Term VI EE

Sl. No	Code	Course	Study Scheme				Evaluation Scheme							Total Marks	Credit
			Pre-requisite	Contact Hour/Week			Theory				Practical/case study				
				L	T	P	End Exam	Progressive Assessment			End Exam	Progressive Assessment			
								Class Test	Assignment	Attendance		Sessional	Viva		
1	EE411	Heat Engine	-	3	0	0	70	15	10	5	0	0	0	100	3
2	EE-501	Power Electronics	-	3	0	2	70	15	10	5	0	25	25	150	4
3	EE-505	Switch Gear & Protection		3	0	0	70	15	10	5	0	0	0	100	3
4	EE-506	Instrumentation & Control	-	3	0	2	70	15	10	5	0	25	25	150	4
5	EE-513	Seminar & Industrial Visit		0	0	6	0	0	0	0	0	50	0	50	2
6	EE-514	Projects	-	0	0	8	0	0	0	0	0	100	50	150	5
7	EE-601-EE-606	Elective-II	-	3	0	2	70	15	10	5	25	25	0	150	4
TOTAL				15	0	20	350	75	50	25	25	225	100	850	25

Name of the course : HEAT ENGINE	
Course code: EE411	Semester : Sixth
Teaching Scheme	Maximum Marks : 100
	PA and End Examination Scheme
Theory : 3 hrs/week	Class test: 15 Marks
Tutorial: 0 hrs/week	Assignment / Quiz etc: 15 Marks
Practical : 0 hrs/week	End Semester Theory Exam: 70 Marks
Credit : 3	End Semester Practical Exam: 0 Marks

Rationale / Aim :-

Diploma engineers are expected to work on the operation, production, maintenance, erection, commissioning etc of various equipment/ machines, which work on principles and uses of heat energy. Such equipment/ machines may be boilers, compressors, turbines, internal combustion engines, refrigeration and air conditioning equipment, etc. Students are also expected to have fundamental knowledge about various types of equipment of power plants such as thermal, nuclear etc. Basic construction and working of these devices and systems should be understood by the diploma engineers.

AIM:

1) To accuire basic principles of heat engine
2) To acquire thorough knowledge about I.C. Engine and Testing
3) To acquire thorough knowledge of Air Compressor
4) To acquire knowledge on principles of refrigeration
5) To acquire knowledge on Gas Turbine
6) To acquire knowledge on Power Generation System

Course Objective :-	
Module/Unit	After completion of the course, students will be able to
1.	Describe the basic principles of heat engine
2.	Explain operation of I.C. Engine
3.	Discuss operation and applications of Air Compressor and refrigeration
4.	Acquire knowledge about Gas Turbine and Power Generation System
Pre-Requisite :-	
1.	

Unit	Topic/Sub Topic	Hour
	1.0 Introduction Definition of thermodynamics and its importance Thermodynamics terms like cycles, system, surroundings, properties, Path, state, process (Isobaric, Isochoric, Isothermal etc.) 1.3 First law of thermodynamics and its limitations 1.4 Clausius and Kelvin Planck Statements their equivalence, 1.5 Concept of Reversible and Irreversible processes, 1.6 Entropy, Calculation Of entropy changes during various processes.	7
	2.0 I.C. Engine & Testing 2.1 Various ideal thermodynamic cycles, Otto, diesel and dual cycles with simple numerical. 1.2 Terms related to I.C.engines scavenging, Pre-ignition, Detonation	10

	2.3 Engine power – IBP, FP & BP, Mechanical, thermal, relative, volumetric efficiencies, fuel consumption , BSFC. 2.4 Morse test, heat balance sheet 2.5 Concept of pollutants in exhaust gases in petrol & diesel engine such as CO, unburnt Hydro carbon , their effect on Environment Exhaust gas analysers for petrol & diesel engines	
	3.0 Air Compressor 3.1 Industrial use of compressed air. Classification, construction and working of single and two stage compressors. 3.2 Efficiency- volumetric, isothermal, mechanical (numerical) . 3.3 Multi-staging- Advantage of multi-staging. 3.4 Rotary compressors like Centrifugal, Roots Blower, Vane type, and Screw type. 3.5 Pneumatic tools.	6
	4.0 Principles of Refrigeration 4.1 Reverse Carnot cycle Principal of refrigeration COP Heat pump & Refrigeration Units of refrigeration. 4.2 Vapour compression cycle its representation on P-H & T-S diagram. 4.3 Calculation of work input, Refrigerating effect with simple numerical various types of refrigerant used , 4.4 Application of refrigeration, Vapour absorption cycle, Electrolux refrigerator. 4.5 Types of refrigerants and properties. Applications of Refrigeration systems.	7
	5.0 Gas Turbine 5.1 Working cycle, classification, application of gas turbine. 5.2 Constant volume and constant pressure Gas turbines. 5.3 Principle of Turbojet, Turboprop, Ranjet Rokets, Rocket jets, Rocket fuels	5
	6.0 Power Generation System 6.1 Layout-of thermal ,Gas turbine power plant, Nuclear power plant. 6.2 Elements of Nuclear power stations ,Nuclear reactor , types of nuclear reactor such as PWR, BWR, CANDU, BLEEDING type reactor.	5
	Total	45

Reference

S.No.	Name of book .	Author	Publication
1	Thermal Engineering	Domkundwar	S.Chand
2.	Thermal Engineering	Ballaney	Dhanpatrai
3.	Engg. Thermodynamics	Nag P.K.	Tata Macgraw Hill
4.	Thermodynamics .	Wark	Tata Macgraw Hill

Name of the course : POWER ELECTRONICS			
Course code: EE501		Semester : Sixth	
Teaching Scheme		Maximum Marks : 150	
		PA and End Examination Scheme	
Theory :	3 hrs/week	Class test:	15 Marks
Tutorial:	0 hrs/week	Assignment / Quiz etc:	15 Marks
Practical :	2 hrs/week	End Semester Theory Exam:	70 Marks
Credit :	4	End Semester Practical Exam:	50 Marks

Rationale / Aim :-

Power electronics is a course that concerns the applications of electronic principles in situations that are rated at power level rather than signal level. Many semiconductor devices such as SCR, Diac, Triac, MOSFET, transistors etc. are available for power applications. The use of these semiconductor devices has provided an impetus to industrial applications relating to the field of electrical, electronics, instrumentation and control engineering. An effort is made in this course to provide understanding of the various power electronics applications to enable the students to acquire some core skills.

AIM:

1) To accuire basic principles of power electronics devices
2) To acquire thorough knowledge about thyristor protection circuits and ratings
3) To acquire thorough knowledge of commutating circuits
4) To acquire knowledge on choppers
5) To acquire knowledge on inverters and UPS
6) To acquire knowledge on Cyclo-converter
7) To acquire knowledge on industrial applications

Course Objective :-	
Module/Unit	After completion of the course, students will be able to
1.	Explain the basic operating principles of power electronics devices
2.	Disccuss about thyristor protection circuits and ratings
3.	Develop knowledge on commutating circuits and choppers
4.	Describe the operation of inverters and UPS and cyclo-converter
Pre-Requisite :-	
1.	

