WEST BENGAL STATE COUNCIL OF TECHNICAL EDUCATION

TEACHING AND EXAMINATION SCHEME FOR DIPLOMA COURSES

COURSE NAME: ***DIPLOMA IN ELECTRICAL ENGINEERING (INDUSTRIAL CONTROL)***
COURSE CODE : ***EEIC***
DURATION OF COURSE : 6 SEMESTER
SEMESTER: ***FIFTH SEMESTER***

Sl. No.	SUBJECT	PERIODS			EVALUATION SCHEME							CREDITS
	THEORY	L	T	P	SESSIONAL EXAM			ESE	PRACTICAL (SESSIONAL)		TOTAL MARKS	
					TA	CT	TOTAL		(INT.)	(EXT.)		
1	Industrial Control - I	03	--	03	10	20	**30**	70	25	50	**175**	5
2	Switchgear & Protection	03	--	02	10	20	**30**	70	25	25	**150**	4
3	Microprocessor & Microcontroller	03	--	02	10	20	**30**	70	25	25	**150**	4
4	Industrial Instrumentation	04	--	02	10	20	**30**	70	50	25	**175**	5
6	Industrial Project & Entrepreneurship Development	01	--	03					25	50	**75**	3
7	***Elective - I*** (Any One) 1) Power Plant Instrumentation & Control 2) Heating , Ventilation and Air conditioning 3) Energy Conservation & Audit 3) Illumination Engineering	03	--	02	10	20	**30**	70	25	25	**150**	3
8	Professional Practices - III	--	--	02			**00**		50		**50**	1
	TOTAL	***17***	***00***	***16***	***50***	***100***	***150***	***350***	***225***	***200***	***925***	***25***
							500		***425***			

STUDENT CONTACT HOURS PER WEEK: **33 HRS**
THEORY AND PRACTICAL PERIODS OF 60 MINUTES EACH
ABBREVIATIONS: L - Lecture, T - Tutorial, P – Practical, TA - Teachers Assessment, CT- Class Test, ESE - End Semester Exam, INT-Internal, EXT-External
TA: Attendance & surprise quizzes = 6 marks. Assignment & group discussion = 4 marks.
Total Marks : 925
Minimum passing for sessional marks is 40%, and for theory subject 40%.

Name of the Course: ***DIPLOMA IN ELECTRICAL ENGINEERING (INDUSTRIAL CONTROL)*** Subject : **INDUSTRIAL CONTROL-I**	
Course Code: **EEIC/S5/IC-I**	Semester: ***FIFTH***
Duration: ***ONE SEMESTER***	Maximum Marks: ***175***
Teaching Scheme	**Examination Scheme**
Theory : 3 hrs./week	Mid Semester Exam.: **20 Marks**
Tutorial: -- hrs./week	Attendance, Assignment & interaction: **10 Marks**
Practical: 3 hrs./week	End Semester Exam.: **70 Marks**
Credit: 5	Practical: **75 Marks**

Aim:

SI. No.	
1.	To study the principles, concepts & control aspects of electrical machines.
2.	To Identify various components of conventional & electronics controller components of electrical machines.

Objective:

Electric motors are extensively used in all types of industries because of high efficiency and easy control. Most of these motors for precise control use power electronics equipment. An Electrical Engineering diploma holder has to deal with manually operated old machines and automatic controlled modern machines and equipment. To deal successfully with wide spectrum of requirements in the industry, the pass out diploma holders should have adequate knowledge of control components, conventional electromagnetic controllers, conventional and solid state control of electric machines and electric drives. The study of this subject would certainly build up confidence among the students to face the challenges of industry.

Pre-Requisite:

SI. No.	
1.	Basic Electrical Engineering.
2.	Fundamentals of AC, DC Machines.

UNIT	CONTENTS	HOUR	MARKS
1	***Speed Control of D.C. Motors:*** (a) Conventional Control: Methods of Speed control, Armature circuit resistance control, Field control, Motor voltage control (Ward Leonard methods only). (b) Solid State Control: Half controlled and fully controlled rectifier fed schemes (Single Phase and Three Phase) for D.C. separately excited and Series motors, Soild state Ward Leonard schemes, Chopper control scheme (Time Ratio Control Only).	***7***	***10***
2	***Speed Control of Three Phase Induction Motors*** Solid State Control: Line A.C. voltage controller scheme, Voltage source fed scheme, Pulse width modulated fed inverter scheme, Comparison of VSI fed and CSI fed schemes, Cyclo-Converter fed scheme, Static rotor resistance scheme, Slip power recovery scheme. Block diagram explanation of closed loop control scheme, Applications of various schemes.	***9***	***14***
3	***Solid State Control of Synchronous Motor:*** Self commutated inverter fed scheme, Voltage source inverter fed scheme, Block diagram explanation of closed loop scheme.	***8***	***11***

