding etc.

Microprocessors and microcomputers have made their impact on power electronics based industrial equipment. Their application for control of electric devices is used as a brain and the power semiconductors are considered as muscles of the equipment.

With rapid development in modern technology, power electronic equipments are integral part of control system.

General Objectives:
The students will be able to:

1. Understand the physical processes for the switching of a thyristor.
2. Know the various methods of triggering a thyristor and different gate turn-on methods.
3. Develop logic about the turning off mechanism of a thyristor and get acquainted with some methods of turning a thyristor off.
4. Become familiar with other members of the thyristor family as well as other power electronic devices.
5. Know the characteristics of different power electronic devices.
6. Know the working of rectifiers, choppers, inverters and industrial applications of the thyristor.

Learning Structure:

Application	Devices are used in heat controls, light control, motor controls, HVDC
Procedure	Testing of Inverters, converters and choppers in various controls
Principles	Triggering of Thyristor, Principle of Conversion, Inversion and Chopping
Concepts	SCR Triggering and turning off, Converter, Inverter, Chopper
Facts	Power Semiconductor devices, Thyristor family, Electric Heating, Electric Welding, Battery Charger

Theory:

Topic and Contents	Hours	Marks
Topic 1: Introduction to Power Electronics **Specific Objectives:** ➢ State purpose of power conversion. ➢ List application areas of Power Electronics. ➢ Select specific Thyristor device for required application. **Contents:** • Necessity of Power conversion using solid state devices • Applications of Power Electronics • Thyristor family ❖ Characteristics and symbolic representation of SCR, DIAC, TRIAC, GTO, SUS, LASCR, IGBT. • SCR: Construction, operation, Two transistor analogy • Triggering methods of SCR ❖ Voltage triggering. ❖ dv/dt triggering. ❖ Light triggering. ❖ Gate triggering ✓ DC gate triggering ✓ AC gate triggering. ✓ Pulse gate triggering. • SCR Turn-off process with waveforms of Voltage and Current • SCR Specifications/Ratings: Voltage , Current , Power , Temperature • SCR selection factors • SCR testing	10	20
Topic 2 : Converters **Specific Objectives:** ➢ Operation of controlled converters ➢ Classification of Controlled converters. ➢ Identify different types of converters for required applications **Contents:** • Necessity of Convertors • Concept of firing angle and conduction angle • Single phase fully controlled half wave converter - With resistive load - RL load without freewheeling diode. - RL load with freewheeling diode. • Single phase full wave controlled converter - With resistive load - With RL load • Single phase fully controlled bridge converter - With resistive load - With RL load • Three phase fully controlled bridge converter - With R load • Comparison of 3Ø and 1Ø converters on the basis of efficiency, ripple factor , RMS Values and average values • Effect of source impedance on converter operation.	12	20

• Cycloconverters: 1Ø - Principle of operation, input and output waveforms.		
Topic 3 : Inverters **Specific Objectives:** ➢ List different types of inverters and applications. ➢ Selection of 1Ø or 3Ø inverters for required application. **contents:** • Need of Inverter • Classification : - 1Ø and 3Ø inverters. - Line (Natural) commutated Inverters - Forced commutated inverters: Series, parallel and bridge inverters.(circuit, description and waveforms) • Series inverters: Operation of basic series inverter , Modified series inverter, Three phase series inverter. • Parallel inverters: Operation of basic parallel inverter circuit. • Single Phase Bridge Inverter - Half bridge inverter - Full bridge inverter • Voltage and frequency control of 1Ø inverter - Necessity of control of output voltage. - Methods for output voltage control: External control of DC voltage, External control of AC voltage and internal control. - Pulse width modulation (PWM) method: Single pulse width modulation, multiple pulse width modulation, Sinusoidal pulse width modulation. • Waveform control (Harmonic Reduction): Single pulse width modulation, transformer connections, using filter (LC, Resonant) • Concept of MOSFET Inverter and comparison with thyristor based inverter	14	20
Topic 4 : Choppers **Specific Objectives:** ➢ Necessity of chopper. ➢ Selection of chopper as per the requirement of application. **contents:** • Chopper principle • Control techniques: Constant Frequency System, Variable Frequency System. • Classification of choppers :Class A, class B, class C, class D, class E • Commutation methods for choppers: Auxiliary commutation, load commutation. • Jones chopper • Step up chopper.	10	16
Topic 5 : Applications of Power Electronics **Specific Objectives:** ➢ State basic principles of AC and DC Machines. ➢ Selection of SCR control circuit as per the requirement of application. **contents:** 5.1 DC Drives • Speed control of DC series motor with 1Ø half and full control	18	16

converter, step up and step down chopper 5.2 AC Drives • Speed control of 3Ø induction motor - Variable frequency control : Voltage source inverter, current source inverter, cycloconverter • Other applications: Circuit diagram, operation - Static circuit breaker(DC and AC) - Induction heating control - Dielectric heating control - Electric welding control - Battery charger control - Automatic street lighting circuit using SCR - Static VAR compensation system - Close loop speed control method for D C and AC servo moto		08
Total	**64**	**100**