Unit	Topic/Sub Topic	hour
	1 **Power Electronics Devices** • Introduction to thyristor family • Construction, working principle, symbol, characteristics and application of SCR, UJT, DIAC, TRIAC, LASCR, IGBT, GTO • Mountings of SCR	5
	2 **Thyristor Protection Circuits and Ratings** • Need of protection • Over voltage and over current protection • dv/dt and di/dt ratings of thyristor • Use of snubber circuit	7

	• Use of free wheeling diode • Use of thermistor • Use of heat sink • Knowledge of different packages available for thyristor • Knowledge of different ratings of thyristor	
	3 **Commutating Circuits** • Types of commutation • Natural commutation • Forced commutating method • Series resonance/current commutation • Voltage commutations • Auxiliary thyristor for commutation • External pulse commutation	7
	4 **Choppers** • Concept of choppers • Types of chopper circuits (A type to E-type) • Jones chopper circuit • Morgans chopper circuit	7
	5 **Inverters and UPS** • Working principle of inverter • Inverter circuits using transistor and thyristor and their comparison • Series inverter using thyristor • Parallel inverter using thyristor • Use of pulse width modulation (PWM) circuit • Concept of UPS • Block diagram of UPS	6
	6 **Cyclo-converter** • Operating principle of cyclo-converter • Types of cyclo-converters • Single phase to single phase cyclo -converter • Single phase to bridge cyclo-converter	6
	7 **Industrial Applications** • Speed control of D.C. motor using armature voltage control • Speed control of D.C. motor using chopper circuit • Different types of speed control methods for induction motor such as stator voltage control, frequency control	7
	Total	45

List of Experiments:

1. Use relevant instruments to determine the performance of Thyristor, TRIAC & DIAC
2. Use relevant instruments to determine the time delay relay circuit in UJT relaxation oscillator
3. Use TRIAC as AC load control
4. Use relevant instruments to determine the performance of IGBT & GTO
5. Assemble a snubber circuit and comment on its performance
6. Assemble a SCR commutating circuits and comment on its performance
7. Assemble a Chopper circuit using SCR and comment on its performance
8. Use chopper circuits to control Speeds of DC motor
9. Assemble a parallel inverter using two thyristors
10. Assemble a cycloconverter circuit using thyristors and comment on its performance
11. Use thyristor -UJT circuit to control speeds of a universal motor.
12. Use computer simulations for the above lab experiences

REFERENCES

S.No.	Title	Author & Publisher/Edition/ Year
1	Power Electronics	S.K.Mandal, McGraw Hill Education
2	Thyristor Engineering	Berde, M.S., Khanna Pub. New Delhi, latest
3	Power Electronics	Bimbhra, P.S., Khanna Pub. New Delhi, 1996
4	Laboratory Manual on power electronics	Earnest, Joshua, Mathew, Susan S., Walkey, A.S., Soni, Shyamoli, TTTI, Bhopal, 2002
5	Power Electronics	Rashid, M.H., Prentice Hall of India, New Delhi, latest
6	Power Electronics	Sen P.C., Tata McGraw Hill New Delhi, 1999
7	Power Electronics	Vithayathil, Joseph, McGraw Hill, New York, 1994
8	Power electronics computer simulation software - Caspoc	www.caspoc.com; Trinity Microsystems Pvt. Ltd., 313, III Floor, Triveni Complex, Laxmi Nagar, Delhi – 110 092, 2001

Name of the course : SWITCHGEAR & PROTECTION

Course code: EE505		Semester : Sixth	
Teaching Scheme		Maximum Marks : 100	
		PA and End Examination Scheme	
Theory :	3 hrs/week	Class test:	15 Marks
Tutorial:	0 hrs/week	Assignment / Quiz etc:	15 Marks
Practical :	0 hrs/week	End Semester Theory Exam:	70 Marks
Credit :	3	End Semester Practical Exam:	0 Marks

Rationale / Aim :-

In power stations and sub-stations, applications of switchgear and various protective schemes applied to various electrical equipments, machines, busbars, feeders, transmission lines, distribution lines etc. are essential to minimize normal and abnormal faults and for safety of human beings. This course is intended to develop in the students the skill in operating various controls and switchgear used in power systems. Student need to take remedial measures for faults/abnormalities in machines/equipment in power system using appropriate diagnostic instruments and devices.

AIM:

1) To accuire basic principles of protection
2) To acquire thorough knowledge about over voltage protection
3) To acquire thorough knowledge of protective relays
4) To acquire knowledge on instrument transformers
5) To acquire knowledge on neutral earthing
6) To acquire knowledge on circuit interrupting devices
7) To acquire knowledge on protection schemes

Course Objective :-	
Module/Unit	After completion of the course, students will be able to
1.	Explain the basic principles of protection
2.	Disccuss about protective relays and over voltage protection system
3.	Develop knowledge on instrument transformers and neutral earthing
4.	Describe circuit interrupting devices and protection schemes
Pre-Requisite :-	
1.	

Unit	Topic/Sub Topic	hour
	1 **Principles of Protection** • Line diagram of a power system and its elements • Faults and abnormalities, their causes, types and effects • Functions of basic elements of a protective system • Backup protection and its types	5
	2 Over Voltage Protection • Causes of over voltages • Methods of reducing over voltages • Operating principles, construction and applications of lightning arrestor • Insulation co-ordination and volt-time characteristic	6

	3	**Protective Relays** • Concept of protective relaying • Classification of relays and their selection • Construction and working principle of relays • Basic terms related to relays like pick-up value, reset value and operating current etc. • Settings of various types of relays • Maintenance and testing of relays • Use of static relays in modern power system • Working principle of microprocessor-based relays	8
	4	**Instrument Transformers** • Instrument transformers used for protection • Polarity marking of CT & PT and their specifications • Connection diagram of CT & PT in a 1-phase and 3-phase protective systems	6
	5	**Neutral Earthing** • Importance of neutral earthing • Methods of neutral earthing and its advantages	5
	6	**Circuit Interrupting Devices** • Necessity and types of interruption devices like ACB, OCB, AB Switch, SF6 and vacuum circuit breakers • Line diagram of a protective system showing different circuit interrupting devices • Sequence of operation and interlocking • Requirement and types of isolators • Types of fuses and their characteristics • Testing and application of fuses • Working principle ACB, OCB, AB Switch, SF6 and vacuum circuit breakers • Arc formation process • AC circuit, zero current interruption	8
	7	**Protection Schemes** • Abnormalities and faults in a power system and its effects • Protection schemes for alternator • Protection against prime mover failure and unbalance loading • Protection of transformers • Protection of transmission line and feeders • Protection of motors • Protection of busbars	7
		Total	45

REFERENCE:

S.No.	Title	Author/ Publisher/Edition/Year
1	Power System Protection and Switchgear	Badriram, Tata McGraw-Hill, New Delhi, 1994
2	Switchgear and Protection	Deshpande, Tata McGraw-Hill, New Delhi, latest
3	Electrical Power System	Mehta, V.K., Khanna Publishers, New Delhi, 1996
4	Testing, Commissioning, Operation & Maintenance of Electrical Equipment	Rao, S. Tata McGraw-Hill, New Delhi, 3rd, 1996
5	Operation And Maintenance of Electrical Equipment, Vol I & II	Rao. B.V.S.,Wheeler Publishing, New Delhi, 2nd, 1994
6	Power System Protection Static Relays with μp applications	Rao. S, Tata McGraw-Hill, New Delhi, 2nd, 1995
7	Electrical Power	Uppal, S.L., Khanna Pub. New Delhi, 1995

