PART- II

(5^{th} & 6^{th} Sem.)

CURRICULUM OF DIPLOMA PROGRAMME ON

ELECTRICAL & ELECTRONICS ENGINEERING (EEE)

IN

MULTI POINT ENTRY & CREDIT SYSTEM

For the State of Nagaland

Path Finder for Excellence in Technical Education

National Institute of Technical Teachers' Training & Research, Kolkata

Block – FC, Sector – III, Salt Lake City, Kolkata – 700 106

http://www.nitttrkol.ac.in

2019

TERM:V

Sl.no.	Sub. Code	Name of Course	Study Scheme				Evaluation Scheme							
			Pre-req.	L	T	P	Theory Marks			Pract. Marks			Total Marks	Credits
							End Exam	Progressive Assessment		End Exam	Progressive Assessment			
								Class Test	Assignment*		Sessional	Viva		
1	EEE501	Microprocessors		3	1	2	75	10	15	25	25	0	150	5
2	EEE502	Power Electronics		3	1	2	75	10	15	25	25	0	150	5
3	EEE601-606	Elective-I		3	0	4	75	10	15	25	25	0	150	5
4	EEE410	Electrical Estimation and Costing.		2	1	4	50	10	15	25	25	0	125	5
5	EEE512	Professsional Practice -4		0	0	2	0	0	0	0	50	0	50	1
6	EEE506	Communication Engineering		3	1	4	75	10	15	25	25	0	150	6
Total				**14**	**4**	**18**	350	50	75	125	175	0	**775**	**27**

* The marks for assignment (15) should include five (5) marks for attendance

TERM -VI

Sl.no.	Sub. Code	Name of C ourse	Study Scheme				Evaluation Scheme							
			Pre-req.	L	T	P	Theory Marks			Pract. Marks			Total Marks	Credits
							End Exam	Progressive Assessment		End Exam	Progressive Assessment			
								Class Test	Assignment*		Sessional	Viva		
1	EEE504	Switchgear & Protection		3	0	0	75	10	15	0	0	0	100	3
2	EEE505	Control Systems		3	1	2	75	10	15	25	25	0	150	5
3	EEE507	Testing and Maintenance of Machines and Equipment		2	0	4	0	0	0	25	25	0	50	4
4	EEE508	Project Work		0	0	10	0	0	0	0	50	50	100	5
5	EEE601-606	Elective-II		3	0	4	75	10	15	25	25	0	150	5
6	EEE513	Professional Practice -V		0	0	4	0	0	0	0	50	0	50	2
7	G303-G307	Softcore II		3	0	0	75	10	15	0	0	0	100	3
		Total		**14**	**1**	**24**	**300**	40	60	75	175	50	**700**	**27**

* The marks for assignment (15) should include five (5) marks for attendance

1	EEE514	Industrial Training of three weeks, preferably in two phases (after acquiring 100 credits)										**200**	**10**
		Total										**200**	**10**

TERM - V

MICROPROCESSORS

L	T	P		
3	1	2		
Total Contact Hours		**: 90 Hrs**	**Total Marks: 150**	**Curri. Ref. No.: EEE 501**
Theory		: 45 Hrs		**Theory**
Tutorial		: 15 Hrs		End Term Exam : 75
Practical		: 30 Hrs		Progressive Assessment : 25
Pre Requisite		**:**		**Practical**
				End Term Exam : 25
Credit		**: 5**		Progressive Assessment : 25

RATIONALE:

Presently microprocessor programming and interface is highly required for diploma engineers. Though the progress and advancement in this area is very fast, the study of the basic principles of 8085 microprocessor system is still continuing. The study of Microprocessor and its peripheral devices are included in this part. A lot of emphasis has been given to do some exercise on design aspects for the better understanding. A lot of lab exercises have been included for better understand of the subject. After completion of the course, students will be able to:

- Write assembly language programs in 8085
- Interface general purpose programmable peripheral devices-8255, 8253, 8259, 8257, 8279
- Interface D/A and A/D converters
- Control Stepper motor, DC motor, liquid level, temperature and traffic light control

DETAILED COURSE CONTENT:

Unit	Topic/Subtopic	Hours	Marks
I	**1. Introduction to Microprocessor** 1.1 Basic concept of microprocessor 1.2 Difference between microprocessor and microcomputer 1.3 Applications of microprocessors	3	5
II	**2. 8085 Microprocessor** 2.1 Architecture of 8085-Address bus, data bus, control bus, ALU, Registers, control logic etc. 2.2 Pin Diagram of 8085 2.3 Operation-Microprocessor initiated, internal data, memory Read/Write, I/O Read/Write	10	15

	2.4 Timing Cycle		
III	**3. Programming in 8085 Microprocessor** 3.1 Data transfer instruction 3.2 Arithmetic and logic operation 3.3 Branch operation 3.4 Writing assembly language programs and debugging 3.5 Looping, counting, indexing 3.6 Additional data transfer and 16 bit Arithmetic instructions 3.7 Arithmetic operation (memory related) 3.8 Rotate, compare 3.9 Counters and time delays- Illustrative programs 3.10 Stack and subroutines-conditional call and return instructions 3.11 Code conversion, BCD arithmetic and 16 bit data operations 3.12 Assemblers	**15**	**25**
IV	**4. Interfacing Peripherals** 4.1 Parallel I/O & interfacing applications 4.2 Interrupts 4.3 Interfacing data converters- D/A, A/D converters 4.4 General purpose programmable peripheral devices- 8255, 8253, 8259, 8257 4.5 Programmable keyboard/display interface 8279 4.6 Serial I/O and data communication	**10**	**20**
V	**5. Microprocessor-Based Systems** 5.1 Microprocessor based Stepper motor control 5.2 Microprocessor based DC motor Control 5.3 Microprocessor based Temperature controller 5.4 Microprocessor based Liquid level controller 5.5 Microprocessor based Traffic light control system	**7**	**10**

LEARNING RESOURCES

(a) Textbooks mentioned in the references.
(b) Laboratory manuals, work book etc.

LIST OF EXPERIMENTS

1. Write Assembly language programming for the following problems:
   - Addition of two numbers
   - Subtraction of two numbers

- Addition of a series of ten numbers
- 1's complement and 2's Complement of a 8-bit number
- Addition of two 16-bit numbers.
- Multiplication of two 8-bit number
- Division of two 8-bit number
- Find the largest number from a string
- Find the smallest number from a string
- Arranging numbers in ascending & descending order.

2. Interface IC 8255 with microprocessors
3. Interface IC 8253 with microprocessors
4. Interface A/D & D/A converters with microprocessor
5. Microprocessor based Stepper motor control
6. Microprocessor based DC motor Control
7. Microprocessor based Temperature controller
8. Microprocessor based Liquid level controller
9. Microprocessor based Traffic light control system

REFERENCE BOOKS:

1. Microprocessors and Microcontrollers Architecture, Programming and Interfacing using 8085, 8086 and 8051 by S. K. Mandal, Mc Graw Hill Education
2. Microprocessor Architecture by Gaonkar, Wiley Eastern
3. Microprocessor by Douglus Hall, Prentice Hall
4. 8086/8088 Family Architecture Programming and Design by Gibson and Lice, Prentice Hall
5. Introduction to Microprocessors by Laventhal, Prentice Hall
6. Introduction to microprocessor by A.P.Mathur, Tata McGraw Hill

POWER ELECTRONICS

L	T	P		
3	1	2		**Curri. Ref. No.: EEE 502**
Total Contact Hours		**: 120 Hrs**		**Theory**
Theory		: 45 Hrs	**Total Marks: 150**	End Term Exam : 75
Tutorial		: 15 Hrs		Progressive Assessment : 25
Practical		: 30 Hrs		**Practical**
Pre Requisite		**:**		End Term Exam : 25
Credit		**: 5**		Progressive Assessment : 25

RATIONALE:

Power Electronics is an interdisciplinary area using the members of Thyristor family & control electronics to control the switch ON and switch OFF processes of the devices and principles of control theory. The field of control electronics also had a great change due to the digital integrated and microprocessor control. The area power electronics had a two sided development (a) the semiconductor devices of improved performance (b) control circuit of these devices. Thus the care has been taken to include the study of the characteristics of the power devices which are being used and also their control circuit's starting from their rudimentary level to the block diagram study of the sophisticated computer control system. After study this subject student should be able to acquire knowledge in

- The characteristics of power devices like thyristor, power diode, power transistor, MOSFET, GTO, and IGBT
- Field of application of the power diode and thyristor
- The construction and working principles of speed control circuits of d.c. and a.c. machines
- The construction and working principles of a.c. voltage regulators
- The construction and working principles of choppers, inverters, and uninterrupted power supplies.

DETAILED COURSE CONTENT:

Unit	Topic/Sub Topic	Hours	Marks
I	**1. Power Devices** 1.1 Construction, working principle and characteristics of power diode	10	20

	1.2 Construction, working principle and characteristics of power transistor 1.3 Construction, working principle and characteristics of SCR, TRIAC & DIAC 1.4 Construction, working principle and characteristics of MOSFET 1.5 Construction, working principle and characteristics of GTO 1.6 Construction, working Principle and characteristics of IGBT 1.7 Specification and rating of thyristor 1.8 Applications of power devices		
II	**2. Triggering Circuits & Commutation** 2.1 Gate pulse triggering of SCR by R, RC and UJT Circuits 2.2 Isolation requirement for triggering of SCR 2.3 Isolation by pulse transformer and opto-isolator 2.4 Commutation of SCR, natural commutation and forced commutation.	**8**	**10**
III	**3. Controlled Rectifier** 3.1 Half Wave Controlled rectifier 3.2 Semi-Converter 3.3 Full-wave Controlled rectifier 3.4 Control of D.C. shunt motor by SCR and DIAC combination	**10**	**15**
IV	**4. AC Voltage Regulator, Chopper & Inverter** 4.1 Define AC voltage regulator 4.2 Working principle of single phase & three phase AC voltage regulator with resistive load 4.3 Define chopper 4.4 Working principle of step down, step up & buck-boost converter 4.5 Define inverter 4.6 Working principle of single phase and three phase bridge inverter	**10**	**20**
V	**5. Application of Power Electronics** 5.1 Speed control of DC motors 5.2 Speed control of single phase induction motor 5.3 UPS	**7**	**10**

RESOURCES:

(a) Textbooks mentioned in the references.
(b) Laboratory manuals, work book etc.

LIST OF EXPERIMENTS

1. To draw the characteristics curve of S.C.R.
2. To assemble the turn ON and turn OFF circuit of SCR and check the performance
3. To assemble and run inverter circuit (Transistorized)
4. To assemble and run inverter circuit (SCR version)
5. To assemble & control the current through DC load by phase shift method.
6. To develop the circuit for current regulation through heater by phase shift control of triac
7. To control the speed of a D.C. motor through full wave rectifier bridge and SCR (phase shift control)
8. To regulate the speed of a D.C. motor by using of zero crossing detector and UJT oscillator
9. To regulate the speed a D.C. motor by pulsed triggering through opto-coupler
10. To regulate the speed of a D.C. motor by gated pulsed triggering and through pulsed transformer
11. To regulate the speed of an A.C. load by PWM circuit
12. To develop the buck-boost converter circuit for D.C. to D.C. conversion and check its performance
13. To run and study of a closed loop D.C. Motor control system
14. To assemble & run the soft start method of starting of induction motor.
15. To develop forced commutation circuits for resistive load and inductive loads.

REFERENCE BOOKS

1. Power Electronics by S. K. Mandal, Mc Graw Hill Education
2. Power Electronics by Md. H. Rashid, PHI
3. Power Electronics by Vdedam Subrahmanium, New Age International Publisher
4. Power Electronics by P.C. Sen, T.M.H.

Elective Courses

POWER PLANT ENGINEERING

L	T	P		Curri. Ref. No.: EEE 601	
3	0	4			
Total Contact Hours		**: 105 Hrs**		**Theory**	
Theory		: 45 Hrs	**Total Marks: 150**	End Term Exam	: 75
Practical		: 60 Hrs		Progressive Assessment	: 25
Pre Requisite		**:**		**Practical**	
				End Term Exam	: 25
Credit		**: 5**		Progressive Assessment	: 25

RATIONALE:-

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. After study this subject student should be able to describe

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

DETAILED COURSE CONTENT:

Unit	Topic/Sub Topic	Hours	Marks
I	**1. Economics of Power Generation** 1.1 Load duration curves 1.2 Location of power plants 1.3 Power plant economics	2	3
II	**1. 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 feed-water heating 2.8 Feed-water heaters 2.9 Carnotization of rankine cycle 2.10 Stream power plant 2.11 Deaerator 2.12 Layout of steam power plant 2.13 Efficiencies in a steam power plant	5	10
III	**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	5	8
IV	**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 burning coal 4.5 Fuel bed combustion 4.6 Pulverized coal firing system 4.7 Combustion of fuel oil 4.8 Combustion of gas	5	7
V	**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	8	15

	5.7 Steam generator control 5.8 Electrostatic precipitators 5.9 Ash handling system 5.10 Feed-water treatment 5.11 Condensers 5.12 Circulating water system 5.13 Cooling towers		
VI	**6. Steam Turbines** 6.1 Flow through nozzles 6.2 Turbine blading 6.3 Electrical energy generation	**4**	**5**
VII	**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 hydro-electric power plants 7.6 Turbines of hydro-electric power plants 7.7 Performance of turbines 7.8 Selection of turbines	**6**	**10**
VIII	**8. Diesel Engine and Gas Turbine Power Plants** 8.1 Advantages and disadvantages of diesel engine power plant 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	**6**	**10**
IX	**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**	**7**

LIST OF EXPERIMRNTS

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

L	T	P		Curri. Ref. No.: EEE 602	
3	0	4			
Total Contact Hours		**: 105 Hrs**		**Theory**	
Theory		: 45 Hrs	**Total Marks: 150**	End Term Exam	: 75
Practical		: 60 Hrs		Progressive Assessment	: 25
Pre Requisite		**:**		**Practical**	
				End Term Exam	: 25
Credit		**: 5**		Progressive Assessment	: 25

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

MICROCONTROLLERS

RATIONALE :

This course is an introduction to the fundamentals of architecture and implementation of embedded micro controllers. The architecture covers the arithmetic logic unit, instructions, registers, memory, and input & output. The implementation covers parallel input & output, serial communication, timers, interrupt control and feedback control. Upon completion of this course the student will be able to:

- Describe the architecture of the 8051 microcontroller,
- Create an assembly language source file using the 8051 editor.
- Assemble 8051 programs and link object files.
- Interpret the assembler's error messages, and make the changes if necessary
- Interface the microcontroller with external devices through its I/O ports.
- Use the microcontroller timer and interrupt facilities.
- Use the Boolean bit manipulation of the 8051 micro controller.