Practical:
Skills to be developed:

- **Intellectual Skills**
  1. Select appropriate circuits and instruments
  2. Testing and troubleshooting
- **Motor Skills**
  1. Accuracy of measurement
  2. Proper connection
  3. Draw characteristics

List of Practical:

1. Plot V-I charactristics of SCR and find latching current (IL), holding current (IH) and the forward break over voltage (VFBO).
2. Observe the output waveforms of single phase full wave controlled rectifier with resistive load, inductive load with and without freewheeling diode. Measure the load voltage with variations in firing angle.
3. Observe the output waveform of three phase full wave controlled rectifier with resistive load, inductive load without and with freewheeling diode. .
4. Understand single phase series inverter and to measure the output signal resonance frequency and voltage.
5. Understand current commutated step down chopper and observe the change in output voltage.
6. Understand operation of battery charger using SCR and observe change in charging voltage and current.
7. Understand the speed control of DC series motor using SCR phase control and plot speed Vs. armature voltage characteristics.
8. Understand the speed control of three phase induction motor using PWM inverter and plot speed Vs. torque characteristics.
9. Visit to traction system/coal handling in thermal power station/process industry/oil extraction plant or any other similar industry and prepare a report .Deliver seminar on the small topic related to visit or any other topic allotted by the teacher.

Learning Resources:
Books:

Sr. No.	Author	Title	Publisher
1	M. D. Singh K. B. Khanchnadani	Power Electronics	Tata Mcgraw Hill
2	S. K. Bhatacharya S. Chattarjee Ttti Chandigad	Industrial Electronics & control	Tata Mcgraw Hill
3	P. C. Sen	Power Electronics	Tata Mcgraw Hill
4	M. D. Rashid	Power Electronics	Pearson
5	V. R. Moorthi	Power Electronics	OXFORD
6	Mohan, Undeland Riobbins	Power Electronics	Willey Student Edition
7	S. K. Bhatacharya	Fundamentals of Power Electronics	Vikas Publication
8	V. Jagannathan	Power Electronics Devices & Circuits	PHI
9	--	SCR Manual	General Electric Co.

Websites:

- freevideolectures.com/Course/2351/Power-Electronics
- freevideolectures.com/.../Industrial-Drives-and-Power-...
- www.learnerstv.com/Free-Engineering-Video-lectures-ltv127
- www.circuitstoday.com/scr-characteristics
- en.wikipedia.org/wiki/Thyristor
- www.freepatentsonline.com/5216683.html
- en.wikipedia.org/wiki/Inverter_(electrical)

Course Name : Diploma in Electrical Engineering

Course Code : EE

Semester : Sixth

Subject Title : Illumination Engineering

Subject Code : 17639

Teaching and Examination Scheme:

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS	TH	PR	OR	TW	TOTAL
04	--	02	03	100	--	--	25@	125

NOTE:

- **Two tests each of 25 marks to be conducted as per the schedule given by MSBTE.**
- **Total of tests marks for all theory subjects are to be converted out of 50 and to be entered in mark sheet under the head Sessional Work. (SW)**

Rationale:

This subject is included to teach the students various aspects of illumination and illumination schemes. Students will be able to apply principles & laws of illumination. Students will have the knowledge of various types of lamps, lighting accessories & control circuit and their applications. He/she will become aware of his/her role in designing and installing illumination equipment as per new illumination trends. With changing life style and interest in recent trends in illumination, there is vast scope for illumination engineers to innovate and cater to the needs of domestic, commercial and industrial consumers. With experience one can start own business in the field of illumination engineering.

General Objectives:

The Students will be able to:

1. Understand the meaning of the terms used in illumination engineering
2. Realise the requirements of various types of consumers
3. Study requirements of illumination levels for various applications.
4. Understand the requirements of illumination equipment and accessories for different applications

Learning Structure:

Applications	Design illumination schemes as per the requirements, procure the material and supervise the execution of the work
Procedure	Design illumination system using appropriate methodology. Procure the material, install and test the system
Concepts & Principle	Illumination, Light intensity, Lumen, Lux, Direct / Indirect lighting system, sine board/ advertisement, Luminaries
Facts	Illumination Level, Light intensity, Cables/Wires, Lighting Accessories.

Theory:

Topic and Contents	Hours	Marks
Topic 1. Fundamentals of Illumination **Specific Objectives** ➢ Identify and measure the level of illumination ➢ Design illumination schemes ➢ Use IEI standards for illumination schemes • Fundamentals of Illumination • Illumination terminology: Illumination, Light intensity, Lumen, Lux • Laws of Illumination (Simple numerical) • Features of good Illumination scheme • Advantages of good Illumination scheme	06	08
Topic 2. Lamps & Lighting Accessories **Specific Objectives** ➢ Differentiate between the various types of lamps. ➢ Collect technical data of lamps and lighting accessories ➢ Identify mountings arrangement for light sources • Types of lights: a. Visible light b. Ultraviolet light c. Infrared light • Types of lamps: a. Incandescent lamp b. ARC lamps – ac &dc arc lamp c. Fluorescent lamp d. Mercury vapour lamp , HPMV lamp, Mercury iodide lamp e. Sodium vapour lamp f. Neon lamp , Neon Sign Tubes g. Halogen lamp h. CFL Lamps i. Metal halides lamp j. LED lamps k. Special purpose lamps • Construction, working principle advantages and disadvantages of all lamps • Comparison between incandescent & Florescent lamps • Lighting schemes: selection of lamp, illumination efficiency , glare & power consumption a. Direct & Indirect b. Semi direct & semi indirect c. General lighting scheme • Lighting calculation methods a. Watt /m2 method b. Lumens or light flux method c. Point to point method (Simple numerical)	12	20
Topic 3. Illumination Control & Control Circuits **Specific Objectives** ➢ Select controlling methods of brightness/colour of light source as per requirements	10	16