Name of the course : INSTRUMENTATION & CONTROL

Course code: EE506	Semester : Sixth
Teaching Scheme	Maximum Marks : 150
	PA and End Examination Scheme
Theory : 3 hrs/week	Class test: 15 Marks
Tutorial: 0 hrs/week	Assignment / Quiz etc: 15 Marks
Practical : 2 hrs/week	End Semester Theory Exam: 70 Marks
Credit : 4	Progressive Assessment On Practical Exam: 50 Marks

Rationale / Aim :-

The instrumention and control is required to develop some level of specialization in diploma students of electrical engineering as maintenance personnel in the maintenance of sophisticated instruments. Instrumentation in all fields of engineering is becoming increasingly sophisticated with the advancement in electronic techniques together with computers entering the field of data processing, where the inputs have to be much more accurate and the controllers much faster in response. This course of instrumentation and control develops an understanding of sensors, transducers, signal conditioner and suitable display; recording devices.

AIM:

1) To accuire basic concepts and Dynamic Characteristics of Instruments
2) To acquire thorough knowledge about Transducers
3) To acquire thorough knowledge of Instrumentation System
4) To acquire knowledge on Data Handling and Telemetering
5) To acquire knowledge on Control Systems in Instrumentation
6) To acquire knowledge on Control System Components
7) To acquire knowledge on Controllers
8) To acquire knowledge on Display and Recording Devices

Course Objective :-	
Module/Unit	After completion of the course, students will be able to
1.	Describe the basic concepts and dynamic characteristics of instruments
2.	Explain operation about Transducers, Instrumentation System, Data Handling and Telemetering
3.	Discuss about Control Systems in Instrumentation
4.	Explain about control system components, controllers, display and recording devices
Pre-Requisite :-	
1.	

Unit	Topic/Sub Topic	hour
	1 Basic Concepts and Dynamic Characteristics of Instruments • Measurements and its aim • Functional elements of instruments • Performance characteristics • Statistical analysis • Transfer function, properties of transfer function • Standard inputs to study time domain response • Step input, ramp input, impulse input • Zero order instrument, first order instrument • Dynamic response of first order instruments	6

		• Second order instruments • Dynamic response of second order instruments	
	2	**Transducers** • Classification of transducers • Types of errors in transducer • Applications of transducer for the measurement of length, thickness, displacement, velocity, force, weight, torque, pressure, level, temperature, strain, pH. measurement, speed etc. • Selection of transducer for specific application	8
	3	**Instrumentation System** • Block diagram of a general instrumentation system and their broad functions • Block diagram of instrumentation system for measurement of various non-electrical parameters	4
	4	**Data Handling and Telemetering** • Measuring methods • Voltage measurement by different methods • Various bridges for voltage measurement • Balancing methods • Different electrical signal transmission methods • Types of telemetering • Voltage, current frequency and position telemetering • Impulse telemetering • Radio frequency telemetering system • Indicators used in instrumentations	6
	5	**Control Systems in Instrumentation** • Role of control system in instrumentation • Open loop and close loop control system • Different types of control system such as ON-OFF, step, continuous, PID control etc. • Servomechanism and regulators with suitable examples	5
	6	**Control System Components** • Control components • Construction, working principle, merits and demerits and applications of following control components • AC; DC Servo motor • Synchros • AC, DC tachogenerator • Stepper motor • Solenoid valve, motorized valve, servo valve • Control transformer • Servo voltage stabilizer	6
	7	**Controllers** • Classification of modes of controllers • ON-OFF mode controller	5

	• Proportional mode controller • Integral mode controller • Derivative mode controller • P+I mode controller • P+D mode controller • P+I+D mode controller (Three mode controller)	
	8 Display and Recording Devices • Characteristics of digital display: specification, resolution, sensitivity, accuracy • Digital display elements: alphanumeric displays, LEDs, LCDs, Display system, dot matrix system, seven segment system • Recording: chart recorders, printer, laser printers, ink jet printer	5
	Total	45

List of Experiments:

1. Displacement measurement using LVDT
1. Weight measurement using strain gauge bridge
2. Speed measurement of motor using magnetic proximity switch
3. Speed measurement of motor using photo electric pickup
4. Temperature measurement using thermocouple
5. Temperature measurement using resistance temperature detector
6. Temperature measurement using thermistor
7. Performance of piezo electric transducers
8. Displacement measurement with help of light dependent resistor
9. Displacement measurement using inductive pick up transducer
10. Pressure measurement using load cell
11. Performance of strip chart recorder
12. Performance X-Y recorder
13. Liquid level measurement using capacitive type transducer
14. Proportionate mode of control
15. Proportionate + integral type control
16. Proportionate + integral + derivative control
17. Performance of data acquisition system

REFERENCE:

S.No.	Title	Author; Publisher/Edition/Year
1	Instrumentation for Engineering Measurements	Cerni & Foster; Tata McGraw Hill, New Delhi, 5th, 1986
2	Electronic Instrumentation &Measurement Techniques	Cooper; Prentice Hall, New Delhi, 8th, 2000
3	Instrumentation for Engineering Measurements	Dally, J.W. & Others; John Wiley & Sons, New York, 1st, 1984
4	Introduction to Instrumentation and Control	Ghosh, A.K.; PHI, New Delhi, 1992
5	Process Control Instrumentation Technology	Johnson, McGraw Hill, New York, 1992
6	Instrumentation, Measurement & Feedback	Jones; McGraw Hill, New York, 1st, 1994
7	Electronic Instrumentation	Kalsi, J.S.; Tata McGraw-Hill, New Delhi, 1995
8	Handbook of Bio-Medical Instrumentation	Khandpur; Tata McGraw-Hill, New Delhi, 2001
9	Electronic Instrumentation	Malvino; Tata McGraw Hill, New Delhi, 2nd, 1987
10	Instrumentation Devices and Systems	Rangan, C.S., et al; Tata McGraw Hill, New Delhi, 1990
11	Electronic Measurements & Instrumentation	Rao & Sutrave; Nirali Prakashan, Pune, 2nd, 1988
12	A course in Electrical & Electronic Measurements & Instruments	Sawhney; Dhanpat Rai & Sons, New Delhi, 11th, 2000
13	Industrial Instrumentation and Control	Singh, S.K.; Tata McGraw Hill, New York, 1991

Name of the course : SEMINAR & INDUSTRIAL VISIT	
Course code: EE513	Semester : Sixth
Teaching Scheme	Maximum Marks : 50
	PA and End Examination Scheme
Theory : 0 hrs/week	Class test: 0 Marks
Tutorial: 0 hrs/week	Assignment / Quiz etc: 0 Marks
Practical : 6 hrs/week	End Semester Theory Exam: 0 Marks
Credit : 2	End Semester Practical Exam: 50 Marks

Rationale / Aim :-

This course will make student to familiarize and develop exposure industrial practices. Course will also help student to present seminar on suitable topics related to subjects by following paper methodology/guidelines.