DETAILED COURSE CONTENTS:

Unit	Topic / Sub Topic	Hours	Marks

I	**1. Introduction to Microcontroller:** 1.1 History of microcontroller 1.2 Embedded system 1.3 Microcontroller vs microprocessor 1.4 Applications of micro controller	**5**	**5**
II	**2. 8051 Architecture:** **2.1** Block diagram of 8051 micro controller 2.2 Oscillator and clock 2.3 Program counter and data pointer 2.4 A and B register 2.5 Flags and PSW 2.6 Internal memory 2.7 Internal RAM organization 2.7.1 General purpose RAM 2.7.2Bit addressable 2.7.3 Working registers 2.8 Stack and stack pointer 2.9 Special function register 2.10 Internal ROM 2.11 Pin diagram of 8051	**8**	**15**
III	**3. Timer:** 3.1 Counter and timer 3.2 Timer modes of operation: TCON, TMOD	**4**	**6**
IV	**4. Serial Data Input/output and Interrupts:** 4.1 Serial data interrupts, SCON. PCON 4.2 Serial data transmission and reception 4.3 Interrupts, timer flag interrupts, serial port interrupts, external interrupts 4.4 Interrupts enable (IE) SFR, interrupts priority (IP) SFR 4.5 Reset, interrupts control	**5**	**8**
V	**5. 8051 Instruction and Addressing Modes:** 5.1 Addressing mode: immediate, register, direct & indirect addressing mode 5.2 Instruction for moving data 5.2.1 External data move 5.2.2 Data exchange 5.3 Instruction for logical operation 5.3.1 Byte and bit level logical operation 5.3.2 Rotate and swap 5.4 Instruction for arithmetic operation 5.4.1 Incrementing and decrementing	**7**	**14**

	5.4.2 Addition and subtraction 5.4.3 Multiplication and division 5.5 Jumps and call instructions		
VI	**6. Basic Programming Model and Concept** 6.1 Assembly language Programming concept 6.2 Flow chart	**3**	**6**
VII	**7. 8051 Example Problems** 7.1 Addition, subtraction, multiplication etc 7.2 Data move/transfer 7.3 Comparisons 7.4 Use of subroutine/Loop	**8**	**16**
VIII	**8. Stack and Subroutines:** 8.1 Stack usage, implementation of PUSH and POP 8.2 Subroutine usage, implementation of CALL and RET	**5**	**5**

LIST OF EXPERIMENTS:

1. Study the Microcontroller Training kit, identification of the following
   (a) Central processing Unit with Crystal
   (b) Memory (b1) RAM (b2) ROM areas
   (c) Power back up terminals
   (d) Keyboard
   (e) Display
   (f) USART chip
   (g) I/O port
   (h) Programmable interval timer
   (i) Serial communication support
   (j) Keyboard/ Display interface
   (k) To locate the above sections on a layout diagram
2. Write Assembly language programs in 8051 trainer kit
3. Write Assembly language program of addition of two numbers
4. Write Assembly language program of subtraction of two numbers
5. Write Assembly language program of multiplication of two numbers
6. Write Assembly language program of division of two numbers
7. Write Assembly language programs by using conditional and unconditional jump instructions
8. Write Assembly language program by using the call and return subroutine instructions
9. Write Assembly language programs to find the square of a number using Look-up table
10. Write and execute a program by using delay subroutine
11. Write and execute a program for A to D converter
12. Write and execute a program for D to A converter
13. Study the 8051 micro controller based DC motor speed control system
14. Study the 8051 micro controller based Stepper motor speed control system

REFERENCE BOOKS:

1. The 8051 Microcontroller Architecture, Programming and Applications by Kenneth J. Ayala, McGraw Hill

L	T	P		
3	0	4		**Curri. Ref. No.: EEE603**
Total Contact Hours		**: 105 Hrs**		**Theory**
Theory		: 45 Hrs	**Total Marks: 150**	End Term Exam : 75
Practical		: 60 Hrs		Progressive Assessment : 25
Pre Requisite		**:**		**Practical**
				End Term Exam : 25
Credit		**: 5**		Progressive Assessment : 25

2. The 8051 Microcontroller and Embedded Systems by Muhammad Ali Mazidi, Pearson Education India
3. Microcontrollers Architecture, Programming, Interfacing and System Design by Raj Kamal, Pearson Education
4. 8085 Microcontroller & Embedded Systems by Rajiv Kapadia, Jai Co Publishing Home

ELECTRICAL DRIVES

RATIONALE:

The course on Electric Drives is designed to introduce the concept of control of electric drives for various types of mechanical loads. In this course, mainly the dc motor, induction motor and synchronous motor steady-state modeling and steady state torque and speed control of these motors are emphasized. The course exposes the applications of semiconductor controlled converters to control the DC and AC machines for better torque and speed response.

DETAIL OF COURSE CONTENT:

Unit	Topic / Sub Topic	Hours	Marks
I	**1. Introduction to Electric Drives** 1.1 Define electric drive 1.2 Advantages and disadvantages of electric drive 1.3 Factors governing selection of electric motors 1.4 Comparative discussion between the various electric drive duties- continuous, short-time & intermittent 1.5 Quadrantal diagram for speed-torque characteristics 1.6 Hoist mechanism 1.7 Types of braking	7	12
II	**2. Industrial Drives** 2.1.Requirements of various types of common loads such as - Hoist, Elevator, Conveyor, Rolling mills, Centrifugal pumps, Punches, Shears etc. 2.2 Selection of motors in respect of types, size and rating for above loads on the basic of mechanical characteristics, speed control, reversibility, working environment and cost.	6	10
III	**3. Heating and Power Rating of Drive Motors** **3.1** Load diagrams **3.2** Overload capacity **3.3** Heating and cooling of motors **3.4** Selection of motor power capacity.	7	8
IV	**4. Electric Traction** 4.1 Electric traction 4.2 Different systems of track electrification (Block diagram) DC, AC, Composite 4.2.1 Advantage & disadvantages of each 4.2.2 Analysis of single phase 25 KV AC system and DC system 4.3. Traction mechanics 4.3.1 Types of services. 4.3.2 Speed time curve. 4.3.3 Simplified speed time curve (no derivation) 4.3.4 Average speed and schedule speed. 4.3.5 Factors affecting the schedule speed. 4.3.6 Tractive effort 4.3.7 Specific energy consumption 4.3.8 Factors affecting specific energy consumption. 4.3.9 Simple numerical on simplified speed time curves and specific energy consumption 4.4. Mechanics of train movement 4.4.1 Adhesion & coefficient of adhesion 4.4.2 Concept of weight transfer 4.4.3 Effect of unsprung mass and wheel diameter 4.5. Traction Motors:	15	25

	4.5.1 Desirable characteristics of traction motors 4.5.2 Special features of traction motor 4.5.3 Suitability of DC series motor for traction 4.5.4 Suitability of three phase induction motor for traction.		
V	**5. DC & AC Drives** 5.1 Speed control of separately excited DC motor by single phase fully controlled converter 5.2 Speed control of separately excited DC motor with three phase fully controlled converter 5.3 Speed control of DC series motor with chopper control. 5.4 Speed control of DC servomotor 5.5 Speed control of Three phase Induction motor with variable frequency PWM VSI 5.6 Speed control of Three phase Induction motor with variable voltage variable frequency control 5.7 Speed control of AC servomotor 5.8 Static VAR compensation system - Principle of operation & Block diagram 5.9 Uninterrupted power supply-Principle of operation and block diagram of on load & off load type UPS.	**10**	**20**

LIST OF EXPERIMENTS:

1. Starting of DC series motor
2. Speed control of DC shunt and DC series motor
3. Starting of three phase induction motor
4. Speed control of three phase induction motor
5. Dynamic braking of DC motor
6. Plugging of induction motor
7. Braking of induction motor
8. Study of electric traction system
9. Speed control of DC servomotor
10. Speed control of AC servomotor
11. Power factor (pf) improvement using capacitor
12. Study of uninterruptable power supply.

REFERENCE BOOKS:

1. Fundamental of Electrical Drives by G.K.Dubey, Narosa Publishing House
2. A First Course on Electrical Drives by S.K.Pillai, Wiley-Eastern Limited
3. Electric Drives: Concepts and Applications by Vedam Subrahmanyam, Tata McGraw-Hill Education
4. Electrical Machines P.S. Bimbhra, Khanna Publishers
5. Basic Electrical Engineering, V.N. Mittle, Tata McGraw-Hill

6. Electrical Machines, Nagrath & Kothari, Tata McGraw-Hill

UTILISATION OF ELECTRICAL POWER

L	T	P		Curri. Ref. No.: EEE 604	
3	0	4			
Total Contact Hours		**: 105 Hrs**		**Theory**	
Theory		: 45 Hrs	**Total Marks: 150**	End Term Exam	: 75
Practical		: 60 Hrs		Progressive Assessment	: 25
Pre Requisite		**:**		**Practical**	
				End Term Exam	: 25
Credit		**: 5**		Progressive Assessment	: 25

RATIONALE:

All service sectors namely railway, industries, offices, multinational companies always deal with the utilization of electrical energy in the following fields e.g. electrical heating, welding, illumination. Students must be thoroughly acquainted

with the principles of application of electrical energy in the above fields. In this course the Students should understand the facts, concepts, principles and procedures related to the utilisation of electric power so that they can acquire supervisory skills, which will help them to discharge their role as a supervisor when they start working in the industry.

DETAIL OF COURSE CONTENTS:

Unit	Topic / Sub Topic	Hours	Marks
I	**1. Electrical Heating** 1.1. Advantages of electric heating 1.2. Classification of electric heating methods 1.3 Resistance heating: construction, operation and application 1.3.1 Direct resistance heating: Salt bath furnace 1.3.2 Indirect resistance heating: Resistance ovens 1.3.3 Name of some common heating element materials 1.3.4 Causes of failure of heating elements 1.4 Arc heating: construction, operation and application 1.4.1 Direct arc furnace 1.4.2 Indirect arc furnace. 1.5 Induction heating: construction & operation and application) 1.5.1 Core type induction furnaces 1.5.2 Coreless induction furnace. 1.6 Dielectric heating: 1.6.1 Principle of dielectric heating. 1.6.2 Advantages of dielectric heating 1.6.3 Limitations of dielectric heating. 1.6.4 Applications of dielectric heating.	10	15
II	**2. Electric Welding** 2.1. Methods of electric welding 2.2 Resistance welding: 2.2.1 Principle of resistance welding 2.2.2 Advantages of resistance welding 2.2.3 Types of resistance welding 2.2.4 Spot welding machine 2.3 Electric Arc Welding 2.3.1 Formation and characteristics of electric arc 2.3.2 Effect of arc length 2.3.3 Arc blow 2.3.4 Electrodes for metal arc welding 2.3.5 V-I Characteristics required for of arc welding. 2.4 Arc Welding Machines 2.4.1 DC welding machines - MG set, AC rectified welding unit	10	20

	2.4.2 AC welding machines - Welding transformer		
III	**3. Refrigeration** 3.1 Laws of thermodynamics 3.2 Comparison between heat engine, heat pump and refrigeration 3.3 Definitions of refrigeration, ton of refrigeration, COP, enthalpy, entropy 3.4 Vapour compression system 3.5 Vapour absorption system 3.6 Air refrigeration system	**8**	**10**
IV	**4. Economic Aspects of Utilising Electrical Energy** 4.1 Economic aspects of utilising electrical energy 4.2 Costing of electrical energy: fixed charges, semi fixed charges and running charges 4.3 Formulation of electrical tariffs 4.4 Various types of tariffs: tariffs in force for domestic, commercial and industrial consumer 4.5 Energy conservation: importance and need of energy conservation 4.6 Measures for energy conservation in (i) electric drives (ii) electric traction (iii) electric heating (iv)refrigeration and air conditioning (v) illumination	**10**	**20**
V	**5. Illumination** 5.1 Luminaries 5.2 Design of illumination scheme 5.3 Requirements of residential, commercial and factory illumination scheme 5.4 Design of illumination scheme for residential, commercial and factory	**7**	**10**

LIST OF EXPERIMENTS:

1. Resistance heating
2. Induction heating
3. Electric Arc Welding
4. Refrigeration
5. Energy conservation
6. Design of illumination scheme for residential building
7. (i) Visit a medium size manufacturing industry/substation/generating station and observe

the drive, arrangement, instrumentation & control system, procedures, instrumentation,
tools, machines & sequencing of operation

(ii) Write reports, draw the plant layout. State the principles of the operation and control of
the manufacturing system

REFERENCE BOOKS

1. Utilization of Electric Power and Electric Traction by J. B.Gupta, S.K.Kataria & Sons Pub.
2. Utilisation of Electrical Power by R. K. Rajput, Laxmi Publications
3. Utilisation of Electric Power: Including Electric Drives and Electric Traction by N. V. Suryanarayana, New Age International
4. A Course in Electrical Power by M.L.Soni, Dhanpat Rai & Sons,
5. Generation, Distribution & Utilisation of Electrical Energy by C.L.Wadhwa, Wiley Eastern Ltd.

REPAIRING OF ELECTRICAL MACHINE & HOUSEHOLD EQUIPMENT

L	T	P	Total Marks: 150	Curri. Ref. No.: EEE 605
3	0	4		
Total Contact		: 105 Hrs		Theory

Hours			
Theory	: 45 Hrs		End Term Exam : 75
Practical	: 60 Hrs		Progressive Assessment : 25
Pre Requisite	:		**Practical**
			End Term Exam : 25
Credit	**: 5**		Progressive Assessment : 25

RATIONALE:

The shop floor experience is needed on dismantling and assembly of Electrical machines and household equipment within the curriculum of Diploma in Electrical Engineering. The learning procedure for repairing of electrical machine and household equipment 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. After completion of the course, students will be able to:

- Dismantle and assemble of electrical machines like motor, transformer, switch units and starter.
- Repairing of electric iron, OTG, electric oven, water heater, geyser, vacuum cleaner, split type or window air-conditioning.