➢ Select proper light source as per application ➢ Design control circuit for illumination. • Purpose of lighting control • Working principle and operation of : • Dimmer - a. Resistance type dimmer b. Salt water dimmer Dimmer Transformer 1) Auto transformer dimmer 2) Two winding transformer dimmer • Electronic Dimmer : working principle and operation a. Thyrister operated dimmer b. Triac operated dimmer • Control of Enhance Lighting • Methods used for light control : • Control circuits for lamps : single lamp controlled by single switch, two switches, • Single Lamp control by two point method , three point method & four point method • Polar curve : its meaning and applications for designing the lamps		
Topic 4. Illumination for Interior Applications **Specific Objectives** ➢ Select lux level required for every working plane as per application ➢ Calculate total lux level required for the working plane ➢ Selection to proper light source • Standards for various situations in Interior Illumination • Methods for Designing illumination schemes • Design considerations for Interior location of Residential Commercial, Industrial premises • Design Illumination scheme for different Interior locations of Residential, Commercial, Industrial unit • Numerical on above sub topics	12	20
Topic 5. Illumination for Outdoor Applications **Specific Objectives** ➢ Select proper wattages for light source as per its illumination efficiency ➢ Locate specific mountings of lighting sources for outdoor applications ➢ Consider effect of environmental conditions for working hours of light sources • General requirements for lighting schemes Specific requirements for above schemes • Factory Lighting • Street Lighting • Flood Lighting • Railway platform Lighting • Lighting for Advertisement/Hoardings • Sports Lighting • Simple numerical based on design of simple schemes	12	20
Topic 6. Lighting for Special Applications **Specific Objectives**	12	16

➢ Understand use of special purpose lamps. ➢ Select proper lamps in order to save energy. • Lighting schemes and general requirements for : • Agricultural & Horticultural applications • Health Care Centers and Hospitals • decorative lighting • stage lighting • Aquariums & Shipyards		
Total	**64**	**100**

Practicals:
Intellectual Skills:
1. Apply different designing skill.
2. Select proper equipment.

Motor Skills
1. Measurement of illumination.
2. Drawing skill.

List of Assignments:
1. Estimate and compare luminous efficiency of incandescent and compact fluorescent lamp.
2. Compare performance of magnetic and electronic ballast. Estimate the energy saving with electronic ballast.
3. Understand energy efficient illumination equipments.
4. Design illumination scheme for any one of the following. (A)Flat (B)Bunglow (C)Row House and similar
5. Design illumination scheme for any one of the following. (A) Mall (B) Cloth shop (C) Restaurant (D) Showroom.
6. Write a report on illumination scheme used in industry by visiting small or medium industry.
7. Conduct illumination assessment in workplace using luxmeter
8. Understand biological implication of artificial illumination.

Learning Resources:
1. **Books:**

Sr. No.	Name of the Author	Title of the Book	Name of the Publisher
1.	N. V. Suryanarayana	Utilisation of Electrical Power	Wiley Eastern Limited
2.	Jack l. Lindsey	Applied illumination engineering	The Fairmont Press Inc.
3.	R.H. Simons& Robart Bean	Lighting Engineering & applied calculations	Architectural Press (ISBN0750650516)

2. ISO, IS, BS standards, Data Sheets, IE Rules Handbook
   IS 2418, 9974, 9900, 2218, 5077, 4012, 4013, 1885, 1947, 4347, 6665, 3287, 1777, 3646, 2672, 10894, 1944, 10322, 2140

3. www.onlinefreeebooks.net
   www.ies.org/shop/
   www.opticalres.com/lt/illuminationfund.pdf

Course Name : Diploma in Electrical Engineering

Course Code : EE

Semester : Sixth

Subject Title : Modern Electric Traction (Elective)

Subject Code : 17640

Teaching and Examination Scheme:

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS	TH	PR	OR	TW	TOTAL
04	--	02	03	100	--	--	25@	125

NOTE:

- **Two tests each of 25 marks to be conducted as per the schedule given by MSBTE.**
- **Total of tests marks for all theory subjects are to be converted out of 50 and to be entered in mark sheet under the head Sessional Work (SW).**

Rationale:

In these days electric traction is used for mass transport of goods and passengers over short and long distances at faster rate. In electric traction, electric motors are used to propel different vehicles like trolley bus, tram car, electric trains and the latest vehicles that include metro trains, sky bus and mono rail.