Objecttves:

On completion of this course the student will be able to :

- Increase their understanding of ideas as presented by the work at hand
- Involve activity in their own learning
- speak more effectively
- Listern better
- Prepare report on seminar topic/project topic

Suggested activities to be done /practice:

1. Arrangment of expart lectures/talks with student involvement.
2. Preparation of report in related topic/project
3. Develop presentation with using modern aids
4. Arrangement of Group Discussion
5. Arrangement of Industrial visit

Name of the course : PROJECTS	
Course code: EE514	Semester : Sixth
Teaching Scheme	Maximum Marks : 150
	PA and End Examination Scheme
Theory : 0 hrs/week	Class test: 0 Marks
Tutorial: 0 hrs/week	Assignment / Quiz etc: 0 Marks
Practical : 8 hrs/week	End Semester Theory Exam: 0 Marks
Credit : 4	End Semester Practical Exam: 150 Marks

Rationale / Aim :-

Project work is a consolidation of various problem statements, which has undertaken during the preceding semesters. Therefore, the given project is intended to integrate as many acquired skills as possible. The project work will not only consist of practical skills, but it could also consist of application of various cognitive skills as well as demonstration of certain desirable attitudes by the student relevant to the implementation of the chosen/given project.

SCHEDULE OF PROJECT WORK

For a period of one semester, the project work could contain the following broad schedule for implementing the project and writing the project report.

a) Title of Project
b) Project Description
c) Methods of doing the project and choice of method adopted for doing this project.
d) Action Plan
e) Prototype design on paper
f) Testing Methodology
   - Resources Required
   - Procedure in steps
   - Precautions
   - Observations and calculations
   - Results
   - Interpretation of results
   - Conclusions
   - References.

6.0 SUGGESTED ASSESSMENT OF PROJECT WORK

Some broad criteria for assessing the project are given here. Minor modifications depending on the type of project could be done.

a) Process – 70% Weightage

Criteria considered

i.	Preparation of action plan	- 5%
ii.	Selection of proper method	- 5%
iii.	Selection of proper resources	- 10%
iv.	Experimentation	- 30%
v.	Group working and leadership	- 10%
vi.	Following safe practices	- 5%
vii.	Recording in log-book	- 5%

b) Product – 30% Weightage

Criteria considered

viii.	Completed project	-10%
ix.	Project report	-20%

SUGGESTED IMPLEMENTATION STRATEGIES

a) Project could be performed by group of two to five students.
b) Project should integrate all problem statements, which could consist of practical skills, intellectual skills, interpersonal skills, market survey skills etc.
c) Monitoring the project at every stage.
d) Project guide should carry out progressive assessment for every stage of project.

REFERENCES

S.No.	Title	Author/ Publisher/Edition/Year
1	Design Suitable Learning Experiences for Laboratory Work and Direct Laboratory Experiences to Achieve Specified Aims - Competency-based Self-learning Module.No.4; REC-British Council India Project	Earnest, Joshua; Mathew, Susan S.; Srivastava, M.K.; Banthiya, N.K.; TTTI, Bhopal, 1999

ELECTIVE COURSES

Name of the course : Computer Based Industrial Control

Course code: EE601	Semester :
Teaching Scheme	Maximum Marks : 150
	PA and End Examination Scheme
Theory : 3 hrs/week	Class test: 15 Marks
Tutorial: 0 hrs/week	Assignment / Quiz etc: 15 Marks
Practical : 2 hrs/week	End Semester Theory Exam: 70 Marks
Credit : 4	End Semester Practical Exam: 25 Marks

Rationale / Aim :-

The subject Computer based Industrial Control is required to impart computer application oriented knowledge of technology related with industrial control field. This subjects includes control instrumentation, computer hardware and software, data communication links. It also incorporates programmable logic controllers, distributed control system, SCADA system, display systems and some industrial control applications. In addition to the theoretical study of the above topics, the practical aspects of the topics has been taken care. Some problems have also been included here, so that the student can develop the problem solving attitude during their service career.

AIM:

- To describe the fundamentals of computer based industrial control
- To describe the building blocks of automation system
- To describe the architecture and programming of programmable controllers
- To describe the construction and working principles of distributed control system and display systems
- To describe the industrial control applications

Course Objective :-	
Module/Unit	After completion of the course, students will be able to
1.	Identify potential areas for automation and justify need for automation
2.	Describe the major components required for automatic process control system.
3.	Explain the construction of PLC, DCS and SCADA

4.	Discuss industrial control applications of compter

Pre-Requisite :-	
1.	

Unit	Topic/Sub Topic	hour
	1 Fundamentals of Computer Based Industrial Control 1.1 Current Trends in Computer Control of Process Plants 1.2 Feedback Control 1.3 Basic Principles of a single controller loop 1.4 Two-position control 1.5 Multi-position Control 1.6 PID Control 1.7 Multi-variable Control 1.8 Feed Forward Control	**10**
	2 Building Blocks of Automation System 2.1 Processing System 2.2 Multimicroprocessor Systems 2.3 Local Area Networks 2.4 Analog and Digital I/O Modules 2.5 Supervisory Control and Data Acquisition Systems	**8**
	3. Programmable Controllers 3.1 Principles of Operation 3.2 Architecture of Programmable Controllers 3.3 Programming the Programmable Controller	**6**
	4. Distributed Control System 4.1 Functional requirements of distributed Process Control System 4.2 System Architecture 4.3 Distributed Control Systems 4.4 Some Examples of Distributed Control Systems 4.5 SCADA	**8**
	5. Display Systems 5.1 Display Parameters 5.2 Display in Process Control Environment	**5**
	6. Industrial Control Applications 6.1 Cement Plant 6.2 Thermal Power Plant 6.3 Water Treatment Plant 6.4 Steel Plant	8

	Total	45
	List of Experiments: 1. Modeling and Designing control strategies of a typical process 2. Process simulation using MATLAB Simulink 3. Problems based on stability and frequency response 4. Study of Dynamic behaviour of 2nd order systems. 5. Study of flow control loop using PID controller 6. Study of Level Control loop using PID controller 7. Simulation study of cascade control preferably for chemical process. 8. Simulation study of feed-forward control preferably for chemical process. 9. Simulation study of ratio control preferably for chemical process. 10. Implement temperature control system with PID controller or ON OFF controller. 11. Perform system identification of first or second order system with input and output data. 12. Use the in-built PID controller in PLC. Implement On/ OFF control for temperature process with PLC. 13. Develop and implement any PLC and/or DCS program for any control system using FBD and SFC programming language. 14. Interfacing of PLC to a DCS system through Modbus. 15. Developing and implementing any control loop using PLC system. 16. Developing and implementing any control loop using DCS system **Reference:** 1. Computer Based Industrial Control, Krishna Kant, PHI 2. Automation, Production Systems and Computer Integrated manufacturing, M.P.Groover, Pearson Education 3. An Introduction to Automatic Process Planning Systems, Tiess Chiu Chang & Richard A Wysk 4. Performance Modeling of Automated manufacturing Systems, Viswanandham	

Name of the course : Utilization of Electrical Power

Course code: EE602	Semester : Fifth
Teaching Scheme	Maximum Marks : 150
	PA and End Examination Scheme
Theory : 3 hrs/week	Class test: 15 Marks
Tutorial: 0 hrs/week	Assignment / Quiz etc: 15 Marks
Practical : 2 hrs/week	End Semester Theory Exam: 70 Marks
Credit : 4	End Semester Practical Exam: 50 Marks

Rationale / Aim :-

There is a great demand for utilization of electrical power in various fields in the form of power for electrolysis and illumination, electrical heating, electrical welding, electrical traction and electrical drives. Hence these aspects are taken care of in the subject of utilization of electrical power and traction to give exposure of the student. In addition to the theoretical study of the topics as mentioned above care has been taken for including the practical aspects of the topics.