DETAIL OF COURSE CONTENTS:

Unit	Topic/Sub Topic	Hours	Marks
I	**1. Repair of Electrical Machines** 1.1 List the troubles of electrical machines: DC motor, DC generator, induction motor 1.2 Repairing of electrical machines: DC motor, DC generator, induction Motor	8	14
II	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	8	10
III	3. **Electrical Panel Repairing** 3.1 To describe the periodic maintenance of switch, fuse unit changeover, bus bar and different type starters	5	10
IV	4. **Ceiling Fan/Exhaust Fan** 4.1 To describe the repairing of ceiling/exhaust fan	5	10
V	5. **Fluorescent Lamp/Sodium Vapour Lamp and House Hold Appliances** 5.1 To describe the repair work and testing procedure of fluorescent lamp, sodium vapour lamp, electric iron, OTG, electric oven, water heater / geyser, vacuum cleaner, split type / window air-conditioning	8	14
VI	**6. Electrical Safety** 6.1 Understand the meaning and causes of electrical	6	10

	accidents 6.2 State factors on which severity of shock depends 6.3 Understand the procedure for rescuing a person who has received an electric shock 6.4 Describe methods of providing artificial respiration 6.5 Understand Do's and Don'ts listed in I.S. for substation operation. 6.6 Describe the procedure to be followed for shut down of substation and power line 6.7 State the precautions to be taken to avoid fire due to electrical reasons 6.8 Describe the operation of fire extinguisher 6.9 IE ACT- statutory regulation for safety of persons and equipment		
VII	**7. Testing of Electrical Machines** 7.1 Routine and special tests. 7.2 Compare direct testing, indirect testing and regenerative testing for efficiency and temperature rise. 7.3 Mechanical tests before commissioning of machines. 7.4 Electrical tests/inspections before commissioning of machines.	**5**	**7**

LIST OF EXPERIMENTS

1. To state the method of inspection and determination of defects in an assembled electrical machine
2. To dismantle electrical machines and determine the defects in a disassemble machine
3. To repair and reassemble the electrical machines
4. To repair the ship ring and commutator of electrical machines
5. To repair shaft of electrical machines
6. To repair winding of electrical machines
7. To state the method of inspection and determination of defects in an assembled transformer
8. To repair core and windings of transformer
9. To repair top changer, tanks, conservators and fillings of transformer
10. To assemble transformer
11. To test and measure parameters of transformer as per Bureau of Indian Standard Specification.
12. To state the periodic maintenance of switch, fuse unit changeover, bus bar and different type starters
13. To dismantle and repair of ceiling/exhaust fan, electric iron, OTG, electric oven, water heater, geyser, vacuum cleaner, split type/window air-conditioning
14. To state the method of the fault detecting procedure of the ceiling/exhaust fan
15. To test the ceiling/exhaust fan as per Bureau of Indian Standard

Specification

16 To repair lamp fitting

17. To prepare the operation and maintenance schedule of a diesel generating set

REFERENCE BOOKS

1. Testing Commissioning Operation & Maintenance of Electrical Equipment by S.Rao,
   Khanna Publisher
2. Electrical Equipment Handbook: Troubleshooting and Maintenance by, Phillip Kiameh, McGraw-Hill
3. Electrical Power Equipment Maintenance and Testing by Paul Gill, CRC Press
4. Fundamentals of Maintenance of Electrical Equipments by K.B.Bhatia, Khanna Publishers

NON-CONVENTIONAL SOURCES OF ENERGY

L	T	P		Curri. Ref. No.: EEE 606	
3	0	4			
Total Contact Hours		**: 105 Hrs**		**Theory**	
Theory		: 45 Hrs	**Total Marks: 150**	End Term Exam	: 75
Practical		: 60 Hrs		Progressive Assessment	: 25
Pre Requisite		**:**		**Practical**	
				End Term Exam	: 25
Credit		**: 5**		Progressive Assessment	: 25

RATIONALE:

Energy is the crucial input in the process of economic, social and industrial development. High energy consumption as traditionally been associated with high quality of life. 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. After completion of the course, students will be able to

- Explain the construction and working principles of wind energy systems and Solar PV systems
- Describe the construction and working principles of Bio-gas plant
- Explain the construction and design principles of Mini and Micro-hydro power plant, Tidal and Ocean energy
- Discuss working principles of renewable energy system management.

DETAILED COURSE CONTENT:

Unit	Topic/Sub Topic	Hours	Marks
I	**1. Solar energy** 1.1 Solar radiation 1.1.1 To describe (a) Global, direct and diffused radiation. (b) Spectral distribution of direct solar radiation through four types of curves. (c) Radiation measuring Instruments (d) Data from a radiation measurement network. 1.2 Water and air heating application 1.2.1 To describe the construction and uses of water heating system through (a) Flat plate collector	**12**	**18**

	(b) Spiral or "sea shell" collector (c) Heat pipe collector (d) Cylindrical heater/storage system 1.2.2 To describe three types of air heaters used to dry crop in lower latitude or space heating in higher latitude. 1.2.3 To describe the integration of an air collector into a heating and cooling system 1.2.4 To know some storage units 1.3 Space heating application: To describe the utilization of air heater and thermal energy storage in space heating application 1.4 Thermal Power and other applications (a) Head Engine (b) Large scale power Generation (c) Furnaces (d) cookers (e) refrigeration and cooling (f) Heat pumps (g) solar ponds (h) distillation (i) industrial application of process heat and transport 1.5 Photovoltaic Technology a) Principle of solar cells b) Solar cells and modules c) Applications of photovoltaic systems		
II	2. **Bio-Energy and other form of Energy** 2.1 To define Bio-Energy 2.1.1 To describe the sources of Bio-Energy 2.1.2 To describe the renewal system of Bio-Energy 2.1.3 To describe the following processes (a) Pyrolysis of wood (b) Gasification of wood (c) Producer gas preparation (d) Briquetting (e) Hydrolysis of wood ethanol (f) Liquification of wood to oil (g) Energy plantation and power programme (h) Biological conversion 2.2 Animal Energy 2.2.1 To define the Animal Energy 2.2.2 To describe the method of utilization of Animal Energy 2.3 Energy from the Ocean 2.3.1 To describe the basic process of Ocean Thermal Energy Conversion (To state (a) the location of OTEC plants (b) Application of OTEC and (c) Economic Consideration) 2.3.2 To describe (a) the method of utilization of wave Energy (b) the method of obtaining power from salinity gradients (c) utilization of Tidal power 2.4 Hydrogen Energy	**10**	**15**

	2.4.1 To describe the method of production of mass-scale hydrogen preparation 2.4.2 To describe the method of utilization of hydrogen as alternative Energy source. 2.4.3 To state the advantages and disadvantages of Hydrogen Energy		
III	**3. Wind Energy** 3.1 To state the historical development of wind generated Electricity in the following countries (a) Denmark (b) USA (c) Russia (d) united kingdom 3.2 To enumerate the wind energy potential 3.2.1 To state the annual velocity and power duration curves. 3.2.2 To describe the windmill 3.2.3 To describe the use of wind energy as (a) power generation (b) water pumping system 3.2.4 To describe the method of wind Energy conservation, distribution and utilization system.	**8**	**12**
IV	**4. Solar Cell** 4.1 Standard silicon solar cell Technology (single crystal wafers to solar cells, solar cell to solar cell modules, module construction, cell operating temperature, module durability, module circuit design, Energy accounting) 4.2 Improved silicon cell Technology 4.2.1 To explain the properties of solar grade silicon 4.2.2 To describe the method of preparation of solar sheet and specify (a) Solar sheet requirement (b) Ingot Technologies (c) Ribbon Silicon 4.2.3 To describe the cell fabrication and Interconnection techniques 4.3 Concentric systems 4.3.1 To describe the principle of ideal concentrators 4.3.2 To describe the principle of (a) stationary and periodically adjusted concentrator (b) tracking concentrator (c) concentrator cell design 4.3.3 Ultra-high efficiency systems 4.3.4 To describe the basic principle for developing ultra-high efficiency system (multi gap cell concepts, thermo photo voltaic conversion) 4.4 Photo Voltaic systems components and Application 4.4.1 To describe the principle of Energy storage system 4.4.2 To describe the principle of power conditioning	**15**	**30**

	system 4.4.3 To state the photo voltaic applications 4.5 Design of stand Alone system 4.5.1 To describe (a) the solar module performance (b) Battery Performance (performance of lead Acid Battery, Nickel cadmium Batteries) (c) Power control system (d) the method of regulation and system sizing (e) to state the application in water pumping 4.6 Residential and Centralized Photo voltaic power systems 4.6.1 To describe the (a) detail layout of the residential systems (b) module mounting technique (c) thermal generation system (d) system configuration 4.6.2 To describe the design principle of central power plant of solar cell system (general considerations, operating modes) 4.6.3 To describe the working principle of satellite solar power stations		

LIST OF EXPERIMENTS

1. Solar Radiation Measurement
2. Exploring Solar Panels
3. Effect of Load on Solar Panel Output
4. Effect of Temperature on Solar Panel Output
5. Solar Panel Output: Effect of Shade
6. Solar Panel Output: Effect of Angle
7. Solar Distillation
8. Pumping Water with Solar Energy
9. Solar Cooker
10. Preparation of delicious food by using solar cooker.
11. Solar Water Heater
12. Solar Lanterns and Street light
13. Study of Bio gas plant
14. Wind Turbine Output: The Effect of Load
15. Effect of Load on Wind Turbine Output
16. Exploring Wind Turbine Blades

REFERENCE BOOKS

1. Non-Conventional Energy Sources by B.H Khan, Tata McGraw Hill
2. Energy Technology (non-conventional, renewable and conventional) by S Rao and BB Parulekar, Khanna Publishers
3. Solar Energy – Principles of thermal collection and Storage by SP Sukhatme, Tata McGraw

Hill Publication
4. Solar Energy Utilization by GD Rai, Khanna Publishers
5. Reviews of Renewable Energy Sources by MS. Sodha, S.S. Mathur, MAS Malik, TC Kandpal, Wiley Eastern Limited

ELECTRICAL ESTIMATION & COSTING

L	T	P		
2	1	4		**Curri. Ref. No.: EEE 410**
Total Contact Hours		**: 105 Hrs**		**Theory**
Theory		: 30 Hrs	**Total Marks: 125**	End Term Exam : 50
Tutorial		: 15 Hrs		Progressive Assessment : 25
Practical		: 60 Hrs		**Practical**
Pre Requisite		**:**		End Term Exam : 25
Credit		**: 5**		Progressive Assessment : 25

RATIONALE:

Electrical engineering diploma holders are very often faces the problems of estimation of the electrical installation work and the design aspects of the illumination system and electrical control panel. The basic idea of electrical installations, the detail of electrical components and accessories and luminaries and design procedure of illumination system are discussed here. The study of bureau of Indian standard specifications are also to be discussed in this subjects. After completion of the course, students will be able to:

- Describe the steps of design procedure of domestic and industrial wiring
- Estimate and costing for domestic and industrial wiring
- Design the circuits of motor controllers
- Estimate the quantity and cost of components
- Prepare the list of components with full specification
- Select correct size of components
- Design and estimate the illumination system for domestic, office, street light courtyard and factors installation

DETAILED COURSE CONTENT:

Unit	Topic/Subtopic	Hours	Marks
I	**1. Symbols and Codes** 1.1 Symbols in electrical engineering 1.2 Conventions for circuit and schematic representation of electrical and electronic components, instruments and equipment	2	2
II	**2. Elements of Estimation and Costing** 2.1 Types of estimation and estimation tools 2.2 Overhead and service charges 2.3 Purchase procedure	4	8
III	**3. Domestic and Industrial Wiring** 3.1 Layout and estimation of residential wiring 3.2 Layout and estimation of industrial wiring 3.3 IE rules	8	15
IV	**4. Estimation and Costing of Electrical Products & Services** 4.1 Market survey for cost of given product like DOL starter, small motor, MCBs, etc. 4.2 Market survey for availability of required materials, their cost and other requirements 4.3 Detailed estimation and preparation of cost schedule for repair and maintenance of electric fan, automatic electric iron, single-phase transformer, mixer, D.O.L. starter etc.	8	15
V	**5. Distribution Panel Design** 5.1 To design and estimate distribution panel including the bus bar and metering system 5.2 To prepare the detail diagram 5.3 To prepare the list of equipment with detail specification 5.4 To estimate the cost	8	10

LEARNING RESOURCES

a) Text books mention in the reference
b) Laboratory manuals

LIST OF EXPERIMENTS

1. To remove the insulation of Wires (Skinning of conductors) and measure the

gauge of
a given wire with the help of wire gauge.

2. To prepare a Rat tail joint, T-joint and straight joint in 1.5mm² P.V.C wire.
3. To prepare a straight Joint, and T-joint in stranded V.I.R or P.V.C wire (married joint).
4. To prepare a straight and tee joint of twin core P.V.C wire.
5. To prepare the Connection of a Fluorescent tube with A.C Supply.
6. To prepare the connection of a Two Way Switch in a Staircase Lighting system.
7. To fix the electrical Accessories on the board and Blocks.
8. To make the connection of various types of electrical circuits.
9. Estimate the costing of an Electrical House wiring for a given Layout diagram.
10. Draw the wiring diagram of Electrical house wiring for a given layout diagram.
11. Draw the connection diagram of MCB, DB, RCCB in house wiring.

REFERENCE BOOKS

1. House Wiring by B.D. Arora, R.B. Publications
2. A Course in Electrical Installation Estimating & Costing by J. B. Gupta, S K Kataria & Sons
3. Electrical Estimating and Costing by M.N. Bajpai, Saroj Publication
4. Electrical Costing, Estimating and Contracting by S.K. Bhattacharya, TTTI, Chandigarh
5. Electrical Engineering Drawing by Nagpal, G.R., Khanna Publications
6. Electrical wiring, estimating and costing, Uppal, S.L., Khanna Publisher

PROFESSINAL PRACTICES - IV

L	T	P		Curri. Ref. No.: EEE 512	
0	0	2			
Total Contact Hours		**: 30 Hrs**		**Theory**	
Theory		: NIL	**Total Marks: 50**	End Term Exam	: NIL
Practical		: 30 Hrs		Progressive Assessment	: NIL
Pre Requisite		**:**		**Practical**	
				End Term Exam	: NIL
Credit		**: 1**		Progressive Assessment	: 50

RATIONALE:

In addition to exposure both in theoretical and practical from an academic institution, it is desired that student should be familiar with the present day industry working environment and understand the emerging technologies used in these organization. Due to globalization and competition in the industrial and service sectors, acquiring overall knowledge will give student better opportunity for placement facility and best fit in their new working environment. In the process of selection, normal practice adopted is to see general confidence, positive attitude and ability to communicate, in addition to basic technological concepts. The purpose of introducing professional practices is to provide opportunity to students to undergo activities which will enable them to develop confidence. Industrial visits, expert lectures, seminars on technical topics and group discussion are planned in a semester so that there will be increased participation of students in learning process. After completion of the course, students will be able to:

- Acquire information from different sources
- Prepare notes for given topic
- Present given topic in a seminar

- Interact with peers to share thoughts & Prepare a report on industrial visit, expert lecture

DETAIL OF COURSE CONTENT:

Unit	Topic/Sub Topic	Hours
I	**Industrial / Field Visit :** Structured Field visits be arranged and report of the same should be submitted by the individual student, to form part of the term work. Visits to any ONE from the list below (should not have completed in earlier semester): i) Multistoried building for power distribution ii) Any industry with process control and automation iii) District Industries Centre (to know administrative set up, activities, various schemes etc) iv) Railway / metro railway signaling system v) Motor rewinding in a motor rewinding shop vi) Visit warehouse / Rail yard / port and observe Material Handling Management & documentation. vii) A thermal / Hydel power generating station viii) A Wind mill and / or Hybrid power station of wind and solar ix) An electrical substation x) A switchgear manufacturing / repair industry xi) Protection system in a large industry. xii) Visit to maintenance dept of a large industry. xiii) A large industry to study protection system xiv) Industry of power electronics devices xv) Transmission tower project area xvi) Any contemporary industry under MSME sector to understand detail of operation and starting of a new venture. xvii) A large industry to study protection system xviii) Industry of power electronics devices xix) Transmission tower project area xx) Any contemporary industry under MSME sector to understand detail of operation and starting of a new venture. xix) Any other technical field area as may be found suitable alternative to above list.	8
II	**Guest Lecture by Professional / Industrial Expert:** The guest lecture (s) any three of two hours duration each from the field/industry experts, professionals or from experienced faculty members (from own department or other departments) will be encouraged) are to be arranged from the following or alike topics. A brief report to be submitted on the guest lecture by each student as a part of term work. **Group A (at least one)** i) Career opportunities for diploma engineers ii) Industrial Dispute and Labour Laws iii) Challenges in industrial working environment for diploma	8

	engineers iv) Scope for diploma electrical engineers iv) Working in shop floor. v) Opportunities in the service sector vi) Any other topic of relevance as may be deemed fit for fresh engineers as he starts his career in industry. **Group B (at least one)** i) Eco friendly air conditioning / refrigeration. ii) Modern trends in AC machine iii) Testing of switchgear iv) Biomedical instruments – working, calibration etc. v) Automobile pollution, norms of pollution control. vi) nanotechnology vii) Modern techniques in Power Generation viii) New trends in power electronics devices ix) TQM x) Recent modification in IE rules xi) Standardization/ISO certification xii) Role of micro, small and medium enterprise in Indian economy. xiii) Entrepreneurship development and opportunities xiv) Interview techniques xv) Any topic that could not be covered in earlier semesters and having relevance to technical knowledge gathered in all semesters.	
III	**Information search :** Information search can be done through manufacturers, catalogue, internet, magazines, books etc and a report need to be submitted. Can be done in a group of 2/3 students Topic suggested (any two)Teachers may assign work on any other cross disciplinary subjects for enrichment of knowledge outside course work of Electrical discipline) 1. Blue tooth technology 2. Artificial technology 3. Data warehousing 4. Cryptography 5. Digital signal processing 6. Bio-informatics 7. Magnetic levitation system 8. Recent development in electrically operated vehicles for mass transport 9. Comparative study of metro railway in Kolkata and Delhi 10. Alternative fuel and energy options 11. Comparison of transformer companies 12. Latest trends in classification of insulating materials 13. Design consideration for dry type transformers 14. State and national statistics of power generation 15. Market survey of contactors, relays and their comparative	**6**

	analysis. 16. Market survey of any other electrical product which must include among other things various manufacturers, cost, specification, application areas etc.	
IV	**Group Discussion** The students should discuss in a group of six to eight students. Each group to perform any TWO group discussions. Topics and time duration of the group discussion to be decided by concerned teacher. Concerned teacher may modulate the discussion so as to make the discussion a fruitful one. At the end of each discussion each group will write a brief report on the topic as discussed in the group discussion. Some of the suggested topics are – i) Scope of outsourcing of electrical Engineering services. ii) Pollution Control iii) Rain water harvesting iv) Trends in energy conservation v) Safety in day to day life vi) Use of plastic carry bag (social & domestic Hazard) vii) Pollution control vii) Any other common topic related to electrical field as directed by concerned teacher.	**4**
V	**Seminar / Poster Presentation:** Students should select a topic for seminar based on recent development in Electrical Engineering fields, emerging technology etc. Concerned Teachers will guide students in selecting topic.	**4**

EXAMINATION SCHEME (SESSIONAL)

1. Continuous internal assessment of 50 marks is to be carried out by the teachers throughout the sixth semester. Distribution of marks: Information search = 10, seminar = 10, Group discussion = 5, field visit = 10, guest lecture attendance and report = 15

COMMUNICATION ENGINEERING

L	T	P		
3	1	4		**Curri. Ref. No.: EEE 506**
Total Contact Hours		**: 120 Hrs**		**Theory**
Theory		: 45 Hrs	**Total Marks: 150**	End Term Exam : 75
Tutorial		: 15 Hrs		Progressive Assessment : 25
Practical		: 60 Hrs		**Practical**
Pre Requisite		**:**		End Term Exam : 25
Credit		**: 6**		Progressive Assessment : 25

RATIONALE:

This course concentrates on the field of analog communication and pulse code modulation. It also includes the advantages and disadvantages of digital and analog communications. After passing through the course the students will be acquainted with the basic communication systems. Upon successful completion of this course the students will be able to

- Explain the basic requirements of an analog communication system
- Understand analog modulation including PAM, PWM and PPM
- Discuss the functioning of transmitter and receiver
- Explain PCM, delta modulation and multiplexing

DETAIL COURSE CONTENT:

Unit	Topic/Subtopic	Hours	Marks
I	**1. Introduction to Communication Engineering** 1.1 Importance of communication 1.2 Elements of a communication system 1.3 Types of electronic communication 1.4 Electromagnetic spectrum 1.5 Bandwidth 1.6 Noise	2	4
II	**2. Analog Modulation** 2.1 Concept and necessity of modulation 2.2 Definition of amplitude, frequency and phase modulation 2.3 Derivation of sidebands in AM systems, evaluation of power, sideband depth, percentage of modulation 2.4 Expression of sidebands in FM and PM systems and its Interpretation, modulation index and bandwidth requirement 2.5 Comparison of AM, FM and PM 2.6 Basic ideas of Pulse Amplitude Modulation (PAM), Pulse Width modulation (PWM) and Pulse Position Modulation (PPM), principle of generation and reception of PAM, PWM & PPM with block diagram and their applications	7	12
III	**3.Transmitting Systems** 3.1 Block diagram and function of different stages of AM and FM broadcast transmitter 3.2 Working principles of SSB systems with block diagram: Filter Method, Phase Shift Method	5	10
IV	**4. Demodulation** 4.1 Principle of detection with diode detector 4.2 AGC circuit delayed AGC 4.3 Foster-Seeley discriminator 4.4 Ratio Detector, Limiter, Standard AFC circuits	6	10
V	**5. Receiving System** 5.1 Block diagram and principle of operation of super heterodyne receiver, IF amplifier and choice of IF, Mixer and converter, Alignment and tracking, Tone and volume control, Band spreading, Receiver	7	12

	characteristics, Testing 5.2 Block diagram and operating Principle of FM receiver, Pre-emphasis and de-emphasis, AFC and alignment of FM receiver		
VI	**6. Pulse Code Modulation** 6.1 Idea of digital communication, Advantages of digital communication over analog communication 6.2 Basic steps in PCM system: Filtering, Sampling, Quantizing, Encoding. 6.3 Block schematic description of transmitter and receiver of PCM system 6.4 Principles of linear and non-linear quantization	**7**	**12**
VII	**7. Delta Modulation** 7.1 Block schematic description of delta modulation technique 7.2 Limitations of delta modulation, Slope overload and granular noise 7.3 Concept of adaptive delta modulation technique	**6**	**8**
VIII	**8. Multiplexing** 8.1 Idea of multiplexing and its necessity 8.2 Types of multiplexing: TDM and FDM 8.3 PCM, TDM in modern applications 8.4 Merits and demerits of TDM and FDM.	**5**	**7**

LIST OF EXPERIMENTS

1. To study the amplitude modulation and demodulation technique
2. To study the frequency modulation and demodulation technique
3. To study the frequency spectrum of AM and FM with the help of spectrum analyzer
4. To study the analog signal sampling and reconstruction of the effect of
   (a) different sampling frequencies on reconstructed signals
   (b) varying duty cycle of sampling frequency on the amplitude of reconstructed signal.
5. To study some radio receiver measurements: (a) sensitivity, (b) selectivity and (c) fidelity.

- **REFERENCE BOOKS:**

1. Communication Electronics by Frenzel, Tata McGraw-Hill

2. Electronic Communication System by Kennedy, Tata McGraw-Hill
3. Principles of Communication System by Taub & Schilling, Tata McGraw-Hill
4. Electronic Communication by Roddy & Coolen, Prentice Hall of India
5. Communication System by Simon Haykin, WI Ltd.
6. Telemetry Principles by D. Patranabis, Tata McGraw-Hill
7. Electronic Communication System by Dungan, Vikash Publishing House
9. Modern Digital and Analog Communications Systems by B. P. Lathi, Oxford University Press

TERM-VI

SWITCHGEAR & PROTECTION

L	T	P		Curri. Ref. No.: EEE 504	
3	0	0			
Total Contact Hours		**: 45 Hrs**		**Theory**	
Theory		: 45 Hrs	**Total Marks: 100**	End Term Exam	: 75
				Progressive Assessment	: 25
Pre Requisite		**:**		**Practical**	
				End Term Exam	: NIL
Credit		**: 3**		Progressive Assessment	: NIL

RATIONALE:

In power stations and sub-stations, applications of switchgear and various protective schemes applied to various electrical equipment, 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. After successful completion of this course the students will be able to

- Explain the basic principles of protection
- Acquire thorough knowledge about over voltage and over current protection
- Acquire thorough knowledge of protective relays
- Describe operating principle of instrument transformers
- Acquire knowledge on neutral earthing, circuit interrupting devices and protection schemes

DETAILED COURSE CONTENTS:

Unit	Topic/Subtopic	Hours	Marks
I	**1. Introduction to power system protection:** 1.1 Line diagram of a power system and its elements 1.2 Faults and abnormalities, their causes, types and effects 1.3 Functions of basic elements of power system protection 1.4 Backup protection and its types	4	5
II	**2. Protective Relays** 2.1 Concept of protective relaying 2.2 Classification of relays and their selection 2.3 Construction and working principle of relays 2.4 Basic terms related to relays like pick-up value, reset value and operating current etc. 2.5 Settings of various types of relays 2.6 Maintenance and testing of relays 2.7 Use of static relays in modern power system 2.8 Working principle of microprocessor-based relays	10	16
III	**3. Over current Protection** 3.1 Causes of over current 3.2 Operating principles, construction & applications of over current relays	4	6
IV	**4. Over Voltage Protection** 4.1 Causes of over voltages 4.2 Methods of reducing over voltages 4.3 Operating principles, construction & applications of lightning arrestor 4.4 Insulation co-ordination and volt-time characteristic	5	8

V	**5. Instrument Transformers** 5.1 Instrument transformers used for protection 5.2 Polarity marking of CT & PT and their specifications 5.3 Connection diagram of CT & PT in a 1-phase and 3-phase protective systems	5	8
VI	**6. Neutral Earthing** 6.1 Importance of neutral earthing 6.2 Methods of neutral earthing and its advantages	4	6
VII	**7. Circuit Interrupting Devices** 7.1 Necessity and types of interruption devices like ACB, OCB, AB Switch, SF6 and vacuum circuit breakers 7.2 Line diagram of a protective system showing different circuit interrupting devices 7.3 Sequence of operation and interlocking 7.4 Requirement and types of isolators 7.5 Types of fuses and their characteristics 7.6 Testing and application of fuses 7.7 Working principle ACB, OCB, AB Switch, SF6 and vacuum circuit breakers 7.8 Arc formation process 7.9 AC circuit, zero current interruption	8	16
VIII	**8. Protection Schemes** 8.1 Protection schemes for alternator 8.2 Protection against prime mover failure and unbalance loading 8.3 Protection of transformers 8.4 Protection of transmission line and feeders 8.5 Protection of motors 8.6 Protection of bus-bars	5	10

LEARNING RESOURCES

- Textbooks mentioned in the references

REFERENCE BOOKS

1. Power System Protection and Switchgear by Badriram, Tata McGraw-Hill
2. Electrical Power System by Deshpande, Tata McGraw-Hill

3. Testing, Commissioning, Operation & Maintenance of Electrical Equipment by S. Rao, Tata McGraw-Hill
4. Electrical Power System by V.K Mehta, Khanna Publishers
5. Operation And Maintenance of Electrical Equipment, Vol I & II by B.V.S.Rao, Wheeler Publishing
6. Power System Protection Static Relays with μp applications, S. Rao, Tata McGraw-Hill
7. Electrical Power Systems, S.L.Uppal, Khanna Publishers

CONTROL SYSTEMS

L	T	P	Total Marks: 150	Curri. Ref. No.: EEE505	
3	1	2			
Total Contact Hours		**: 90 Hrs**		**Theory**	
Theory		: 45 Hrs		End Term Exam	: 75
Tutorial		: 15 Hrs		Progressive Assessment	: 25
Practical		: 30 Hrs		**Practical**	
Pre Requisite		**:**		End Term Exam	: 25
Credit		**: 5**		Progressive Assessment	: 25

RATIONALE

An automatic control systems saves manpower, reduces cost of production, increases the accuracy of the finished product and helps in mass production so that the knowledge of this subject is required to have deeper grasp of the control environment/ techniques as need to be studied in this subject. After successful completion of this course the students will be able to

- Explain the basic principles of control system
- Describe time response analysis of the system
- Discuss stability analysis of the system

DETAILED COURSE CONTENT:

Unit	Topic/Subtopic	Hours	Marks
I	**1. Introduction** 1.1 Basic elements of control system 1.2 Open loop control system 1.3 Closed loop control system & control system terminology 1.4 Automatic controlled closed loop systems 1.5 Example of automatic control systems 1.6 Basic elements of a servo mechanism 1.7 Use of equivalent systems for system analysis 1.8 Linear systems, non-linear systems 1.9 Control systems examples from chemical systems. Mechanical systems, electrical systems 1.10 Introduction to Laplace transform.	8	10
II	**2. Control system representation** 2.1 Transfer function 2.2 Block diagram & reduction of block diagram 2.3 Problems based on block diagram 2.4 Mason's formula	10	18
III	**3. Time response Analysis** 3.1 Standard test signals 3.2 Time response of first and second-order system 3.3 Time constant, time response of second order system 3.4 Time response specifications 3.5 Steady- state errors and error constants 3.6 Problems in first and second order systems	9	12
IV	**4. Transfer Function Analysis** 4.1 Analysis of AC and DC servomotors, synchros Stepper motor	8	15

	4.2 AC position control system		
V	**5. Stability Analysis:** 5.1 Routh Hurwitz Criterion 5.2 Root Locus plot 5.3 Bode Plot 5.4 Nyquist Plot	**10**	**20**

LIST OF EXPERIMENTS

1. Study of characteristic of servomotor
2. Characteristics and speed control of a stepper motor
3. To demonstrate the synchro characteristic and use a synchro pair error detector
4. Characteristics of a potentiometer
5. Study of speed control of motor with tachometer feedback.
6. Design of a DC speed control system
7. Simulation of a position control system
8. Study of ON-OFF controller

REFERENCE BOOKS:

1. Control Systems Engineering by Nagrath and Gopal, New Age International Publishers Ltd
2. Automatic Control Systems by KUO, Wiley
3. Modern Control Engineering by Ogata, Pearson Education India