Indian Railways (IR) is the largest organization that has very large job potential and opportunities for electrical engineering diploma holders; hence they should know the recent technological developments in this area of electric traction. This has made it essential for electrical engineering diploma student to study the subject; completely dedicated to electric traction.

General Objectives:

Students will be able to

1) Identify and describe the use of components of power supply arrangements for electric traction
2) Know different overhead equipment's
3) Compare the different type of current collecting systems and current collecting gears
4) Explain various types of signals and track circuits
5) Describe supervisory control used in electric traction
6) Know special requirements of train lighting system
7) Understand the importance of electric locomotive maintenance and protective system
8) Describe the recent trends in electric traction- LEM propelled traction, Metro Rail System, Mono Rail System

Learning Structures:

Application	The student will use his knowledge while working as supervisor / controller in the field, where electric traction is used as service for mass transport, maintenance engineer, loco pilot and motorman
Procedure	1. Operation of power supply arrangements, OHE, current collecting equipments, signaling and train lighting. 2. Operation of power and auxiliary circuits of electric locomotive. 3. Protection and maintenance of electric locomotive.
Concept & Principle	1. Electric power transmission and distribution system 2. Signaling 3. Train lighting 4. Linear Electric Motor (LEM) 5. Magnetic Levitation
Facts	Electrical Machines, Substation components, Illumination scheme, Electrical Circuits, Switchgear and Protection and Electrical Safety

Theory:

Topic and Contents	Hours	Marks
Topic 1: Power Supply Arrangements Specific Objectives: ➢ Interpret the layout of traction power supply arrangement, ➢ Draw layout of traction power supply arrangement, and ➢ Explain the functions of various constituents of traction power supply arrangement Contents: (Scope – To be restricted as per allotted time and marks) 1.1 Introduction to Traction Supply System 1.2 Constituents of Supply System. • Substations • Feeding Posts. • Feeding and Sectioning Arrangements. • Sectioning and Paralleling Post. • Sub Sectioning and Paralleling Post. • Sub Sectioning Post • Elementary Section. 1.3 Miscellaneous Equipments at Control Post or Switching Stations. 1.4 Major Equipments at Substation • Transformer. • Circuit Breaker. • Interrupter. 1.5 Protective System for AC Traction • Transformer • 25 kV Catenary	12	20
Topic 2: Overhead and Current Collecting Equipments Specific Objectives: ➢ Comprehend the importance of Overhead and Current Collecting Equipments in traction power supply, ➢ Identify Overhead Equipments in traction power supply and state its function, ➢ Describe the functions of Current Collecting Equipments in traction power supply ➢ Select current collecting equipment as per the requirements Contents: (Scope – To be restricted as per allotted time and marks) 2.1 Overhead Equipments (OHE) • Principles of Design of OHE - Composition of OHE - Height of Contact Wire - Contact Wire Gradient - Encumbrances - Span Length • Automatic Weight Tension and Temperature Compensation • Un-insulated and Insulated Overlaps, Neutral Section, Section Insulator and Isolator • Polygonal OHE - Single Catenary Construction - Compound Catenary Construction - Stitched Catenary Construction	10	20

- Modified Y Compound Catenary • Effect of Speed on OHE • OHE Supporting Structure • Different types of signal boards of OHE 2.2 Current Collecting Equipments • Systems of Supplying Power in Electric Traction - Third Rail or Conductor Rail System - Overhead System • Current Collectors for Overhead System - Trolley Collector or Pole Collector - Bow Collector - Pantograph Collector • Types of Pantographs - Diamond Pantograph - Faiveley Type • Methods of Raising and Lowering of Pantograph		
Topic 3: Signaling and Train Lighting Specific Objectives: ➢ Appreciate the importance of signaling and train lighting, ➢ State different types of signals and their meanings, and ➢ State and explain different methods of train lighting Contents: (Scope - To be restricted as per allotted time and marks) 3.1 Signaling • Requirements of Signaling System • Types of Signals • Colour Light Signals • Three and Four Aspects of Colour Light Signals. • Track Circuits. - DC Track Circuit - AC Track Circuit 3.2 Supervisory Control • Advantages of Remote Control • Systems of Remote Control - DC versus Voice Frequency (VF) Signaling - Remote Control System Equipment and Network • Mimic Diagram • Control Desk for TPC 3.3 Train Lighting • Systems of Train Lighting • Special Requirements of Train Lighting • Method of obtaining Unidirectional Polarity • Method of obtaining Constant Output • Single Battery System. • Double Battery Parallel Block System. • Failure of under frame Generating Equipments. • End on Generation.	14	20
Topic 4: Electric Locomotives Specific Objectives: ➢ Draw power circuit of Electric Locomotive and state the functions of various constituents of it, ➢ State the various Equipments in Auxiliary Circuit and their functions,	10	16