UNIT	CONTENTS	HOUR	MARKS
4	***Solid State Control of FHP AC Motors/DC Motors:*** D. C. Motor Control: Half wave and Full wave single thyristor schemes. A. C. Motor Control: Triac Control Scheme, Single plase A. C. voltage controller scheme.	*10*	*13*
5	***Control Components:*** Relays (General purpose, Over load, Timing), Contactors (Solenoid Type, Clapper Type), Fuses and combination fuse switch units, Miniature circuit breaker, Push buttons, Limit switches, Phase failure relay, Selector switch, Master controller and Drum switches.	*7*	*11*
6	***Electromagnetic Controllers:*** Symbols for various components, Schematic control diagram, Wire control diagram. Forward/reverse operation of three phase squirrel cage induction motor, Slip ring induction motor starter, plugging of squirrel cage induction motor, dc shunt motor starter, Synchronous motor starter, Starter for capacitor type split phase motor, Reversal of universal motor.	*7*	*11*
	TOTAL	*48*	*70*

Contents (Practical)	
Sl. No.	***Skills to be developed***
1.	**Intellectual Skills:** 1. Identify different types of motor controller. 2. Test the different types of controller circuits. 3. Idea about various characteristics of different motors. 4. Knowledge about chopper circuits & thyrister drives.
2.	**Motor Skills:** 1. Setup various test circuits. 2. Find out the test parameters and to draw various characteristics.

List of Practicals

1. Speed control of D. C. shunt motor using Armature Voltage Control method (Ward Leonard method of speed control).
2. To plot speed - Torque characteristics of D. C. shunt motor at different firing angles when the motor is fed by a fully controlled/half controlled thyrister rectifier.
3. To plot speed- Torque characteristics of D.C. shunt motor fed by a chopper using time ratio control technique only.
4. To plot speed- torque characteristics of Three Phase cage induction motor at two different frequency with the help of cyclo-converter.
5. Speed control of FHP motor using Solid State A. C. Voltage Controller.
6. Study of Dynamic braking of D. C. shunt/separately excited motor and to see the effect of resistance on braking time of the machine.
7. Study of Plugging method of Induction motor braking and to study the effect of variation of supply voltage on braking time.
8. Study of Star/Delta, Autotransformer starting methods of Three Phase induction motor starting.

Practical:

Skills to be developed:

Intellectual Skills:

1. To select appropriate devices & instruments.
2. Testing & troubleshooting.

Motor Skills:

1. Ability to draw the circuit diagrams.
2. Ability to interpret the circuits and waveforms.

EXAMINATION SCHEME (THEORITICAL)

GROUP	UNIT	ONE OR TWO SENTENCE ANSWER QUESTIONS				SUBJECTIVE QUESTIONS			
		TO BE SET	TO BE ANSWERED	MARKS PER QUESTION	TOTAL MARKS	TO BE SET	TO BE ANSWERED	MARKS PER QUESTION	TOTAL MARKS
A	1,2,3	11	TWENTY	ONE	1X20 = 20	FOUR	FIVE, TAKING AT LEAST TWO FROM EACH GROUP	TEN	10X5 = 50
B	4,5,6	12				FIVE			

EXAMINATION SCHEME (SESSIONAL)

1. **Continuous Internal Assessment of 25 marks** is to be carried out by the teachers throughout the Fifth Semester. **Distribution of marks: Performance of Job – 15, Notebook – 10.**
2. **External Assessment of 50 marks** shall be held at the end of the Fifth Semester on the entire syllabus. One Experiment per student from any one of the above is to be performed. Experiment is to be set by lottery system. **Distribution of marks: On spot job – 30, Viva-voce – 20.**

Name of the Course: ***DIPLOMA IN ELECTRICAL ENGINEERING (INDUSTRIAL CONTROL)*** Subject : ***Switchgear and Protection***	
Course Code: **EEIC/S5/SWGRP**	Semester: ***FIFTH***
Duration: ***ONE SEMESTER***	Maximum Marks: ***150***
Teaching Scheme	**Examination Scheme**
Theory : 3 hrs./week	Mid Semester Exam.: **20 Marks**
Tutorial: -- hrs./week	Attendance, Assignment & interaction: **10 Marks**
Practical: 2 hrs./week	End Semester Exam.: **70 Marks**
Credit: 4	Practical: **50 Marks**

Aim:

SI. No.	
1.	To study the principles, concepts & procedural aspects of switchgear & protection.
2.	To Identify various components of switchgear & protection systems.
3.	To Identify faults & know how to repair the switchgear.|

Objective:

SI. No.	
1.	Learn the principles, concepts & procedural aspects of switchgear & protection.
2.	• Identify the various components of switchgear & protection systems.
3.	• know the specifications & select switchgear & protection system

Pre-Requisite:

SI. No.	
1.	Power system
2.	Fundamentals of AC, DC Machines

Contents (Theory)