AIM:

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

- To classify various methods of traction and traction motor and type of control and types of breaking.To describe the construction and working principles of synchronous machines

Course Objective :-	
Module/Unit	After completion of the course, students will be able to
1.	Explain the Electrolytic Process and Electrical Heating
2.	Describe the working principles of ARC Welding
3.	Explain the construction and design of Illumination
4.	Discuss working principles of Industrial Drives and Electric Traction

Pre-Requisite :-	
1.	

Unit	Topic/Sub Topic	hour
	1. ELECTROLYTIC PROCESS 1.1 Explain fundamental principle of ionic dissociation. 1.2 State Faraday's laws of electrolysis 1.3 State Simple examples of extraction of metals. 1.4 Give Elementary idea about commercial usefulness of electrode position	**5**
	2. ELECTRICAL HEATING 2.1 State Advantage of Electrical Heating. 2.2 Explain Mode of heat transfer and Stephen's Law of Radiation and Radiant heater. 2.3 Discuss Heating resistance ovens. 2.4 Explain principle of core type and coreless type induction furnaces. 2.5 Explain principles of direct are and indirect arc furnaces. 2.6 Explain Directive heating and its applications.	**8**
	3. PRINCIPLES OF ARC WELDING 3.1 Explain principle of arc welding. 3.2 Explain D.C &A.C phenomena 3.3 Explain study of D.C & A.C. arc welding plants of single and multi-operation type. 3.4 Explain types of arc welding. 3.5 Explain principles of resistance welding 3.6 Explain descriptive study of resistance welding plant.	**8**
	4. ILLUMINATION 4.1.1 Radiant efficiency 4.1.2 Luminous flux	**10**

	4.1.3 Luminous intensity 4.1.4 Lumen 4.1.5 Intensity of illumination 4.1.6 MHCP 4.1.7 MSCP 4.1.8 MHSCP 4.1.9 Brightness 4.1.10 Solid angle 4.2. Explain polar curves 4.3 Explain the inverse square law and the cosine law. 4.4 Describe light distribution and control and related definitions like maintenance factor and depreciation factors. 4.5 Design simple lighting schemes and depreciation factor. 4.6 Explain Filament lamps, effect of variation of voltage on working of filament lamps. 4.7 Explain Discharge lamps. 4.8 State Basic idea about excitation in gas discharge lamps. 4.9 State constructional factures and operation of Fluorescent lamp, Sodium vapour lamps, High presser mercury vapour lamps, Neon signs.High lumen output & low consumption Fluorescent lamps.	
	5. **INDURESTIAL DRIVES** 5.1 State group and individual drive. 5.2 Explain choice of electric drives. 5.3 Explain starting and running characteristics of DC and AC motor 5.4 State Application of : DC motor 3 phase induction motor 3 phase synchronous motors Single phase induction Series and repulsion motor industry.	**7**
	6 **ELECTRIC TRACTION** 6.1 Explain system of traction. 6.2 Explain DC and AC traction motor. 6.3 Explain single phase motor for traction. 6.4 Explain control of motor 6.4.1 Tapped field control 6.4.2 Multi-unit control 6.4.3 Metadyne control 6.4.4 Rheostatic control 6.5 Explain Braking of the following types 6.5.1 Regenerative Braking 6.5.2 Braking with 1-phase series motor 6.5.3 Magnetic Braking	**7**
	Total	**45**

List of Experiments:

1. Perform experiments on direct resistance heating
2. Perform experiments on induction heating
3. Application of microwave heating
4. Perform arc welding
5. Prove the inverse square law in illumination
6. Design simple lighting scheme of an education institute
7. Starting of dc motoros
8. Starting of induction motors
9. Braking of dc motors
10. Braking of induction motors
11. Control of DC motors
12. Control of induction motors

REFERENCE BOOKs

1. A course of electric power by Soni, Gupta & Bhatnager.
2. Utilization of Electrical Energy by E.I. Taylor
3. Utilization of Electrical Energy by Reaction by G.C. Gerg.
4. Electrical power, Gupta J. B., Kataria & Sons Pub. New Delhi
5. Utilisation of electrical energy & Electric Traction, Gupta J. B., Katson Pub. New Delhi

Name of the course : Power Plant Engg.	
Course code: EE603	Semester : Fifth
Teaching Scheme	Maximum Marks : 150
	PA and End Examination Scheme
Theory : 3 hrs/week	Class test: 15 Marks
Tutorial: 0 hrs/week	Assignment / Quiz etc: 15 Marks
Practical : 2 hrs/week	End Semester Theory Exam: 70 Marks
Credit : 4	End Semester Practical Exam: 50 Marks

Rationale / Aim :-

Electricity in bulk quantities is produced in Thermal, Nuclear, Hydraulic, Gas turbine and Geothermal power plants. Thermal, Nuclear, and Geothermal power plants work with steam as the working fluid. Gas turbine plants are often used as peaking units and run for short periods in a day to meet the peak load demand. Hydraulic power plants are essentially multipurpose such as power generation, irrigation, flood control, fisheries, afforestation and navigation. In this subject the construction, and working principles of Electrical Power Plant Engineering are to be studied in detail. In addition to the theoretical study of the topics as mentioned above care has been taken for including the practical aspects of the topics.

AIM:

- To describe the principles of economics of power generation
- To describe the construction and working principles of stream power plant and explain rankine cycle and carnot cycle.
- To describe the fuels and combustion, coal analysis, fuel oil and petroleum gas, combustion mechanism and firing methods.
- To describe the working principles of steam generators steam turbines.
- To describe the operation of hydroelectric power plant, diesel engine and gas turbine power plants and nuclear power plants

Course Objective :-	
Module/Unit	After completion of the course, students will be able to
1.	Explain the the principles of economics of power generation
2.	Describe the the construction and working principles of stream power plant and explain rankine cycle and carnot cycle
3.	Explain the fuels and combustion, coal analysis, fuel oil and petroleum gas, combustion mechanism and firing methods.
4.	Discuss working principles of steam generators steam turbines, hydroelectric power plant, diesel engine and gas turbine power plants and nuclear power plants.

Pre-Requisite :-	
1.	