TESTING AND MAINTENANCE OF MACHINES & EQUIPMENTS

L	T	P	**Total Marks: 50**	**Curri. Ref. No.: EEE507**	
2	0	4			
Total Contact Hours		**: 60 Hrs**		**Theory**	
Theory		: 30 Hrs		End Term Exam	: NIL
Practical		: 30 Hrs		Progressive Assessment	: NIL
Pre Requisite		**:**		**Practical**	
				End Term Exam	: 25

Credit	: 4		Progressive Assessment	: 25

RATIONALE:

It is needed that the shop floor experience on dismantling and assembly of Electrical machines and household equipment 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. After completion of the course, students will be able to

- Dismantle and assemble of electrical machines like motor, transformer, switching units and starters
- Explain different repairing techniques of electrical equipment
- Repair electric iron, electric oven, water heater / geyser and blower

DETAILED COURSE CONTENT:

Unit	Topic/Subtopic	Hours	Marks
I	**1. Introduction to Maintenance of Electrical Equipment** 1.1 Define-Routine, preventive and breakdown maintenance. 1.2 Advantages of preventive maintenance and importance of planning of preventive maintenance schedule. 1.3 Factors affecting the preventive maintenance schedule. 1.4 Internal/external causes for failure/abnormal operations of equipment 1.5 Troubleshooting charts	5	5
II	**2. Safety Regulations** 2.1 Understand the meaning and causes of electrical accidents. 2.2 State factors on which severity of shock depends 2.3 Understand the procedure for rescuing a person who has received an electric shock 2.4 Describe methods of providing artificial respiration 2.5 Understand Do's and Don'ts listed in I.S. for substation operation 2.6 Describe the procedure to be followed for shut down of substation and power line 2.7 State the precautions to be taken to avoid fire due to electrical reasons	8	7

	2.8 Describe the operation of fire extinguisher 2.9 IE ACT – statutory regulation for safety of persons and Equipment		
III	**3. Testing of Electrical Machines** 3.1 Routine and special tests 3.2 Compare direct testing, indirect testing and regenerative testing for efficiency and temperature rise 3.3 Mechanical tests before commissioning of machines 3.4 Electrical tests/inspections before commissioning of machines	**5**	**4**
IV	**4. Insulation Testing** 4.1 Classification of insulating materials as per IS Rule 4.2 Measure insulating resistance and interpret from it the conditions of insulation under different working environments 4.3 Properties of good insulation oil 4.4 List the agents which contaminate the insulating oil 4.5 Procedure for test of oil as insulator as per IS Rule - Dielectric strength test - Acidity test - Sludge test - Crackle test - Flash point test 4.6 Interpret the results of above test and draw conclusions	**5**	**4**
V	**5. Maintenance of Electrical Machines and Equipment** 5.1 Maintenance of DC motor 5.2 Maintenance of Induction motor 5.3 Maintenance of Alternator 5.4 Maintenance of Transformer 5.5 Maintenance of Electrical Service Station 5.6 Maintenance of Household Equipment (Electric Iron, Heater, Blower, AC machine, Washing Machine)	**7**	**5**

LIST OF EXPERIMENTS

1. To state the method of inspection and determination of defects in an assembled electrical machine
2. To dismantle electrical machines and determine the defects in a disassemble machine
3. To repair and reassemble the electrical machines
4. To repair the ship ring and commutator of electrical machines
5. To repair shaft of electrical machines
6. To repair winding of electrical machines
7. To state the method of inspection and determination of defects in an assembled transformer
8. To repair core and windings of transformer
9. To repair top changer, tanks, conservators and fillings of transformer
10 To assemble transformer
11 To test and measure parameters of transformer as per Bureau of Indian Standard Specification.
12 To state the periodic maintenance of switch, fuse unit changeover, bus bar and different type starters
13 To dismantle and repair of ceiling /exhaust fan, Electric Iron, OTG, Electric Oven, Water Heater / Geyser, Vacuum Cleaner, Split type / Window Air-Conditioning
14 To state the method of the fault detecting procedure of the ceiling/exhaust fan
15 To test the ceiling/exhaust fan as per Bureau of Indian Standard Specification.
16 To repair lamp fitting
17. To prepare the operation and maintenance schedule of a diesel generating set

REFERENCE BOOKS

1. Operation and Maintenance of Electrical Equipment, Vol I & II by B.V.S. Rao, Media Promoters & Pub Pvt Ltd
2. Testing Commissioning Operation & Maintenance of Electrical Equipment by S.Rao, Khanna Publisher
3. Electrical Equipment Handbook: Troubleshooting and Maintenance by Phillip Kiameh, McGraw-Hill
4. Electrical Power Equipment Maintenance and Testing by Paul Gill, CRC Press
5. Fundamentals of Maintenance of Electrical Equipments by K.B.Bhatia, Khanna Publishers

PROJECT WORK

L	T	P		Curri. Ref. No.: EEE 508	
0	0	10			
Total Contact Hours		**: 150 Hrs**	**Total Marks: 100**	**Theory**	
Theory		:		End Term Exam	: NIL
Practical		: 150 Hrs		Progressive Assessment	: NIL
Pre Requisite		**:**		**Practical**	
				End Term Exam	: 50
Credit		**: 5**		Progressive Assessment	: 50

RATIONALE:

Project work aims at developing skills in the students whereby they apply in totality the knowledge and skills gained through the course in the solution of a practical problem undertaken as a project work. The students have different aptitudes and strengths. Project work, therefore, should match the strengths of students. For this purpose, students should be asked to identify the type of project work, they would like to execute. It is also essential that the faculty of the respective departments may have a brainstorming session to identify suitable project assignments. The project assignment can be individual assignment or a group assignment. The students should identify themselves or be given project assignment at least two to three months in advance. The project work identified in collaboration with industry/field organization should be preferred. After completion of the course, students will be able to:

- Selecting a suitable topic
- Designing of the job
- Scheduling the job
- Indenting
- Procuring of material
- Maintaining good relation amongst peer group (Team Work)
- Developing leadership quality
- Developing cost awareness
- Effective utilization of time

Suggested List of Laboratory Experiments :-	
S.No	**Laboratory Experiments**
1	Collect proper requirements from the client (both in-house or Industry sponsored).
2	Should provide the project planning sheet. A: Duration of project (Starting and Ending Date). B: Intermediate dates showing the status of project at every stage.
3	Synopsis: Brief note showing what actually the project is supposed to do.
4	Block Diagram of the project.
5	Circuit Diagram of each and every block.
6	Bill of materials.
7	Bread board testing of each and every block.
8	Making of PCB a: Track Layout (top & bottom). b: Component Layout (legend). c: Pad Master (Solder masking)
9	Chassis Design Diagram.
10	Wiring Details. (Optional w.r.t project)
11	Software Flow Chart.
12	Software with proper documentation.
13	Features of Project a: Operating voltage/current b: Inputs and outputs and other added features of project.
14	Future Up-gradation.
15	Operating Manual.
16	Technical Manual

Reference Books:

1. Projects in Electrical, Electronics, instrumentation and Computer Engineering by S Chatterjee & S K Bhattacharya, S. Chand Publishing

Elective Courses

POWER PLANT ENGINEERING

<table>
<tr><td>L</td><td>T</td><td>P</td><td rowspan="8">Total Marks: 150</td><td colspan="2">Curri. Ref. No.: EEE 601</td></tr>
<tr><td>3</td><td>0</td><td>4</td><td colspan="2"></td></tr>
<tr><td colspan="2">Total Contact Hours</td><td>: 105 Hrs</td><td colspan="2">Theory</td></tr>
<tr><td colspan="2">Theory</td><td>: 45 Hrs</td><td>End Term Exam</td><td>: 75</td></tr>
<tr><td colspan="2">Practical</td><td>: 60 Hrs</td><td>Progressive Assessment</td><td>: 25</td></tr>
<tr><td colspan="2">Pre Requisite</td><td>:</td><td colspan="2">Practical</td></tr>
<tr><td colspan="2"></td><td></td><td>End Term Exam</td><td>: 25</td></tr>
<tr><td colspan="2">Credit</td><td>: 5</td><td>Progressive Assessment</td><td>: 25</td></tr>
</table>

RATIONALE:-

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. After study this subject student should be able to describe

- the principles of economics of power generation
- the construction and working principles of stream power plant and explain rankine cycle and carnot cycle.
- the fuels and combustion, coal analysis, fuel oil and petroleum gas, combustion mechanism and firing methods.

- the working principles of steam generators steam turbines.
- the operation of hydroelectric power plant, diesel engine and gas turbine power plants and nuclear power plants

DETAILED COURSE CONTENT:

Unit	Topic/Sub Topic	Hours	Marks
I	**1. Economics of Power Generation** 1.1 Load duration curves 1.2 Location of power plants 1.3 Power plant economics	2	3
II	**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 feed-water heating 2.8 Feed-water heaters 2.9 Carnotization of rankine cycle 2.10 Stream power plant 2.11 Deaerator 2.12 Layout of steam power plant 2.13 Efficiencies in a steam power plant	5	10
III	**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	5	8
IV	**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 burning coal 4.5 Fuel bed combustion 4.6 Pulverized coal firing system	5	7

	4.7 Combustion of fuel oil 4.8 Combustion of gas		
V	**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 Feed-water treatment 5.11 Condensers 5.12 Circulating water system 5.13 Cooling towers	**8**	**15**
VI	**6. Steam Turbines** 6.1 Flow through nozzles 6.2 Turbine blading 6.3 Electrical energy generation	**4**	**5**
VII	**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 hydro-electric power plants 7.6 Turbines of hydro-electric power plants 7.7 Performance of turbines 7.8 Selection of turbines	**6**	**10**
VIII	**8. Diesel Engine and Gas Turbine Power Plants** 8.1 Advantages and disadvantages of diesel engine power plant 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	**6**	**10**
IX	**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	**4**	**7**

	reactors 9.4 Types of reactors`		

LIST OF EXPERIMRNTS

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

L	T	P		
3	0	4		
Total Contact Hours		**: 105 Hrs**	**Total Marks: 150**	**Curri. Ref. No.: EEE 602**
Theory		: 45 Hrs		**Theory**
Practical		: 60 Hrs		End Term Exam : 75
Pre Requisite		**:**		Progressive Assessment : 25
Credit		**: 5**		**Practical**
				End Term Exam : 25
				Progressive Assessment : 25

MICROCONTROLLERS

RATIONALE :

This course is an introduction to the fundamentals of architecture and implementation of embedded micro controllers. The architecture covers the arithmetic logic unit, instructions, registers, memory, and input & output. The implementation covers parallel input & output, serial communication, timers, interrupt control and feedback control. Upon completion of this course the student will be able to:

- Describe the architecture of the 8051 microcontroller,

- Create an assembly language source file using the 8051 editor.
- Assemble 8051 programs and link object files.
- Interpret the assembler's error messages, and make the changes if necessary
- Interface the microcontroller with external devices through its I/O ports.
- Use the microcontroller timer and interrupt facilities.
- Use the Boolean bit manipulation of the 8051 micro controller.

DETAILED COURSE CONTENTS:

Unit	Topic / Sub Topic	Hours	Marks
I	**1. Introduction to Microcontroller:** 1.1 History of microcontroller 1.2 Embedded system 1.3 Microcontroller vs microprocessor 1.4 Applications of micro controller	5	5
II	**2. 8051 Architecture:** **2.1** Block diagram of 8051 micro controller 2.11 Oscillator and clock 2.12 Program counter and data pointer 2.13 A and B register 2.14 Flags and PSW 2.15 Internal memory 2.16 Internal RAM organization 2.16.1 General purpose RAM 2.16.2 it addressable 2.7.3 Working registers 2.17 Stack and stack pointer 2.18 Special function register 2.19 Internal ROM 2.11 Pin diagram of 8051	8	15
III	**3. Timer:** 3.3 Counter and timer 3.4 Timer modes of operation: TCON, TMOD	4	4
IV	**4. Serial Data Input/output and Interrupts:** 4.6 Serial data interrupts, SCON. PCON 4.7 Serial data transmission and reception 4.8 Interrupts, timer flag interrupts, serial port interrupts, external interrupts 4.9 Interrupts enable (IE) SFR, interrupts priority (IP) SFR 4.10	5	10

	eset, interrupts control		
V	**5. 8051 Instruction and Addressing Modes:** 5.1 Addressing mode: immediate, register, direct & indirect addressing Mode 5.3 Instruction for moving data 5.3.1 External data move 5.2.2 Data exchange 5.3 Instruction for logical operation 5.4.3 Byte and bit level logical operation 5.3.2 Rotate and swap 5.5 Instruction for arithmetic operation 5.5.1 Incrementing and decrementing 5.5.2 Addition and subtraction 5.4.3 Multiplication and division 5.5 Jumps and call instructions	**7**	**16**
VI	**6. Basic Programming Model and Concept** 6.1 Assembly language Programming concept 6.2 Flow chart	**3**	**4**
VII	**7. 8051 Example Problems** 7.5 Addition, subtraction, multiplication etc 7.6 Data move/transfer 7.7 Comparisons 7.8 Use of subroutine/Loop	**8**	**16**
VIII	**8. Stack and Subroutines:** 8.1 Stack usage, implementation of PUSH and POP 8.2 Subroutine usage, implementation of CALL and RET	**5**	**5**

LIST OF EXPERIMENTS:

1. Study the Microcontroller Training kit, identification of the following
   - (l) Central processing Unit with Crystal
   - (m) Memory (b1) RAM (b2) ROM areas
   - (n) Power back up terminals
   - (o) Keyboard
   - (p) Display
   - (q) USART chip
   - (r) I/O port
   - (s) Programmable interval timer
   - (t) Serial communication support
   - (u) Keyboard/ Display interface
   - (v) To locate the above sections on a layout diagram
2. Write Assembly language programs in 8051 trainer kit
3. Write Assembly language program of addition of two numbers

4. Write Assembly language program of subtraction of two numbers
5. Write Assembly language program of multiplication of two numbers
6. Write Assembly language program of division of two numbers
7. Write Assembly language programs by using conditional and unconditional jump instructions

L	T	P		Curri. Ref. No.: EEE603	
3	0	4			
Total Contact Hours		**: 105 Hrs**		**Theory**	
Theory		: 45 Hrs	**Total Marks: 150**	End Term Exam	: 75
Practical		: 60 Hrs		Progressive Assessment	: 25
Pre Requisite		**:**		**Practical**	
				End Term Exam	: 25
Credit		**: 5**		Progressive Assessment	: 25

8. Write Assembly language program by using the call and return subroutine instructions
9. Write Assembly language programs to find the square of a number using Look-up table
10. Write and execute a program by using delay subroutine
11. Write and execute a program for A to D converter
12. Write and execute a program for D to A converter
13. Study the 8051 micro controller based DC motor speed control system
14. Study the 8051 micro controller based Stepper motor speed control system

REFERENCE BOOKS:

1. The 8051 Microcontroller Architecture, Programming and Applications by Kenneth J. Ayala, McGraw Hill
2. The 8051 Microcontroller and Embedded Systems by Muhammad Ali Mazidi, Pearson Education India
3. Microcontrollers Architecture, Programming, Interfacing and System Design by Raj Kamal, Pearson Education
4. 8085 Microcontroller & Embedded Systems by Rajiv Kapadia, Jai Co Publishing Home

ELECTRICAL DRIVES

RATIONALE:

The course on Electric Drives is designed to introduce the concept of control of electric drives for various types of mechanical loads. In this course, mainly the dc motor, induction motor and synchronous motor steady-state modeling and steady

state torque and speed control of these motors are emphasized. The course exposes the applications of semiconductor controlled converters to control the DC and AC machines for better torque and speed response.