➢ List Different Type of Relays in Electric Locomotive and state their functions, ➢ List Different Type of Contactors in Electric Locomotive and state their functions, and ➢ Explain the fundamentals of three phase Locomotive Contents: (Scope – To be restricted as per allotted time and marks) 4.1 Classification of Locomotives and EMU 4.2 Power Circuit • Power Circuit Diagram of AC Locomotive • Equipments in Power Circuit and their Functions - Circuit breaker and Earthing Switch - Tap Changer - Traction Transformer - Rectifier: Rectifier Connections - Smoothing Reactor • Equipments in Auxiliary Circuit & their Functions - Head Light - Flasher Light - Horn - Marker Light - Batteries - Arno Converter - Blowers - Exhausters - Compressors - Selsyn transformer. • List and Function of Different Type of Relays • List and Purpose of Different Type of Contactors • Three Phase Locomotive - Power Circuit of Three Phase Locomotive - Power Supply Arrangement for Auxiliary - Machines in Three Phase Locomotive		
Topic 5: Protection and Maintenance of Electric Locomotive Specific Objectives: ➢ Appreciate the importance of protection and maintenance of Electric Locomotive, ➢ Explain various types of protections provided to Electric Locomotive, and ➢ Describe the maintenance policies of Electric Locomotives and state them Contents: (Scope - To be restricted as per allotted time and marks) 5.1 Protection of Electric Locomotive • Broad Strategy For Protection • Surge Protection: - Direct Lightening Strokes - Switching Surges: External and Internal • Overload Protection of Main Power Circuit • Earth Fault Protection of Power and Auxiliary Circuit • Protection from Over Voltage and Under Voltage • Differential Current Protection of Traction Circuits. • Protection against High and Low Air Pressure in the Air Circuit	10	14

• Temperature Monitoring 5.2 Maintenance of Locomotive • Need of Maintenance and Policy of Obsolescence • Defects • Ideal Maintenance • Means to Improve the Reliability of Locomotive • Means to Improve Availability of Locomotive • Means to Reduce Maintenance Cost • Maintenance Record. • Characteristics of Efficient Maintenance • Electrical Faults and Their Causes.		
Topic 6: Modern Trends in Electric Traction Specific Objectives: ➢ State new Developments in the Area of Electric Traction, ➢ Explain the working of Linear Electric Motor (LEM) Traction System, and ➢ State the Levitation Schemes used in Wheel less Traction System Contents: (Scope – To be restricted as per allotted time and marks) 6.1 LEM Propelled Traction • Linear Electric Motor (LEM) • Linear Induction Based Traction System - Moving Primary Fixed Secondary Single Sided LIM - Moving Secondary Fixed Primary Single Sided LIM - Moving Primary Fixed Secondary Double Sided LIM • Strengths/Weaknesses of LIM Propelled Railway Traction - Strengths of LIM Propelled Railway Traction System - Weaknesses of LIM Propelled Railway Traction System • Practical Possibilities of LIM Propelled Transportation	08	10
Total	**64**	**100**

List of Drawing Assignments:

Five Drawing Sheets (Half Imperial Size) and Report on each Sheet

1. Traction Substation and Feeding Post Layout
2. Overhead Equipments (OHE) and Current Collecting Equipments (at least 6 equipments on 2 sheets)
3. Signaling and Train Lighting,
4. Power Circuit in Electric Locomotive and Auxiliary Circuit Equipments

Learning Resources:

1. Books:

Sr. No.	Author	Title	Publisher
1	H. Partab	Modern Electric Traction	Dhanpat Rai & Sons
2	J. Upadhyay S. N. Mahendra	Electric Traction	Allied Publishers Ltd.
3	Om Prakash Kesari	Viddut Engine Parichay (In Hindi)	S. P. Graphics, Nashik.
4	J. B. Gupta	Utilisation of Electric Energy (Including Electric Traction)	Kataria and Sons

4. Websites:

1) http://www.railway-technical.com/etracp.shtml
2) http://www.irfca.org/faq/faq-elec.html
3) http://en.wikipedia.org/wiki/Railway_electrification_system
4) http://en.wikipedia.org/wiki/Traction_substation
5) http://www.irfca.org/faq/faq-elec2.html
6) http://en.wikipedia.org/wiki/Electric_locomotive
7) http://www.irfca.org/faq/faq-loco2e.html
8) http://www.irfca.org/faq/faq-shed.html
9) http://www.irfca.org/docs/ac-auxiliaries.html
10) http://www.railway-technical.com/elec-loco-bloc.shtml

Course Name : Diploma in Electrical Engineering

Course Code : EE

Semester : Sixth

Subject Title : Elements of Industrial Automation (Elective)

Subject Code : 17641

Teaching and Examination Scheme:

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS	TH	PR	OR	TW	TOTAL
04	--	02	03	100	--	--	25@	125

NOTE:

- **Two tests each of 25 marks to be conducted as per the schedule given by MSBTE.**
- **Total of tests marks for all theory subjects are to be converted out of 50 and to be entered in mark sheet under the head Sessional Work (SW).**

Rationale:

A diploma engineer has to look after the day-to-day operations, control and maintenance of controllers used in various automated industrial systems to ensure trouble free working. He should be well conversant with the various technical aspects of commonly used control components and control actions in respect of their working and performance. With the above knowledge, he should also be able to implement innovative ideas of automation wherever necessary.