Unit	Topic/Sub Topic	Hour
	1. Economics of Power Generation 1.1 Load Duration Curves 1.2 Location of Power Plants 1.3 Power Plant Economics	**3**
	2. Analysis of Steam Cycles **2**.1 Stream Power Plant 2.2 Rankine Cycle 2.3 Carnot Cycle 2.4 Mean Temperature of heat addition 2.5 Reheating of Steam 2.6 Regeneration 2.7 Regenerative feedwater heating 2.8 Feedwater heaters 2.9 Carnotization of Rankine Cycle 2.10 Stream Power Plant 2.11 Deaerator 2.12 Layout of Steam Power Plant	**7**

	2.13 Efficiencies in a Steam Power Plant	
	3. Fuels and Combustion 3.1 Coal Analysis 3.2 Fuel Oil 3.3 Petroleum Gas 3.4 Emulsion Firing 3.5 Coal-Oil and Coal-Water Mixtures 3.6 Biomass 3.7 Combustion Reactions 3.8 Mass Balance of Steam Generator 3.9 Energy Balance of Steam Generator 3.10 Draft System 3.11 Heating values; Enthalpy of Combustion 3.12 Equilibrium Constant Kp	**6**
	4. Combustion Mechanism and Firing Methods 4.1 Kinetics of combustion reactions 4.2 Mechanism of Solid Fuel Combustion 4.3 Kinetic and Diffusion Control 4.4 Combustion Equipment for Buring Coal 4.5 Fuel Bed Combustion 4.6 Pulverized Coal Firing System 4.7 Combustion of Fuel Oil 4.8 Combustion of Gas	**5**
	5. Steam Generators 5.1 Types of Steam Generators 5.2 Fire tube Boilers 5.3 Water tube Boilers 5.4 Economisers 5.5 Superheaters 5.6 Reheaters 5.7 Steam Generator Control 5.8 Electrostatic Precipitators 5.9 Ash Handling System 5.10 Feedwater Treatment 5.11 Condensers 5.12 Circulating Water System 5.13 Cooling Towers	**6**
	6. Steam Turbines 6.1 Flow Through Nozzles 6.2 Turbine Blading 6.3 Electrical Energy Generation	**3**
	7. Hydroelectric Power Plant 7.1 Advantages and Disadvantages of Water Power 7.2 Optimization of Hydro-Thermal Mix 7.3 Elements of a Hydroelectric Power Plant 7.4 Classification of HydroElectric Power Plants 7.6 Turbines of HydroElectric Power Plants 7.7 Performance of Turbines 7.8 Selection of Turbines	**5**
	8. Diesel Engine and Gas Turbine Power Plants 8.1 Advantages and Disadvantages of Diesel Engine Power Plant	**6**

	8.2 Types of Diesel plants 8.3 Combustion in a CI Engine 8.4 Performance Characteristics 8.5 Supercharging 8.6 Layout of Diesel Engine Power Plant 8.7 Gas Turbine Power Plant 8.8 Components of Gas Turbine Plant 8.9 Gas Turbine Fuels	
	9. Nuclear Power Plants 9.1 Layout of Nuclear Power Plants 9.2 Moderating Power and Moderating Ratio 9.3 Heat transfer and Fluid flow in Nuclear Reactors 9.4 Types of Reactors	**4**
	Total	**45**

List of Experiments:

1. To study low pressure boilers and their accessories and mountings.
2. To study high pressure boilers and their accessories and mountings.
3. To study the working of impulse and reaction steam turbines
4. To prepare heat balance sheet for given boiler.
5. To find power output & efficiency of a steam turbine.
6. To find the condenser efficiencies.
7. To study cooling tower and find its efficiency.
8. To find calorific value of a sample of fuel using Bomb calorimeter.
9. Calibration of Thermometers and pressure gauges.
10. To study and find volumetric efficiency of a reciprocating air compressor.
11. To find dryness fraction of steam by separating and throttling calorimeter.

Reference Books

1. Power Plant Engineering, P.K.Nag, Tata McGraw Hill
2. Power Plant Engineering, Manoj Kumar Gupta, PHI
3. Power Plant Engineering, R.K.Hegde, Pearson
4. Power Plant engineering, A.K.Raja, New Age International;

Name of the course : Non Conventional Sources of Energy	
Course code: EE604	Semester : Fifth
Teaching Scheme	Maximum Marks : 150
	PA and End Examination Scheme
Theory : 3 hrs/week	Class test: 15 Marks
Tutorial: 0 hrs/week	Assignment / Quiz etc: 15 Marks
Practical : 2 hrs/week	End Semester Theory Exam: 70 Marks
Credit : 4	End Semester Practical Exam: 25 Marks

Rationale / Aim :-

In view of the fast depleting resources of conventional energy, it has become imperative to search for alternative sources of energy, which are not only renewable, but also environment friendly and economically viable. Solar energy, wind energy, biomass energy and hydropower energy etc. are some of the alternatives, which could be banked upon to meet the energy crisis. This course is intended to provide the requisite knowledge and skills of different aspects of these technologies to cope up with the present energy crisis and challenges of the future.

AIM:

- To describe the construction and working principles of wind energy systems
- To describe the construction and working principles of Solar PV system such as Street lights Solar pumps, Solar lanterns and its application
- To describe the construction and design principles of Bio-gas plant
- To describe the construction and working principles of Mini and Micro-hydro power plant, Tidal and Ocean energy
- To describe the method of Renewable energy system management.

Course Objective :-	
Module/Unit	After completion of the course, students will be able to
1.	Explain the construction and working principles of wind energy systems and Solar PV systems
2.	Describe the construction and working principles of Bio-gas plant
3.	Explain the construction and design principles of Mini and Micro-hydro power plant, Tidal and Ocean energy
4.	Discuss working principles of renewable energy system management.

Pre-Requisite :-	
1.	

Unit	Topic/Sub Topic	hour
	1. INTRODUCTION TO RENEWABLE ENERGY SOURCES • Overview of renewable energy sources - Need & importance - Scope & limitations of their use • Types of renewable energy sources - Wind energy - Solar energy - Ocean Energy - Mini & Micro-hydro energy - Bio mass energy - Geo-thermal Energy • Government support & incentive for budget in North-Eastern states - Types of incentive - Product range covered • Advantages and disadvantages of renewable energy sources	5

	2. WIND ENERGY SYSTEMS • Concept of wind energy • Wind turbines: Types, basic terminology like mean wind speed, power coefficient, cut-in speed, cut-out speed, torque and torque coefficient, solidity ratio, swept area, air mass density, velocity index, roughness index of terrain, power curve of wind turbine • Various components of horizontal and vertical axis wind turbines • Maximum power in the wind- Betz coefficient • Local effects on wind flow • Small wind turbine – Construction & Working • Electric generators in small wind turbines • Electric generators in large wind turbines • Operation and maintenance of horizontal and vertical axis wind turbines • Selection of site for siting of wind turbines • Planning the layout of a wind farm in the hilly terrain of North-Eastern states	**10**
	3. SOLAR ENERGY • Basic principles of harnessing solar energy • Solar energy for heating water - Consideration and installation - Specification and list of materials required - Repair and maintenance • Solar energy systems and its application - Street lights - Solar pumps - Solar lanterns - Calculation of energy consumption • Installation, operation and maintenance of solar PV modules	**10**
	4. BIO-MASS ENERGY • Concept of Bio-mass energy - Classification of Bio –mass; Sources of Bio-mass; Energy content in Bio-mass • Energy Plantation • Chemical process of converting biomass into useful energy - Anaerobic fermentation, - Pyrolysis, - gasification • Mechanical process of converting biomass into useful energy - Biomass briquetting, Mixing of biomass with coal • Basics of anaerobic fermentation • Types of Bio-gas plant based on - Construction, - Feed materials, - Use pattern • Factors affecting Bio-gas yield - Temperature, C.N ratio, pH value, total dissolved solid,	**10**