DETAIL OF COURSE CONTENT:

Unit	Topic / Sub Topic	Hours	Marks
I	**1. Introduction to Electric Drives** 1.1 Define electric drive 1.2 Advantages and disadvantages of electric drive 1.3 Factors governing selection of electric motors 1.4 Comparative discussion between the various electric drive duties – continuous, short-time & intermittent 1.5 Quadrantal diagram for speed-torque characteristics 1.6 Hoist mechanism 1.7 Types of braking	7	12
II	**2. Industrial Drives** 2.1.Requirements of various types of common loads such as - Hoist, Elevator, Conveyor, Rolling mills, Centrifugal pumps, Punches, Shears etc. 2.2 Selection of motors in respect of types, size and rating for above loads on the basis of mechanical characteristics, speed control, reversibility, working environment and cost.	6	10
III	**3. Heating and Power Rating of Drive Motors** **3.5** Load diagrams **3.6** Overload capacity **3.7** Heating and cooling of motors **3.8** Selection of motor power capacity.	7	8
IV	**4. Electric Traction** 4.1 Electric traction 4.2 Different systems of track electrification (Block diagram) DC, AC, Composite 4.2.1 Advantage & disadvantages of each 4.2.2 Analysis of single phase 25 KV AC system and DC system 4.3. Traction mechanics 4.3.1 Types of services. 4.3.2 Speed time curve. 4.3.3 Simplified speed time curve (no derivation) 4.3.4 Average speed and schedule speed. 4.3.5 Factors affecting the schedule speed. 4.3.6 Tractive effort 4.3.7 Specific energy consumption 4.3.8 Factors affecting specific energy consumption. 4.3.9 Simple numerical on simplified speed time curves and specific energy consumption 4.4. Mechanics of train movement 4.4.1 Adhesion & coefficient of adhesion 4.4.2 Concept of weight transfer	15	25

	4.4.3 Effect of unsprung mass and wheel diameter 4.5. Traction Motors: 4.5.1 Desirable characteristics of traction motors 4.5.2 Special features of traction motor 4.5.3 Suitability of DC series motor for traction 4.5.4 Suitability of three phase induction motor for traction.		
V	**5. DC & AC Drives** 5.1 Speed control of separately excited DC motor by single phase fully controlled converter 5.2 Speed control of separately excited DC motor with three phase fully controlled converter 5.3 Speed control of DC series motor with chopper control. 5.4 Speed control of DC servomotor 5.5 Speed control of Three phase Induction motor with variable frequency PWM VSI 5.6 Speed control of Three phase Induction motor with variable voltage variable frequency control 5.7 Speed control of AC servomotor 5.8 Static VAR compensation system - Principle of operation & Block diagram 5.9 Uninterrupted power supply-Principle of operation and block diagram of on load & off load type UPS.	**10**	**10**

LIST OF EXPERIMENTS:

1. Starting of DC series motor
2. Speed control of DC shunt and DC series motor
3. Starting of three phase induction motor
4. Speed control of three phase induction motor
5. Dynamic braking of DC motor
6. Plugging of induction motor
7. Braking of induction motor
8. Study of electric traction system
9. Speed control of DC servomotor
10. Speed control of AC servomotor
11. Power factor (pf) improvement using capacitor
12. Study of uninterruptable power supply.

REFERENCE BOOKS:

1. Fundamental of Electrical Drives by G.K.Dubey, Narosa Publishing House
2. A First Course on Electrical Drives by S.K.Pillai, Wiley-Eastern Limited
3. Electric Drives: Concepts and Applications by Vedam Subrahmanyam, Tata McGraw-Hill Education

4. Electrical Machines P.S. Bimbhra, Khanna Publishers
5. Basic Electrical Engineering, V.N. Mittle, Tata McGraw-Hill
6. Electrical Machines, Nagrath & Kothari, Tata McGraw-Hill

UTILISATION OF ELECTRICAL POWER

L	T	P		Curri. Ref. No.: EEE 604	
3	0	4			
Total Contact Hours		**: 105 Hrs**		**Theory**	
Theory		: 45 Hrs	**Total Marks: 150**	End Term Exam	: 75
Practical		: 60 Hrs		Progressive Assessment	: 25
Pre Requisite		**:**		**Practical**	
				End Term Exam	: 25
Credit		**: 5**		Progressive Assessment	: 25

RATIONALE:

All service sectors namely railway, industries, offices, multinational companies always deal with the utilization of electrical energy in the following fields e.g. electrical heating, welding, illumination. Students must be thoroughly acquainted with the principles of application of electrical energy in the above fields. In this course the Students should understand the facts, concepts, principles and procedures related to the utilisation of electric power so that they can acquire supervisory skills, which will help them to discharge their role as a supervisor when they start working in the industry.

DETAIL OF COURSE CONTENTS:

Unit	Topic / Sub Topic	Hours	Marks
I	**1. Electrical Heating** 1.1. Advantages of electric heating 1.2. Classification of electric heating methods 1.3 Resistance heating: construction, operation and application 1.3.1 Direct resistance heating: Salt bath furnace 1.3.2 Indirect resistance heating: Resistance ovens 1.3.3 Name of some common heating element materials 1.3.4 Causes of failure of heating elements 1.4 Arc heating: construction, operation and application 1.4.1 Direct arc furnace 1.4.2 Indirect arc furnace. 1.5 Induction heating: construction & operation and application) 1.5.1 Core type induction furnaces 1.5.2 Coreless induction furnace. 1.6 Dielectric heating: 1.6.1 Principle of dielectric heating. 1.6.2 Advantages of dielectric heating 1.6.3 Limitations of dielectric heating. 1.6.4 Applications of dielectric heating.	10	15
II	**2. Electric Welding** 2.1. Methods of electric welding 2.2 Resistance welding: 2.2.1 Principle of resistance welding 2.2.2 Advantages of resistance welding 2.2.3 Types of resistance welding 2.2.4 Spot welding machine 2.3 Electric Arc Welding 2.3.1 Formation and characteristics of electric arc 2.3.2 Effect of arc length 2.3.3 Arc blow 2.3.4 Electrodes for metal arc welding 2.3.5 V-I Characteristics required for of arc welding.	10	20

	2.4 Arc Welding Machines 2.4.1 DC welding machines - MG set, AC rectified welding unit 2.4.2 AC welding machines - Welding transformer		
III	**3. Refrigeration** 3.1 Laws of thermodynamics 3.2 Comparison between heat engine, heat pump and refrigeration 3.3 Definitions of refrigeration, ton of refrigeration, COP, enthalpy, entropy 3.4 Vapour compression system 3.5 Vapour absorption system 3.6 Air refrigeration system	**8**	**10**
IV	**4. Economic Aspects of Utilising Electrical Energy** 4.1 Economic aspects of utilising electrical energy 4.2 Costing of electrical energy: fixed charges, semi fixed charges and running charges 4.3 Formulation of electrical tariffs 4.4 Various types of tariffs: tariffs in force for domestic, commercial and industrial consumer 4.5 Energy conservation: importance and need of energy conservation 4.6 Measures for energy conservation in (i) electric drives (ii) electric traction (iii) electric heating (iv)refrigeration and air conditioning (v) illumination	**10**	**20**
V	**5. Illumination** 5.1 Luminaries 5.2 Design of illumination scheme 5.3 Requirements of residential, commercial and factory illumination scheme 5.4 Design of illumination scheme for residential, commercial and factory	**7**	**10**

LIST OF EXPERIMENTS:

1. Resistance heating
2. Induction heating
3. Electric Arc Welding
4. Refrigeration
5. Energy conservation
6. Design of illumination scheme for residential building
7. (i) Visit a medium size manufacturing industry/substation/generating station and observe
   the drive, arrangement, instrumentation & control system, procedures, instrumentation,

tools, machines & sequencing of operation

(ii) Write reports, draw the plant layout. State the principles of the operation and control of the manufacturing system

REFERENCE BOOKS

1. Utilization of Electric Power and Electric Traction by J. B.Gupta, S.K.Kataria & Sons Pub.
2. Utilisation of Electrical Power by R. K. Rajput, Laxmi Publications
3. Utilisation of Electric Power: Including Electric Drives and Electric Traction by N. V. Suryanarayana, New Age International
4. A Course in Electrical Power by M.L.Soni, Dhanpat Rai & Sons,
5. Generation, Distribution & Utilisation of Electrical Energy by C.L.Wadhwa, Wiley Eastern Ltd.

REPAIRING OF ELECTRICAL MACHINE & HOUSEHOLD EQUIPMENT

L	T	P	Total Marks: 150	Curri. Ref. No.: EEE 605

3	0	4			
Total Contact Hours		**: 105 Hrs**		**Theory**	
Theory		: 45 Hrs		End Term Exam	: 75
Practical		: 60 Hrs		Progressive Assessment	: 25
Pre Requisite		**:**		**Practical**	
				End Term Exam	: 25
Credit		**: 5**		Progressive Assessment	: 25

RATIONALE:

The shop floor experience is needed on dismantling and assembly of Electrical machines and household equipment within the curriculum of Diploma in Electrical / Electrical and Electronics Engineering. The learning procedure for repairing of electrical machine and household equipment 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. After completion of the course, students will be able to:

- Dismantle and assemble of electrical machines like motor, transformer, switch units and starter.

- Repairing of electric iron, OTG, electric oven, water heater, geyser, vacuum cleaner, split type or window air-conditioning.

DETAIL OF COURSE CONTENTS:

Unit	Topic/Sub Topic	Hours	Marks
I	**1. Repair of Electrical Machines** 1.1 List the troubles of electrical machines: DC motor, DC generator, induction motor 1.3 Repairing of electrical machines: DC motor, DC generator, induction Motor	**8**	**14**
II	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	**8**	**10**
III	3. **Electrical Panel Repairing** 3.1 To describe the periodic maintenance of switch, fuse unit changeover, bus bar and different type starters	**5**	**10**
IV	4. **Ceiling Fan/Exhaust Fan** 4.1 To describe the repairing of ceiling/exhaust fan	**5**	**10**
V	5. **Fluorescent Lamp/Sodium Vapour Lamp and House Hold Appliances** 5.1 To describe the repair work and testing procedure of fluorescent lamp, sodium vapour lamp, electric iron, OTG, electric oven, water heater / geyser, vacuum cleaner, split	**8**	**14**

	type / window air-conditioning		
VI	**6. Electrical Safety** 6.1 Understand the meaning and causes of electrical accidents 6.2 State factors on which severity of shock depends 6.3 Understand the procedure for rescuing a person who has received an electric shock 6.4 Describe methods of providing artificial respiration 6.5 Understand Do's and Don'ts listed in I.S. for substation operation. 6.6 Describe the procedure to be followed for shut down of substation and power line 6.7 State the precautions to be taken to avoid fire due to electrical reasons 6.8 Describe the operation of fire extinguisher 6.9 IE ACT- statutory regulation for safety of persons and equipment	**6**	**10**
VII	**7. Testing of Electrical Machines** 7.1 Routine and special tests. 7.2 Compare direct testing, indirect testing and regenerative testing for efficiency and temperature rise. 7.3 Mechanical tests before commissioning of machines. 7.4 Electrical tests/inspections before commissioning of machines.	**5**	**7**

LIST OF EXPERIMENTS

1. To state the method of inspection and determination of defects in an assembled electrical machine
2. To dismantle electrical machines and determine the defects in a disassemble machine
3. To repair and reassemble the electrical machines
4. To repair the ship ring and commutator of electrical machines
5. To repair shaft of electrical machines
6. To repair winding of electrical machines
7. To state the method of inspection and determination of defects in an assembled transformer
8. To repair core and windings of transformer
9. To repair top changer, tanks, conservators and fillings of transformer
10. To assemble transformer
11. To test and measure parameters of transformer as per Bureau of Indian Standard Specification.
12. To state the periodic maintenance of switch, fuse unit changeover, bus bar and different type starters
13. To dismantle and repair of ceiling/exhaust fan, electric iron, OTG, electric

oven, water heater, geyser, vacuum cleaner, split type/window air-conditioning

14 To state the method of the fault detecting procedure of the ceiling/exhaust fan

15 To test the ceiling/exhaust fan as per Bureau of Indian Standard Specification

16 To repair lamp fitting

17. To prepare the operation and maintenance schedule of a diesel generating set

REFERENCE BOOKS

1. Testing Commissioning Operation & Maintenance of Electrical Equipment by S.Rao,
   Khanna Publisher
2. Electrical Equipment Handbook: Troubleshooting and Maintenance by, Phillip Kiameh, McGraw-Hill
3. Electrical Power Equipment Maintenance and Testing by Paul Gill, CRC Press
4. Fundamentals of Maintenance of Electrical Equipments by K.B.Bhatia, Khanna Publishers

NON-CONVENTIONAL SOURCES OF ENERGY

L	T	P		Curri. Ref. No.: EEE 606	
3	0	4			
Total Contact Hours		**:**		**Theory**	
Theory		: 45	**Total Marks: 150**	End Term Exam	: 75
Practical		: 60		Progressive Assessment	: 25
Pre Requisite		**:**		**Practical**	
				End Term Exam	: 25
Credit		**: 5**		Progressive Assessment	: 25

RATIONALE:

Energy is the crucial input in the process of economic, social and industrial development. High energy consumption as traditionally been associated with high quality of life. 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 environmental 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.

After completion of the course, students will be able to

- Explain the construction and working principles of wind energy systems and Solar PV systems
- Describe the construction and working principles of Bio-gas plant
- Explain the construction and design principles of Mini and Micro-hydro power plant, Tidal and Ocean energy
- Discuss working principles of renewable energy system management.