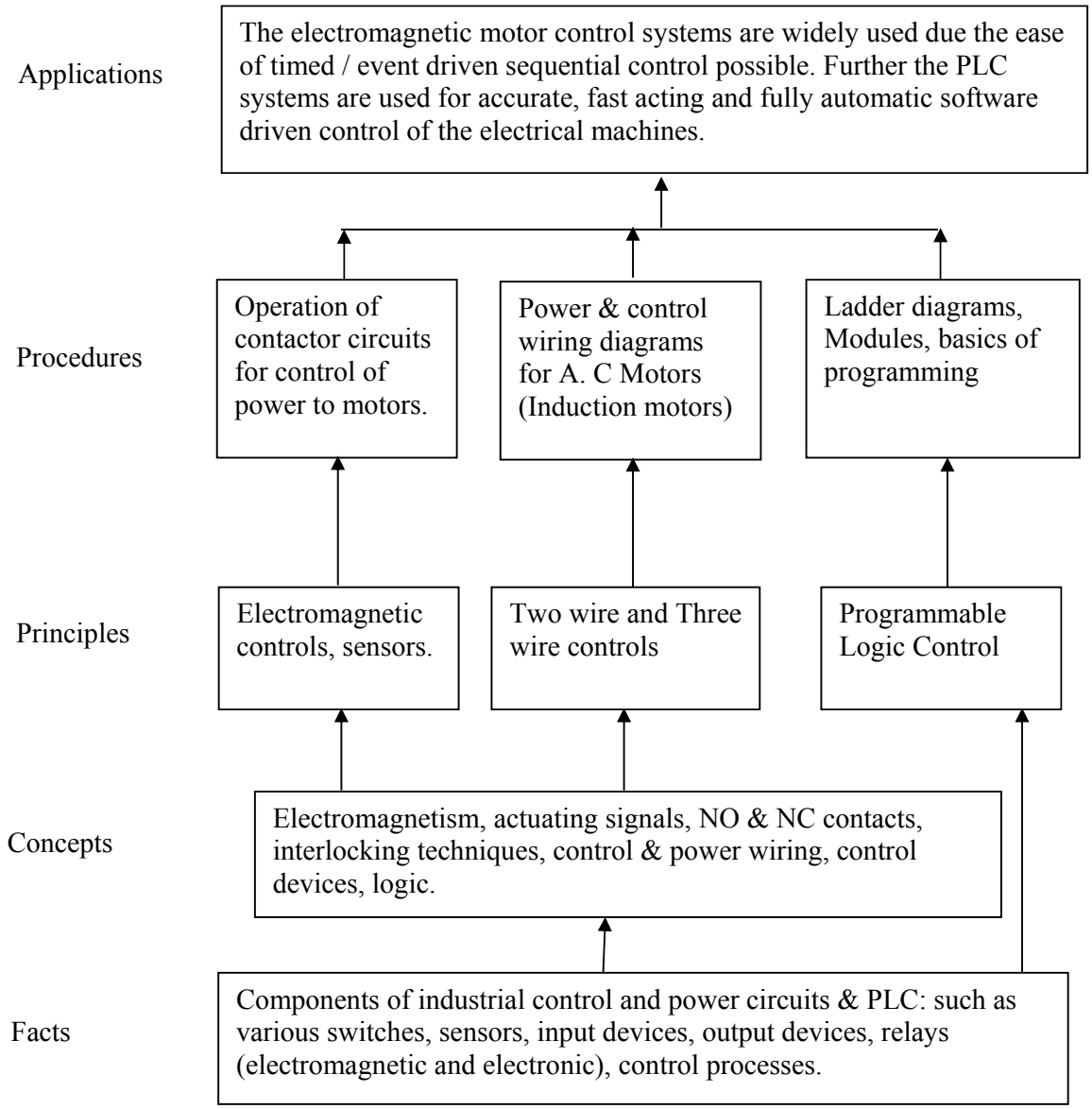
Programmable Logic Controllers (PLC) have revolutionized and replaced the conventional industrial automation systems. A single PLC can reliably handle number of complex control actions in real time with high precision.

Therefore, the electrical diploma engineer must have the basic knowledge of industrial control components, actions and must be well conversant with the use of PLC therein.

General Objectives:

1) Understand the working of various industrial control components.
2) Use principles of machine control to design simple schemes for control.
3) Understand the working of basic control actions (viz. ON-OFF, P+I+D).
4) Know skills to use PLC for implementing simple industrial control applications.