	Moisture content • Commonly used feed stock • Properties & application of Bio gas • Construction details with sketches - Fixed-Dome bio-gas plant - Floating-Drum bio-gas plant • Advantages and disadvantages of each type of bio-gas plant • Overall operation and maintenance of plant, gas appliances and fittings; Charging feed materials, disposal of slurry, cleaning of gas digester • List of safety precautions at bio-gas plant and for end users of bio-gas • Cost analysis of overall construction and operation of bio-gas plant	
	5. OVERVIEW OF OTHER RENEWABLE ENERGY SOURCES • Mini and Micro-hydro power plant - Advantages of Mini and Micro-hydro power plants - Construction and working with sketches of the micro hydro power plants - Operation of Mini and Micro-hydro power plants • Tidal and Ocean energy - Working principle of tidal and ocean energy power plant - Advantages and disadvantages of tidal and ocean energy power plant • Scope of tidal and ocean energy development in India • Incineration power plant - Working principle of Incineration power plant - Sources of feed materials for this plant - Advantages of Incineration power plant • Geo-thermal energy systems - Working principle of geothermal power plant - Advantages of geothermal energy systems - Geothermal energy systems being used in India • Hydrogen energy - Hydrogen energy as sustainable future fuel - Advantages and disadvantages of hydrogen energy • Present applications of hydrogen energy in India and abroad	**5**
	6. INTRODUCTION TO RENEWABLE ENERGY SYSTEM MANAGEMENT • Factors affecting production utilization • Government policies • Procedure for adoption of Renewable Energy Sources as effective alternative for conventional system • Evaluation and analysis procedures for cost effectiveness	**5**
	Total	**45**

List of Experiments:

1. Study of Solar Radiation Measurement
2. Study of Solar Distillation or Solar Still

3. Study of Solar Water Pumping
4. To study the construction details of a box type Solar Cooker
5. Preparation of delicious food by using solar cooker.
6. Study of Solar Water Heater (Thermosiphon) system
7. Study of Solar Water Heater (Forced Circulation) system
8. Study of Solar Lanterns and Street light
9. Study of Bio gas plant
10. Study of Janata Bio gas plant
11. Study of Deenabandhu Biogas plant
12. Study of fuel cells.
13. Study of Horizontal Wind Mill

Reference Books:

S. No.	Title	Author, Publisher, Edition & Year
1.	Biogas Energy in India	Academic book centre Ahmedabad, 1996
2.	Renewable energy: power for a sustainable future	Boyle G, Oxford University Press, New Delhi, 1999
3.	Renewable energy: Environment & Development	Dayal M. Konark Publisher Pvt. Ltd., New Delhi, 2000
4.	Solar Energy System utilization	G.D Rai / R.K KhannaPublishers, New Delhi, 2001
5.	Solar energy fundamentals and applications	H.P.Garg& J.Prakash Tata Mcgraw Hill; New Delhi, 1998
6.	Renewable Energy	Island Press Earthscan Kogan Page, 2000
7.	Bio gas Technology, A practical hand book	Khandelwal K.C.& Mehdiss Tata Mc Graw Hill; New Delhi, 1999
8.	Bio gas systems: Principles and application	Mittal K.M. New age International Ltd. New Delhi 2000
9.	Renewable energy sources and conversion technology	N.K Bansal, Manfred Kleemann, Michael Maliss Tata Mcgraw Hill; New Delhi, 2000
10.	Advances in Biogas technology	O.P Chawla ICAR, New Delhi, 1998
11.	Institutional finance for renewable energy development in India	Sekhar R.C. Urja Bharti, 1995

Name of the course : High Voltage Engg.	
Course code: EE605	Semester : Fifth
Teaching Scheme	Maximum Marks : 150
	PA and End Examination Scheme
Theory : 3 hrs/week	Class test: 15 Marks
Tutorial: 0 hrs/week	Assignment / Quiz etc: 15 Marks
Practical : 2 hrs/week	End Semester Theory Exam: 70 Marks
Credit : 4	End Semester Practical Exam: 50 Marks

Rationale / Aim :-

The demand for the generation and transmission of large amounts of electric power today, necessitates its transmission at extra-high voltages 400 kV or at 800 kV. At present a student of electrical engineering is expected to possess a knowledge of high voltage techniques and should have sufficient background in high voltage engineering. This subject covers different topics in high voltage engineering to serve as a single semester course for final year students. In addition to the theoretical study of the topics related to high voltage engineering care has been taken for including the practical aspects of the topics.

AIM:

- To describe the operation of electric field stresses, gas/vacuum as Insulator and liquid breakdown
- To describe the conduction and breakdown in gases and breakdown in liquid dielectrics
- To describe the breakdown in solids dielectrics and applications of insulating materials
- To describe the generation and measurement of high voltages and currents
- To describe the overvoltage phenomenon, non-destructive testing of materials and electrical apparatus
- To describe the high voltage testing of electrical apparatus

Course Objective :-	
Module/Unit	After completion of the course, students will be able to
1.	Explain the operation of electric field stresses, gas/vacuum as Insulator and liquid breakdown.
2.	Describe the conduction and breakdown in gases and breakdown in liquid dielectrics
3.	Explain the the breakdown in solids dielectrics and applications of insulating materials.
4.	Discuss the generation and measurement of high voltages and currents.
5.	Describe the overvoltage phenomenon, non-destructive testing of materials and electrical apparatus, and the high voltage testing of electrical apparatus.

Pre-Requisite :-	
1.	

Unit	Topic/Sub Topic	hour
	1. Introduction 1.1 Electric Field Stresses 1.2 Gas/Vacuum as Insulator 1.3 Liquid Breakdown 1.4 Solid Breakdown 1.5 Estimation and Control of Electric Stress 1.6 Surge Voltages	4
	2.Conduction and Breakdown in Gases 2.1 Gases as Insulating Media 2.2 Ionization Processes 2.3 Townsend's current Growth 2.4 Townsend's Criterion for Breakdown 2.5 Breakdown in Electronegative Gases 2.6 Time lags for Breakdown 2.7 Breakdown in Non-uniform Fields and Corona Discharges	6