DETAILED COURSE CONTENT:

Unit	Topic/Sub Topic	Hours	Marks
I	**1. Solar energy** 1.1 Solar radiation 1.1.1 To describe (a) Global, direct and diffused radiation. (b) Spectral distribution of direct solar radiation through four types of curves. (c) Radiation measuring Instruments (d) Data from a radiation measurement network. 1.2 Water and air heating application 1.2.1 To describe the construction and uses of water heating system through (a) Flat plate collector (b) Spiral or "sea shell" collector (c) Heat pipe collector (d) Cylindrical heater/storage system 1.2.2 To describe three types of air heaters used to dry crop in lower latitude or space heating in higher latitude. 1.2.3 To describe the integration of an air collector into a heating and cooling system 1.2.4 To know some storage units 1.3 Space heating application: To describe the utilization of air heater and thermal energy storage in space heating application 1.4 Thermal Power and other applications (a) Head Engine (b) Large scale power Generation (c) Furnaces (d)	12	18

	cookers (e) refrigeration and cooling (f) Heat pumps (g) solar ponds (h) distillation (i) industrial application of process heat and transport 1.5 Photovoltaic Technology a) Principle of solar cells b) Solar cells and modules c) Applications of photovoltaic systems		
II	2. **Bio-Energy and other form of Energy** 2.1 To define Bio-Energy 2.1.1 To describe the sources of Bio-Energy 2.1.2 To describe the renewal system of Bio-Energy 2.1.3 To describe the following processes (a) Pyrolysis of wood (b) Gasification of wood (c) Producer gas preparation (d) Briquetting (e) Hydrolysis of wood ethanol (f) Liquification of wood to oil (g) Energy plantation and power programme (h) Biological conversion 2.2 Animal Energy 2.2.1 To define the Animal Energy 2.2.2 To describe the method of utilization of Animal Energy 2.3 Energy from the Ocean 2.3.1 To describe the basic process of Ocean Thermal Energy Conversion (To state (a) the location of OTEC plants (b) Application of OTEC and (c) Economic Consideration) 2.3.2 To describe (a) the method of utilization of wave Energy (b) the method of obtaining power from salinity gradients (c) utilization of Tidal power 2.4 Hydrogen Energy 2.4.1 To describe the method of production of mass-scale hydrogen preparation 2.4.2 To describe the method of utilization of hydrogen as alternative Energy source. 2.4.3 To state the advantages and disadvantages of Hydrogen Energy	**10**	**15**
III	**3. Wind Energy** 3.1 To state the historical development of wind generated Electricity in the following countries (a) Denmark (b) USA (c) Russia (d) united kingdom	**8**	**12**

	3.2 To enumerate the wind energy potential 3.2.1 To state the annual velocity and power duration curves. 3.2.2 To describe the windmill 3.2.3 To describe the use of wind energy as (a) power generation (b) water pumping system 3.2.4 To describe the method of wind Energy conservation, distribution and utilization system.		
IV	**4. Solar Cell** 4.1 Standard silicon solar cell Technology (single crystal wafers to solar cells, solar cell to solar cell modules, module construction, cell operating temperature, module durability, module circuit design, Energy accounting) 4.2 Improved silicon cell Technology 4.2.1 To explain the properties of solar grade silicon 4.2.2 To describe the method of preparation of solar sheet and specify (a) Solar sheet requirement (b) Ingot Technologies (c) Ribbon Silicon 4.2.3 To describe the cell fabrication and Interconnection techniques 4.3 Concentric systems 4.3.1 To describe the principle of ideal concentrators 4.3.2 To describe the principle of (a) stationary and periodically adjusted concentrator b) tracking concentrator (c) concentrator cell design 4.3.3 Ultra-high efficiency systems 4.3.4 To describe the basic principle for developing ultra -high efficiency system (multi gap cell concepts, thermo photo voltaic conversion) 4.4 Photo Voltaic systems components and Application 4.4.1 To describe the principle of Energy storage system 4.4.2 To describe the principle of power conditioning system 4.4.3 To state the photo voltaic applications 4.5 Design of stand Alone system 4.5.1 To describe (a) the solar module performance	**15**	**30**

	(b) Battery Performance (performance of lead Acid Battery, Nickel cadmium Batteries) (c) Power control system (d) the method of regulation and system sizing (e) to state the application in water pumping 4.6 Residential and Centralized Photo voltaic power systems 4.6.1 To describe the (a) detail layout of the residential systems (b) module mounting technique (c) thermal generation system (d) system configuration 4.6.2 To describe the design principle of central power plant of solar cell system (general considerations, operating modes) 4.6.3 To describe the working principle of satellite solar power stations		

LIST OF EXPERIMENTS

17. Solar Radiation Measurement
18. Exploring Solar Panels
19. Effect of Load on Solar Panel Output
20. Effect of Temperature on Solar Panel Output
21. Solar Panel Output: Effect of Shade
22. Solar Panel Output: Effect of Angle
23. Solar Distillation
24. Pumping Water with Solar Energy
25. Solar Cooker
26. Preparation of delicious food by using solar cooker.
27. Solar Water Heater
28. Solar Lanterns and Street light
29. Study of Bio gas plant
30. Wind Turbine Output: The Effect of Load
31. Effect of Load on Wind Turbine Output
32. Exploring Wind Turbine Blades

REFERENCE BOOKS

1. Non-Conventional Energy Sources by B.H Khan, Tata McGraw Hill
2. Energy Technology (non-conventional, renewable and conventional) by S Rao and BB Parulekar, Khanna Publishers
3. Solar Energy – Principles of thermal collection and Storage by SP Sukhatme, Tata McGraw

Hill Publication
4. Solar Energy Utilization by GD Rai, Khanna Publishers
5. Reviews of Renewable Energy Sources by MS. Sodha, S.S. Mathur, MAS Malik, TC Kandpal, Wiley Eastern Limited

PROFESSINAL PRACTICES - V

L	T	P		
0	0	4		**Curri. Ref. No.: EEE 513**
Total Contact Hours		**:**		**Theory**
Theory		:	**Total Marks: 50**	End Term Exam :
Practical		: 60		Progressive Assessment :
Pre Requisite		**:**		**Practical**
				End Term Exam :
Credit		**: 2**		Progressive Assessment : 50

RATIONAL:

The system of education is changing day by day and students learns more through practices in the 21st century. Teaching & learning became only a job & passing point rather than spreading like air in multi-dimensional field. So in order to make the Trainee imbibe with quality & adaptability in the competitive world Professional Practices is introduced in the Curriculum of Diploma in Engineering.

. After completion of the course, students will be able to:

- Acquire information from different sources
- Prepare notes for given topic
- Present given topic in a seminar
- Interact with peers to share thoughts
- Prepare a report on industrial visit, expert lecture

DETAIL OF COURSE CONTENT:

Unit	Topic/Sub Topic	Hours
I	**Industrial / Field Visit :** Structured Field visits be arranged and report of the same should be submitted by the individual student, to form part of the term work. Visits to any ONE from the list below (should not have completed in earlier semester): i) Multistoried building for power distribution ii) Any industry with process control and automation iii) District Industries Centre (to know administrative set up, activities, various schemes etc.) iv) Railway / metro railway signaling system v) Motor rewinding in a motor rewinding shop vi) Visit warehouse / Rail yard / Port and observe Material Handling Management & Documentation. vii) A thermal/Hydel power generating station viii) A Wind mill and/or Hybrid power station of wind and solar ix) An electrical substation x) A switchgear manufacturing / repair industry xi) Protection system in a large industry. xii) Visit to maintenance dept. of a large industry. xiii) A large industry to study protection system xiv) Industry of power electronics devices xv) Transmission tower project area xvi) Any contemporary industry under MSME sector to understand detail of operation and starting of a new venture. xvii) A large industry to study protection system xviii) Industry of power electronics devices xix) Transmission tower project area xx) Any contemporary industry under MSME sector to understand detail of operation and starting of a new venture. xxi) Any other technical field area as may be found suitable alternative to above list	8
II	**Guest Lecture by Professional / Industrial Expert:** The guest lecture(s) any three of two hours duration each from the field/industry experts, professionals or from experienced faculty members (from own department or other departments will be encouraged) are to be arranged from the following or alike topics. A brief report to be submitted on the guest lecture by each student as a part of term work. **Group A (at least one)** i) Career opportunities for diploma engineers ii) Industrial Dispute and Labour Laws iii) Challenges in industrial working environment for diploma engineers	8

	iv) Scope for diploma electrical engineers v) Working in shop floor. vi) Opportunities in the service sector vii) Any other topic of relevance as may be deemed fit for fresh engineers as he starts his career in industry. **Group B (at least one)** i) Eco friendly air conditioning / refrigeration. ii) Modern trends in AC machine iii) Testing of switchgear iv) Biomedical instruments – working, calibration etc. v) Automobile pollution, norms of pollution control. vi) nanotechnology vii) Modern techniques in Power Generation viii) New trends in power electronics devices ix) TQM x) Recent modification in IE rules xi) Standardization / ISO certification xii) Role of micro, small and medium enterprise. In Indian economy. xiii) Entrepreneurship development and opportunities xiv) Interview techniques xv) Any topic that could not be covered in earlier semesters and having relevance to technical knowledge gathered in all semesters.	
III	**Information Search:** Information search can be done through manufacturers, catalogue, internet, magazines, books etc. and a report need to be submitted. Can be done in a group of 2/3 students. Topic suggested (any two)Teachers may assign work on any other cross disciplinary subjects for enrichment of knowledge outside course work of Electrical discipline) 1. Blue tooth technology 2. Artificial technology 3. Data warehousing 4. Cryptography 5. Digital signal processing 6. Bio-informatics 7. Magnetic levitation system 8. Recent development in electrically operated vehicles for mass transport 9. Comparative study of metro railway in Kolkata and Delhi 10. Alternative fuel and energy options 11. Comparison of transformer companies 12. Latest trends in classification of insulating materials 13. Design consideration for dry type transformers 14. State and national statistics of power generation 15. Market survey of contactors, relays and their comparative	6

	analysis. 16. Market survey of any other electrical product which must include among other things various manufacturers, cost, specification, application areas etc.	
IV	**Group Discussion** The students should discuss in a group of six to eight students. Each group to perform any TWO group discussions. Topics and time duration of the group discussion to be decided by concerned teacher. Concerned teacher may modulate the discussion so as to make the discussion a fruitful one. At the end of each discussion each group will write a brief report on the topic as discussed in the group discussion. Some of the suggested topics are – i) Scope of outsourcing of electrical Engineering services. ii) Pollution Control iii) Rain water harvesting iv) Trends in energy conservation v) Safety in day to day life vi) Use of plastic carry bag (social & domestic hazard) vii) Pollution control Any other common topic related to electrical field as directed by concerned teacher.	**4**
V	**Seminar / Poster presentation:** Students should select a topic for seminar based on recent development in Electrical Engineering fields, emerging technology etc. Concerned Teachers will guide students in selecting topic.	**4**

EXAMINATION SCHEME (SESSIONAL)

1. Continuous internal assessment of 50 marks is to be carried out by the teachers throughout the sixth semester. Distribution of marks: Information search=10, seminar=10, Group discussion=5, field visit=10, guest lecture attendance and report = 15

Soft core - II

ENGINEERING ECONOMICS AND ACCOUNTANCY

L	T	P		Curri. Ref. No.: G303	
3	0	0			
Total Contact Hours		**: 45 Hrs**		**Theory**	
Theory		: 45 Hrs	**Total Marks: 100**	End Term Exam	: 75
				Progressive Assessment	: 25
Pre Requisite		**:**		**Practical**	
				End Term Exam	: NIL
Credit		**: 3**		Progressive Assessment	: NIL

RATIONALE :

The knowledge of Engineering Economics and Accountancy is needed by personnel dealing with the cost of products of any kind related to quality and standards of production including its financial control. Engineers / Technicians, in general, need to know the cost of the final products for marketing purposes. The knowledge of Economics as well as Accountancy is required by all people dealing in any business or enterprise.

This particular subjects deals in basic concepts of economics, production of commodities, different types of industries, market forms, objective of economic planning, concept of value of money, causes of unemployment, industrial policy, business transaction and accountancy, maintenance of cash and balances, receipt and expenditures and final accounts.

DETAIL COURSE CONTENT

THEORY:

UNIT	TOPIC / SUB-TOPIC	Lecture Hrs.
1.0	**INTRODUCTION**	**1**
	1.1 Introduction to Economics and its Utility of study	
	1.2 Importance of the study of Economics	
2.0	**BASIC CONCEPTS OF ECONOMICS**	**3**
	2.1 Definition of Utility, Consumption, Want, Value, Price, Goods, National Income.	
	2.2 Classification of goods, characteristics and classification of wealth.	
	2.3 Basic Laws of demand and supply.	
	2.4 Concept and Measurement of Elasticity of demand	
3.0	**PRODUCTION**	**3**
	3.1 Meaning and factors of production.	
	3.2 Land, Labour, Capital and Organisation	
	3.3 Formation of Capital, Break even chart-its uses.	
4.0	**SCALE OF INDUSTRIES**	**2**

4.1 Definition, advantages and disadvantages of small, medium and large scale production

4.2 Internal and External Economies

5.0 MARKET FORMS **3**

5.1 Definition and types of Markets in respect of present trends.

5.2 Features of Perfect, Imperfect and monopoly markets.

5.3 Price determination under perfect competition and monopoly

6.0 ECONOMIC PLANNING **3**

6.1 Features of Under-developed and Developing Countries.

6.2 Meaning, objectives and needs of planning.

6.3 Introduction to industrial development in India during the five year plans.

7.0 MONEY **3**

7.1 Meaning and functions of Money

7.2 Introduction to the concept of the value of money

7.3 Meaning of Inflation, Deflation, Stagnation.

8.0 UNEMPLOYMENT **2**

8.1 Meaning, types and causes of Unemployment

8.2 Unemployment problems in India

9.0 INDUSTRIAL POLICY **3**

9.1 Current Industrial Policy

9.2 Industrial licensing Policy, De-licensing

9.3 Monopolistic and Restricted Trade practices (MRTP) Foreign Exchange Regulation Act (FERA).

10.0 BUSINESS TRANSACTIONS AND ACCOUNTANCY **5**

10.1 Transactions and classifications, need and objectives of proper records including double entry system.

10.2 Classification of Accounts and its description

(in respect of real accounts, personal accounts and nominal accounts)

10.3 Debit and credit concept; golden rules of debit and credit.

10.4 Objectives and principles of double entry book-keeping.

11.0 BOOKS OF ACCOUNTS 2

11.1 Journal and Ledger, their sub-divisions; posting from journals to ledger.

11.2 Balancing of Accounts

12.0 CASH BOOK 2

12.1 Objective of Cash Book (in respect of all kinds of Cash transactions)

12.2 Single column, double column and triple column cash book

12.3 Imprest system of Petty Cash Book.

13.0 TRIAL BALANCE 2

13.1 Objective, Preparation, errors and rectification (in respect of balance of accounts for the total period).

14.0 FINAL ACCOUNTS 5

14.1 Steps of preparing accounts; Trading Account; Profit and Loss Account

14.2 Revenue and Depreciation adjustment

14.2 Introduction to balance sheet

15.0	**CAPITAL AND REVENUE EXPENDITURE DISTRIBUTION**	**3**
	15.1 Receipts and payments	
	15.2 Income and Expenditure differences	
16.0	**MEANING AND PURPOSE OF COSTING**	**2**
	16.1 Elements of Cost-Analysis and classification of expenditure for cost accounts.	
	16.2 Cost Control – Prime cost, Overhead cost, and Indirect materials and tools.	
17.0	**ELECTRONICS COMMERCE – MEANING – SCOPE**	**1**
	17.1 Accounting Software – Tally latest version	

SUGGESTED LEARNING RESOURCES:

Reference Books :

1. Agrawal, A.N., Indian Economy, New Delhi ; wish Prahashan, 2005

2. Wali, B.M., and A.B. Kalkundrikar – Managerial Economics, New Delhi : **R.Chand and Co., 1983**

ENTREPRENEURSHIP DEVELOPMENT

L	T	P		**Curri. Ref. No.: G304**	
3	0	0			
Total Contact Hours		**: 45 Hrs**		**Theory**	
Theory		: 45 Hrs	**Total Marks: 100**	End Term Exam	: 75
				Progressive Assessment	: 25
Pre Requisite		**:**		**Practical**	
				End Term Exam	: NIL
Credit		**: 3**		Progressive Assessment	: NIL

RATIONALE

The course intends to provide the fundamental aspects of entrepreneurship as a means for self employment and culminating in economic development of the country. It deals with basic issues like entrepreneurial characteristics and quality, governmental policy support and overall scenario along with opportunities and the facilities available for entrepreneurship development.