Learning Structure:



Topics and Contents	Hours	Marks
Topic 1:Industrial Control Components Specific Objectives: ➢ Use input devices such as push button, limit switches etc. in industrial machine control ➢ Use output devices such as relays, contactors, solenoid valves etc. as actuators in industrial control ➢ Differentiate 2 wire & 3 wire controls ➢ Define & Differentiate power and control wiring Contents: 1.1 Input devices (Basic working and schematic diagrams with functions) • Definition of control devices such as Push buttons, selector switches. • Solenoid valves, Limit switches and its types • Pressure, temperature, flow, float actuated switches • Reed switches, photoelectric, hall effect, inductive, capacitive proximity switches • Two wire and three wire control. 1.2 Output devices (Basic working and schematic diagrams with function) • Concepts of NO/NC contacts • Electromagnetic Relays, contactors and their ratings, solenoid valves • Solid state Relays • Latching Relays, Bimetallic Thermal Over-load Relay, Time Delay Relays (Timers), Electronic Overload Relay • Pneumatic cylinders • Concepts of Power and control wiring diagrams, main and auxiliary contacts • Interlocking of contactor circuits using push buttons, NC contacts and limit switches. 1.3 Schematic of symbols used in industrial control circuits	12	12
Topic 2: Industrial Machine Power and Control Circuits (contactor based) Specific Objectives: ➢ Prepare power and control circuit diagrams for starters of induction motors and describe briefly the working. ➢ Prepare power and control circuit diagrams for double winding motors and describe briefly the working. ➢ Prepare plugging and braking circuits (control and power) for 3 phase induction motors and describe briefly the working. ➢ Identify applications for servo motors. Contents: 2.1 DOL starters for 3 phase induction motors • Power and control circuit diagrams of forward- stop- reverse type. • Power and control circuit diagrams of forward and random reversing type. 2.2 Star delta starters & auto transformer starters for 3 phase induction motors • Power and control circuit diagrams of semi automatic type. • Power and control circuit diagrams of automatic type using timer • Power and control circuit diagrams for motors using autotransformer type starters 2.3 Starters for slip ring induction motors • Power and control circuit diagrams for Definite Time Limit Starter	14	24

• Power and control circuit diagrams for Current Limit Acceleration Starter • Power and control circuit diagrams for Secondary Frequency Acceleration Starter 2.4 Plugging and dynamic braking of induction motors • Control and power circuits for simple plugging of motor • Dynamic Braking - D.C. injection braking power & control diagrams 2.5 Introduction to AC/DC Servo motors • Basics of construction of servo motors • Principle of working • Application areas in brief		
Topic 3. Introduction to Programmable Logic Controller Specific objectives ➢ Draw generalized block diagram of a PLC ➢ Draw simple block diagrams & state functions of different I/O modules. ➢ Know types and use of Memory in the PLC. Contents: 3.1 Introduction to PLC • Block diagram and working of Programmable Logic Controller • PLC advantages and disadvantages. • Proximity sensors /switches; inductive and capacitive types: description with simple block diagrams; areas of applications. • Opto-isolators, optical sensors. 3.2 PLC modules • digital I/O Modules and their ratings • analog I/O Modules and their ratings • timer/counter Modules • Memory: ROM: types (Mask ROM, PROM, EPROM, EEPROM) and RAM. • Functions of the above memory units. • PLC power supplies block diagram and function of each block.	12	24
Topic 4. Basic Components of PLC. Specific objectives ➢ Draw ladder diagrams for simple logic operations ➢ Use timers, counters in ladder diagrams ➢ Draw ladder diagrams for induction motor starters. Contents: 4.1 Ladder diagrams • Typical PLC inputs. • Typical PLC Outputs. • One contact, one coil circuit • Standard start-stop-seal circuit • Ladder diagrams for simple logic operations(NOT, AND, OR, EXOR) • On delay timer, off delay timer • Ladder diagrams for DOL, Star-delta (automatic) starters. • Up and down counter	14	24
Topic 5. Control Actions Specific objectives ➢ Describe in brief different control actions with their merits. Contents:	12	16

5.1 Process control actions (block diagrams with very brief functioning descriptions) • Proportional Controllers • Integral Controllers • Proportional-Integral Controllers • Derivative Controllers • Proportional-Integral-Derivative Controllers 5.2 Brief description of the PLC working with reference to above studied control actions		
Total	**64**	**100**

Practicals:
Skills to be developed:

Intellectual Skills:

1) Understand control circuit importance.
2) Appreciate the linkage of power and control circuits.
3) Understand the characteristics of the components for motor control and power circuits.
4) To develop the Ladder diagrams as per requirements of processes.
5) To understand & appreciate the importance of analog/digital I/O Modules.

Motor Skills:

1) Connect contactors in circuits.
2) Handle the coil, contacts, reset link and other parts.
3) Handle various parts of the induction motor starters.
4) Connect components of the DOL starter, star-delta starter with the motor circuit and operate them.
5) Develop the control and power circuits of motor operation.
6) Select components for power and control sections of motor.
7) To identify application of analog/digital I/O Modules in PLC.

List of Practicals:

Sr. No.	Laboratory/drawings work
1	Draw Symbols used in electromagnetic control circuit diagrams.
2	Construction & Operation of contactors.
3	Operation of different types of switches, relays used in motor control circuits (push-buttons, limit switches, relays with at least 2 NO and 01 NC contacts)
4	Operation of Direct-On-Line (DOL) starter (connections: power and control diagrams)
5	Operation of Direct-On-Line (DOL) starter with Reversing Control (connections: power and control diagrams)
6	Semi-automatic & Fully Automatic Star-Delta Starter. (connections: power and control diagrams)
7	Operations of motor control circuit of an electric oven (if available) else trace simple power & control circuits of available equipment in workshop or elsewhere in institute.