	2.8 Post-Breakdown Phenomena and Applications 2.9 Vacuum Insulation	
	3. Conduction and Breakdown in Liquid Dielectrics 3.1 Liquid as Insulators 3.2 Pure Liquids and Commercial Liquids 3.3 Conduction and Breakdown in Pure Liquids 3.4 Conduction and Breakdown in Commercial Liquids	**4**
	4. Breakdown in Solids Dielectrics 4.1 Intrinsic Breakdown 4.2 Electromechanical Breakdown 4.3 Thermal Breakdown 4.4 Breakdown of Solid Dielectrics in Practice 4.5 Breakdown in Composite Dielectrics 4.6 Solid Dielectrics Used in Practice	**5**
	5. Applications of Insulating Materials 5.1 Applications in Power Tranformers 5.2 Applications in Rotating Machines 5.3 Applications in Circuit Breakers 5.4 Applications in Cables 5.5 Applications in Power Capacitors	**5**
	6. Generation of High Voltages and Currents 6.1 Generation of high d.c. voltages 6.1 Generation of high alternating voltages 6.1 Generation of impulse voltages 6.1 Generation of impulse currents	**4**
	7. Measurement of High Voltages and Currents 7.1 Measurement of High Direct Current Voltages 7.2 Measurement of High ac and impulse Voltages 7.2 Measurement of High dc, ac and impulse Currents	**4**
	8. Overvoltage Phenomenon 8.1 Lightning Phenomenon 8.2 Overvoltage due to Switching Surges, System Faults and Other Abnormal Conditions 8.3 Principles of insulation co-ordination on High Voltage and Extra High Voltage Power Systems	**4**
	9. Non-Destructive Testing of Materials and Electrical Apparatus 9.1 Measurement of dc resistivity 9.2 Measurement of Dielectric Constant and Loss Factor 9.3 Martial Discharge Measurements	**4**
	10. High Voltage Testing of Electrical Apparatus 10.1 Testing of Insulators and Bushings 10.2 Testing of Insulators and Circuit Breakers 10.3 Testing of Cables 10.4 Testing of Transformars 10.5 Testing of surge diverters	**5**
	Total	**45**

List of Experiments:

1.Determine the flashover voltage of a pin type insulator

2. Determine the flashover voltage of suspension type insulator and to observe the corona effects

3. Compare the flashover voltages wet and dry for a typical outdoor insulator.

4. Investigate the voltage distribution over a suspension insulator string without guard ring.

5. Investigate the voltage distribution over a suspension insulator string with guard ring.

6.Calibrate a Sphere Gap using its breakdown strength against gap setting

7. Calibrate a Rod Gap using its breakdown strength against gap setting

8. Calibrate a Cone Shaped Gap using its breakdown strength against gap setting

9. Calibrate Flat Surface Gap using its breakdown strength against gap setting

10. Calibrate Cone-Flat Surface Gap using its breakdown strength against gap setting

11. Find out the 50% Critical Impulse FlashOver Voltages on the 11KV type Insulator with Positive Impulse Negative Impulse

12. Study of relationship between String Efficiency & the no of Insulators (units) used in a String Insulator.

13. Study of relationship between String Efficiency & the no of Insulators (units) used in a String Insulator with Guard Ring

Reference Books:

1. High voltage engineering, M.S.Naidu and V.Kamaraju, McGraw-Hill
2. High Voltage Engineering, C.L.Wadha, New Age International
3. An Introduction to High Voltage Engineering, Subir ray, PHI
4. High Voltage and Electrical Insulation Engineering, Ravindra Arora and Wolfgang Mosch, Wiley

Name of the course : Repairing of Electrical Machines & Household Equipment	
Course code: EE606	Semester : Fifth/Sixth
Teaching Scheme	Maximum Marks : 150
	PA and End Examination Scheme
Theory : 3 hrs/week	Class test: 15 Marks
Tutorial: 0 hrs/week	Assignment / Quiz etc: 15 Marks
Practical : 2 hrs/week	End Semester Theory Exam: 70 Marks
Credit : 4	End Semester Practical Exam: 50 Marks

Rationale / Aim :-

It is needed that the shop floor experience on dismantling and assembly of Electrical machines and household equipments 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.

c. Repairing of Electric Iron, OTG, Electric Oven, Water Heater / Geyser, Vacuum Cleaner, Split type / Window Air-Conditioning.

Course Objective :-	
Module/Unit	After completion of the course, students will be able to
1.	Dismantle and assemble of Electrical machines like motor, transformer, switching units and starters
2.	Explain different repairing techniques of electrical equipments
3.	Repair Electric Iron, OTG, Electric Oven, and Water Heater / Geyser
4.	Repair Vacuum Cleaner, and Split type / Window Air-Conditioning.

Pre-Requisite :-	
1.	

Unit	Topic/Sub Topic	Hour
	1. Repair of Electrical Machines 1.1 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 method of shaft repair 1.8 To describe the method of terminal and lead repair 1.9 To describe the method of rotor or armature balancing 1.10 To describe the method of winding repair 1.11 To describe the winding insulation and joining techniques 1.12 To perforce the test as per Bureau of Indian Standard 1.13 To apply binding to rotors and armature	15
	2. **Transformer Repairing** 2.1 To describe the repair of low and medium rating power transformer 2.2 To list the factors for inspection before the repair of faults 2.3 To describe the method of inspection of core and winding 2.4 To describe the method of core repairs 2.5 To describe the method of repair, preparation and drying of windings	12

	2.6 To describe the method of repair of top changer 2.7 To describe the method of bushing repair 2.8 To describe the method of repair of tanks, conservators and fillings 2.9 To describe the method of transformer assembly 2.10 To describe the different testing and measurement procedure as per Bureau of Indian Standard Specification.	
	3. **Electrical Panel Repairing** 3.1 To describe the periodic maintenance of switch, fuse unit changeover, bus bar and different type starters 3.2 To prepare the operation and maintenance schedule of a diesel generating set	**6**
	4. **Ceiling Fan/Exhaust Fan** 4.1 To describe the electrical circuits of ceiling/exhaust fan 4.2 To describe the dismantling procedure of a ceiling /exhaust fan 4.3 To state the precautions required to dismantle the ceiling/exhaust fan 4.4 To state the method of the fault detecting procedure of the ceiling/exhaust fan 4.5 To state the procedure for repair of the ceiling/exhaust fan 4.6 To describe the method of testing of ceiling/exhaust fan 4.7 To describe the process of preventive maintenance	**7**
	5. **Fluorescent Lamp/Sodium Vapour Lamp** 5.1 To draw and describe the circuit of the lamp fitting 5.2 To state the procedure for repair of the circuit 5.3 To perform the repair work and testing procedure	**5**
	Total	**45**

List of Experiments

1. To dismantle a electrical dc motor and then assemble the dc motor
2. To dismantle a electrical dc generator and then assemble the dc generator
3. To dismantle a single phase transformer and then assemble the single phase transformer
4. To dismantle a single phase induction motor and then assemble single phase induction motor
5. To dismantle a three phase induction motor and then assemble three phase induction motor
6. To repair the endshield, ship ring and commutator, shaft, terminal and lead, rotor or armature, winding of electrical machines
7. To repair low and medium rating power transformer
8. To repair core, Winding, tap changer, tanks, conservators and fillings of transformer.
9. To repair switch, fuse unit changeover, bus bar and different type starters
10. To test and measure parameters of transformer as per Bureau of Indian Standard Specification.
11. To repair ceiling/exhaust fan, Electric Iron, OTG, Electric Oven, and Water Heater / Geyser

12. To Repair Vacuum Cleaner, and Split type / Window Air-Conditioning.
13. To repair lamp fittings

Reference Books

5. Testing Commissing Operation & Maintenance of Electrical Equipment, S.Rao, Khanna Publisher
6. Electrical Equipment Handbook: Troubleshooting and Maintenance, Phillip Kiameh, McGraw-Hill
7. Electrical Power Equipment Maintenance and testing, Paul Gill, CRC Press
8. Fundamentals of Maintenance of Electrical equipments, K.B.Bhatia, Khanna Publishers