DETAIL COURSE CONTENT

THEORY:

UNIT	TOPIC / SUB-TOPIC	Lecture Hrs.
1.0	INTRODUCTION	10
	1.1 Definition and functions of Entrepreneur, entrepreneurship quality, entrepreneurial spirit, need for entrepreneurship.	
	1.2 Individual and social aspects of business – achievement motivation theory	
	1.3 Social responsibilities of Entrepreneurs	
2.0	FORMS OF BUSINESS ORGANISATION	4
	2.1 Types of company	
	2.2 Merits and demerits of different types	
	2.2 Registration of small scale industries	
	2.4 Conglomeration.	
3.0	SMALL SCALE AND ANCILLARY INDUSTRIES	8
	3.1 Definition – scope with special reference to self employment.	
	3.2 Procedure to start small scale and Ancillary industries	
	3.3 Pattern on which the Scheme/Project may be prepared	
	3.4 Sources of finance - Bank, govt., and other financial institutions.	
	3.5 Selection of site for factory	
	3.6 Factors of selection	
	3.7 N.O.C. from different authorities, e.g., Pollution Control Board, Factories Directorate etc.	
	3.8 Trade License.	
4.0	SYSTEM OF DISTRIBUTION	1
	4.1 Wholesale Trade	
	4.2 Retail trade	
5.0	SALES ORGANISATION	3

5.1 Market survey, marketing trends, knowledge of competitors, product selection & its basis .
5.2 Sales promotion
5.3 Advertisement
5.4 Public relations and selling skills

6.0 PRICING THE PRODUCT **1**

6.1 Basic guidelines

7.0 INTRODUCTION TO IMPORT AND EXPORT **6**

7.1 Procedures for export
7.2 Procedures for import
7.3 Technical collaboration – international trade
7.4 Business insurance
7.5 Rail and road transport
7.6 Forwarding formalities, FOR, FOB, CIF, etc.

8.0 BUSINESS ENQUIRIES **4**

8.1 Enquiries: From SISI, DIC, SFC Dept. of Industrial Development Banks.
8.2 Offers and Quotations
8.3 Orders

9.0 PROJECT REPORT **6**

9.1 Project Report on feasibility studies for small scale industries, proposal for finances from bank and other financial institutions for establishing new industries and its extension, obtaining License enlistment as suppliers, different vetting organizations for Techno Economic feasibility report.
Breakeven analysis, Breakeven point.

10.0 ENVIRONMENT LEGISLATION **2**

10.1 Air Pollution Act
10.2 Water Pollution Act
10.3 Smoke Nuisance Control Act
10.4 ISO: 14000, OSHA

SUGGESTED LEARNING RESOURCES:

Reference Books:

1. Entrepreneurship Development
Prepared by CTSC Manila Publishers by Tata Mc Graw Hill Publishing Co. Ltd.

2. Small Enterprise Management Published by ISTE, Mysore
3. Motivation Published by ISTE, Mysore
4. S.S.M. in Environmental Engineering Published by ISTE, Mysore
5. Entrepreneurship New Venture Creations, Holt, Prentice Hall, India.
6. Essence of TQM by John Bank
7. Rathore, B.S. and J.S. Saini(ed), A Handbook of Entrepreneurship – Panchkula : Aapga, 1997
8. Jose Pauletal, Entrepreneurship Development, Mumbai : Himalaya Publishing House, 1996
9. Khanka, S.S., Entrepreneurship Development, New Delhi : S. Chand and Co., 2001
10. Nagarazan, R.S. and A.A. Arivalagar, TQM New Delhi : New Age International Publishers, 2005
11. Bhatia, R.C., Marketing Communication and Advertising, New Delhi : Galgotia Publishing Co., 2003
12 Sinha, J.C., and V.N. Mugali : A Textbook of Commerce, New Delhi : R. Chand and Co., 1994

PRINCIPLES OF MANAGEMENT

L	T	P	**Total Marks: 100**	**Curri. Ref. No.: G305**	
3	0	0			
Total Contact Hours		**: 45Hrs**		**Theory**	
Theory		: 45Hrs		End Term Exam	: 75
				Progressive Assessment	: 25
Pre Requisite		**:**		**Practical**	
				End Term Exam	: NIL

Credit	: 3		Progressive Assessment	: NIL

RATIONALE :

Management is the integrated component of all areas of technological courses as recognized across the world. Technicians or supervisors coming out of the system hence need to study the basics components of the management relevant to them. Principals of management will enable them to apply basic knowledge of management in their field of work. Keeping with this in mind necessary content details of the course on Principles of Management has been developed. With the assumption that, it will develop some management foundation to the diploma students.

DETAIL COURSE CONTENT

THEORY:

UNIT TOPIC / SUB-TOPIC	Lecture Hrs.
FRAMEWORK OF MANAGEMENT	**8**
1.1 Nature of management	
1.2 Development of management thoughts	
1.3 Management and process skills	
2.0 PLANNING	**9**
2.1 Fundamentals of planning	
2.2 Planning premises and forecasting	
2.3 Decision making	
2.4 Mission and objective	
3.0 ORGANIZING	**10**
3.1 Fundamentals of organizing	
3.2 Design of organization structure	
3.3 Forms of organization structure	
3.4 Power and authority	
3.5 Authority relationship	

4.0 STAFFING **8**

4.1 Fundamentals of staffing

4.2 HR planning

4.3 Recruitment and selection

4.4 Training and development

4.5 Performance appraisal

5.0 DIRECTING **6**

5.1 Fundamentals of directing

5.2 Operational control techniques

5.3 Overall control technique

6.0 TOTAL QUALITY MANAGEMENT 4

6.1 Concepts and definitions

6.2 Sages of quality gurus and their contributions

6.3 Basic tools of TQM

SUGGESTED LEARNING RESOURCES:

Reference books:

1. Principles of management, by: T.Ramasamy (Himalya publishing house)
2. Management by: S. P. Robins
3. Management principles by: Anil Bhat and Arya Kumar
4. Principles and practice of management by LM Prasad
5. Principles of management by LM Prasad
6. Essentials of Management / Joseph L. Massie / Prentice-Hall of India

ORGANIZATIONAL BEHAVIOUR

L	T	P	**Total Marks: 100**	**Curri. Ref. No.: G306**	
3	0	0			
Total Contact Hours		**: 45Hrs**		**Theory**	
Theory		: 45Hrs		End Term Exam	: 75
				Progressive Assessment	: 25

Pre Requisite	:		**Practical**	
			End Term Exam	: NIL
Credit	: 3		Progressive Assessment	: NIL

RATIONALE :

Knowledge in behavioural principles in an organization is an important requirement because concepts such as work motivation, behavioural patterns of individuals as also those of group of individuals etc are intimately related to it. Organizational Behavioural principles, its scopes, applicability etc. are therefore important to know by the students irrespective of the branch of specialization. Based of the above facts following content details of the subject on Organizational Behaviour has been suggested.

DETAIL COURSE CONTENT

THEORY:

UNIT TOPIC / SUB-TOPIC	Lecture Hrs.
1.0 ORGANIZATION:	**8**
Concept and Definition	
Structures (line, staff, functional divisional, matrix)	
2.0 MOTIVATION :	**10**
Principles of Motivation	
Aspects of Motivation	
Job motivation	
Theories of motivation (Maslow, Herzberg, Theory of X&Y of Mc. Gregar)	
3.0 DEVELOPING GOOD WORK HABITS:	**10**
Principles of habit formation	
Attitude and values	
Personality-	
- Concepts	
- Theories	

- Personality and Behaviour

4.0 ORGANIZATIONAL CULTURE: **8**

Concepts and its importance

Determinants of organizational culture

Rules & regulations

5.0 TEAM BUILDING: **9**

Concepts
Team and Group

Formation of Team building

SUGGESTED LEARNING RESOURCES:

Reference Books:

1. Organisational Behaviour — An introductory Text – Huezynski A. & Bucheman C. (Prentice Hall of India)
2. Image of Organisation — Morgan G. (Sage)
3. Understanding Management — Linstoand S. (Sage)
4. Organizational Behaviour — Robbins (Prentice Hall of India)
5. Understanding and Managing – Organizational Behavior — George & Jones
6. Organisational Behaviour, L.M. PRASAD, New Delhi, Sultan Chand & Sons
7. Essentials of Management — Koontz (Tata McGraw Hill)

ENVIRONMENTAL EDUCATION

L	T	P		Curri. Ref. No.: G307	
3	0	0			
Total Contact Hours		**: 45Hrs**		**Theory**	
Theory		: 45Hrs	**Total Marks: 100**	End Term Exam	: 75
				Progressive Assessment	: 25
Pre Requisite		**:**		**Practical**	
				End Term Exam	: NIL
Credit		**: 3**		Progressive Assessment	: NIL

RATIONALE :

Management of Environmental Degradation as also its control using innovative technologies is of prime importance in the times we are living in. Since the days of the famed Rio Summit (1992) awareness about degradation of environment we live in an its management through participation of one and all has literally blossomed into a full fledged movement of universal importance. Technically qualified people, such as the Diploma Engineers, should not only be aware about new technologies to combat environmental degradation at their disposal but also various aspects of environment, ecology, bio-diversity, management, and legislation so that they can perform their jobs with a wider perspective and informed citizens. This course can be taken by all diploma students irrespective of their specializations.

DETAILED COURSE CONTENT

THEORY:

UNIT	TOPIC / SUB-TOPIC	Lecture Hrs.
1.0	**INTRODUCTION**	2
	1.1 Introduction 1.2 Environment and its components 1.3 Environment in India 1.4 Public Awareness	
2.0	**ECOLOGICAL ASPECTS OF ENVIRONMENT**	8
	2.1 Ecology • Eco-system • Factors affecting Eco-system 2.2 Bio-geochemical cycles • Hydrological cycle • Carbon cycle	

- Oxygen cycle
- Nitrogen cycle
- Phosphorous cycle
- Sulphur cycle

2.3 Bio-diversity
2.4 Bio-diversity Index

3.0 NATURAL RESOURCES 5

3.1 Definition of Natural Resources
3.2 Types of Natural Resources
3.3 Quality of life
3.4 Population & Environment
3.5 Water Resources
- Sources of Water

3.6 Water Demand
3.7 Forest as Natural Resource
- Forest and Environment
- Deforestation
- Afforestation
- Forest Conservation, its methods

3.8 Land
- Uses and abuses of waste and wet land

4.0 GLOBAL ENVIRONMENTAL ISSUES 9

4.1 Introduction
4.2 Major Global Environmental Problems
4.3 Acid Rain
- Effects of Acid Rain

4.4 Depletion of Ozone Layer
- Effects of Ozone Layer Depletion

4.5 Measures against Global Warming
4.6 Green House Effect

5.0 ENVIRONMENTAL POLLUTION 9

5.1 Introduction
5.2 Water Pollution
- Characteristics of domestic waste water
- Principles of water treatment
- Water treatment plant (for few industries only- unit operations & unit processes - names only)

5.3 Air Pollution
- Types of air pollutants
- Sources of Air Pollution
- Effects of Air Pollutants

5.4 Noise Pollution

- Places of noise pollution
- Effect of noise pollution

6.0 CLEAN TECHNOLOGY 6

6.1 Introduction to Clean Technologies
6.2 Types of Energy Sources
- Conventional Energy sources
- Non-conventional sources of Energy

6.3 Types of Pesticides
6.4 Integrated Pest Management

7.0 ENVIRONMENTAL LEGISLATION 3

7.1 Introduction to Environmental Legislation
7.2 Introduction to Environmental Laws

8.0 ENVIRONMENTAL IMPACT ASSESSMENT 3

8.1 Introduction to Environmental Impact Assessment
8.2 Environmental Management (elements of ISO 14001)
8.3 Environmental ethics

SUGGESTED IMPLEMENTATION STRATEGIES:

The teachers are expected to teach the students as per the prescribed subject content. This subject does not have any practical but will have only demonstration and field visit as stated. The students will have to prepare report of the site visit.

SUGGESTED LEARNING RESOURCES:

(a) Reference Books:

S. No.	Title	Author, Publisher, Edition & Year
1.	Environmental Engineering	Pandya & Carny, Tata McGraw Hill, New Delhi
2.	Introduction to Environmental Engineering and Science	Gilbert M. Masters Tata McGraw Hill, New Delhi
3.	Waste Water Engineering – Treatment, Disposal & Reuse	Metcalf & Eddy Tata McGraw Hill, New Delhi
4.	Environmental Engineering	Peavy, TMH International New York
5.	Study / training materials, references, reports etc. developed by Central Pollution Control Board, New Delhi as also State Pollution Control Boards	Central Pollution Control Board Postal Address: Parivesh Bhawan, CBD-cum-Office Complex East Arjun Nagar, DELHI - 110 032, INDIA Tel.: 91-11-22307233 Fax: 91-11-22304948

S. No.	Title	Author, Publisher, Edition & Year
		e-mail: ccb.cpcb@nic.in
6.	Environmental Science	Aluwalia & Malhotra, Ane Books Pvt. Ltd, New Delhi
7.	Text Book of Environment & Ecology	Sing, Sing & Malaviya, Acme Learning, New Delhi
8.	Environmental Science & Ethics	Sing, Malaviya &Sing , Acme Learning, New Delhi
9.	Environmental Chemistry	Samir K. Banerji, Prentice Hall of India, New Delhi

(b) Others:

1. Text book mentioned in the references
2. Lab Manuals
3. OHP Transparencies
4. Video film on Environment

SUGGESTED LIST OF DEMONSTRATIONS/FIELD VISIT

- pH value of water sample.
- Hardness of water
- Calcium hardness
- Total Hardness
- Residual Chlorine to a given sample of water
- Turbidity
- B.O.D.
- C.O.D.

Visits: Following visits shall be arranged by the teachers during the semester:

- Water Treatment Plant
- Sewage Treatment Plant
- Maintenance work of water supply mains and sewage system