Sr. No.	Laboratory/drawings work
8	Components of PLC: draw symbolic representation of at least 20 components used to create ladder diagrams.
9	Create ladder diagrams for simple process - machine systems in presence of teacher in the laboratory (any three)

Learning Resources:

1. Books:

Sr. No.	Author	Title	Publisher
1	Eshwar U. S.	Handbook of Electric Motor Controls	Tata McGraw Hill
2	Bhattacharya & Singh	Control of Electrical Machines	New Age International Publishers
3	Webb & Reis	Programmable Logic Controllers-principles and applications	Prentice Hall India
4	Biswanath Paul	Industrial electronics and control (including Programmable Logic Controller) [3rd edition only, not earlier one]	Prentice Hall India
5	Bryan & Bryan	Programmable Controllers Theory and Implementation	An Industrial Text Company Publication
6	John R. Hackworth & Frederick Hackworth (Jr)	Programmable Logic Controllers	Pearson

2. CDs, PPTs, Models, Charts etc. :

Teachers must use educational software such as that available on the internet (eg.TRiLOGI, SIEMENS etc) for the PLC.

3. Websites:

1. www.brothersoft.com/download/plc-simulator,
2. www.edusoft.co.za/ladsim.htm

Course Name : Electrical Engineering Group

Course Code : EE / EP

Semester : Sixth

Subject Title : Project

Subject Code : 17801

Teaching and Examination Scheme:

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS	TH	PR	OR	TW	TOTAL
--	--	04	--	--	--	50#	50@	100

Rationale:

Diploma holders need to be capable of doing self study throughout their life as the technology is developing with fast rate. Student will be able to find out various sources of technical information and develop self-study techniques to prepare a project and write a project report.

This subject is intended to teach students to understand facts, concepts and techniques of electrical equipments, its repairs, fault finding and testing, estimation of cost and procurement of material, fabrication and manufacturing of various items used in electrical field. This will help the students to acquire skills and attitudes to work in industry and can start his own enterprise.

Objectives:

The students will be able to,

1. Work in Groups, Plan the work, and Coordinate the work.
2. Develop leadership qualities
3. Analyse the different types of Case studies.
4. Develop basic technical Skills by hands on experience
5. Write project report.
6. Develop skills to use latest technology in Electrical field.

Learning Structure:

Application	Implementations of skills developed in the World of work, Generating innovative ideas for promoting self-employment of students.
Procedure	Identification of Project, Procurement of Components, Fabrication and Testing, Performance Analysis, Costing, etc
Concepts	Information Gathering Techniques, Presentation Techniques, Basic Engineering Skills, etc.
Facts	Students Have already studied Electrical Circuits, Electrical Machines, Electrical Power System, Electrical Estimation, Utilisation of Electrical Energy, etc.

Contents:

Projects
1. Design of Illumination Scheme (Up to 20 KW) for Hospital / Shopping Mall/Cinema Theatre/Commercial Complex/Educational Institute/Industrial Complex. 2. Design of Rural Electrification Scheme for small Village, Colony. 3. Case Studies Related to Industries – Operation / Maintenance / Repair and Fault Finding. (Refer Guideline Document). 4. Energy Conservation and Audit. 5. Substation Model (Scaled) 6. Wind Turbine Model (Scaled) 7. Pole Mounted Substation Model (Scaled) 8. Rewinding of Three Phase/Single Phase Induction Motor. 9. Rewinding of Single Phase Transformer. 10. Fabrication of Inverter up to 1000 VA, Battery Charger. 11. Fabrication of Small Wind Energy System for Battery Charging. 12. Fabrication of Solar Panel System for Battery Charging. 13. Microprocessor/ Micro controller Based Projects. 14. PC Based Projects and Simulation Projects.
Seminar A group seminar to be conducted after completion of Project work and marks to be allotted separately under head Seminar in CIAAN format of Project

Note: Out of Four hours two hours should be allotted for giving the Instructions for preparing a Project Report. (Refer Guideline Document for Format of Project Report)

Learning Resources:

1. Books/Magazines:

Sr. No.	Name of the Magazine
1.	IEEE Transactions/Journals
2.	Electrical India
3.	IEEMA Journal
4.	Elecrama
5.	Technorama
6.	Urja
7.	Industrial Automation
8.	Electronics for You
9.	Electronics Projects
10.	Computer World
11.	Chip

12.	Any Journal Related to Electrical Engg. / Electronics / Computer / Information Technology

Components of Project Report:

1. Synopsis- Project Summary (One page summary of entire project)
2. Action Plan of Project for both Semesters
3. Introduction (Promoters, Market Scope/ requirement)
4. Project Concept & Product (Details of product)
5. Manufacturing Process & Technology
6. Material and Machinery Required
7. Raw materials, Consumables & Utilities
8. Estimation (Assumptions, requirements)
9. Market (Survey, Demand & Supply)
10. Cost of Project,
11. Future Scope/ Benefit to Society
12. Conclusion.
13. References