Unit	Contents (Theory)	Hrs./Unit	Marks
1	***Fundamental*** 1.1 Necessity & functions of protective system. 1.2 Normal & abnormal conditions. 1.3 Types of faults & their causes. 1.4 Use of current limiting reactors & their arrangements. 1.5 Short-circuit KVA calculations for symmetrical faults - problems.	06	10
2	***Circuit interrupting devices*** 2.1. Basic fuse terminology: fuse element, rated current, fusing current, fusing factor, prospective current, cut-off current, arcing time, rupturing capacity, total operating time. Fuse Characteristics 2.1.1. HRC fuses - construction, types, working, characteristics, selection and applications 2.2. Isolators- vertical break, horizontal break & pentograph type 2.3. Arc formation process, methods of arc extinction, related terms. 2.4. Circuit breakers- Concept, Classification, Working principle, Construction, Specification & Applications of 2.1.1. E.H.V/H.V – Minimum oil circuit breakers (M.O.C.B.), Air Blast Circuit Breaker (A.B.C.B), Sulpher Hexa Fluoride circuit breaker (SF6). Vacuum circuit breaker. 2.1.2. L.V.- Air circuit breakers (ACB),miniature circuit breakers (MCB), Moulded case circuit breakers (MCCB), Earth leakage circuit breaker (ELCB or RCCB), Comparison of fuse & MCCB. 2.1. Selection of MCCB for motor. 2.2. Selection and rating of circuit breakers – breaking capacity, making capacity, rated operating duty, rated voltage. 2.3. Elementary idea of Auto-reclosing.	10	16
3	***Protective Relaying*** 3.1. Zones of protection, primary & back-up protection, Essential qualities of protection, classification of protective schemes, basic relay terminology. 3.2. CT & PT used in protection: Requirements, Brief idea about CVT and CCVT. 3.3. Operating principles and construction (in brief) of: Electromagnetic relays, thermal	15	16

Unit	Contents (Theory)	Hrs./Unit	Marks
	relays, static relays (with merits and demerits), and Microprocessor based relays, Auxiliary switch Flags – conception only. 3.4. Over current relay--- Time-current characteristics of definite time, instantaneous, inverse time and IDMT Relays. Use of very inverse-type O/C relay and extremely inverse type O/C relay. Time-setting, current-setting, PSM – problems. 3.5. Directional Relay - Introduction, Characteristics: Constant product characteristics, Polar characteristics, Concept of dead zone. 3.6. Distance Protection Scheme: Area of applications, Impedance relays, Reactance relay, MHO relay : operating characteristics, effect of arc resistance on their characteristics. 3.7. Differential Relay: Introduction, Current differential protection for an internal fault – fed from single & both end. Voltage balance differential protection – Schematic diagram & operation (in brief). Mention the position of operating coil and the restraining coil for both the cases.		
4	***Equipment Protection:*** 4.1. **Generator protection** – Percentage differential stator protection, brief idea of: - rotor protection due to loss of excitation, protection against rotor overheating because of unbalance in load, overspeed protection, protection against motoring and field suppression. 4.2. **Transformer protection** – Percentage differential protection – problems, Buchholz Relay, rate of rise of pressure relay, over-fluxing protection, O/C protection. 4.3. **Protection of Motor**: Abnormalities & faults. Short circuit protection, Overload protection, Single phase preventor. 4.4. Protection of Busbar & transmission line	10	16
5	***Over voltage Protection*** 5.1. Causes of over voltages. 5.2. Lighting phenomena & over voltage due to lightning. 5.3. Protection of transmission line & substation from direct stroke. 5.4. Types of lightning arresters & surge absorbers & their Construction & principle of operation. 5.5. Protection against traveling waves. 5.6. Insulation co-ordination	5	8
6	Neutral Earthing 6.1. Introduction & importance. 6.2. Types of earthing 6.3. Substation earthing	2	4
	TOTAL	48	70

Contents (Practical)	
Sl. No.	***Skills to be developed***
1.	**Intellectual Skills:** 1. Identify different types of circuit breakers 2. Test the different types of relays. 3. Idea about simulation.
2.	**Motor Skills:** 1. Simulate circuit configuration. 2. Set the relays for various tests.
3.	***List of Practical:*** 3.1. Identify the components of different types of circuit breakers with their specifications (through visits, video or model).: I) Low tension air circuit breaker. (including protective devices) II) Minimum oil circuit breaker (M0CB) III) Miniature circuit breaker (MCB) IV) Air Blast circuit breaker (MCCB) V) Earth Leakage circuit breaker (ELCB) or Residual leakage circuit breaker (RLCB) VI) Sulpher - Hexa fluoride circuit breaker (SF6) VII) Vacuum circuit breaker. 3.2. Plot the inverse characteristics of Induction type/ Micrprocessor Based – (i) O/C relay, (ii) E/F relay using Relay Testing Kit. 3.3. To test percentage Differential Protection of Transformer Using Transformer Differential Relay (Electromagnetic/Microprocessor based). 3.4. For a given 3-ph induction motor with D.O.L. starter:-- Check the operation of single phasing

Contents (Practical)	
	preventer by creating single phasing fault. 3.5. To test Directional Over Current Relay (DOCR) by Relay Testing Kit. 3.6. To simulate Alternator Protection. 3.7. To simulate the operation of Distance Relay. 3.8. To prepare a report on specifications of lightning arresters of different manufacturers through Brochures / Literature 3.9. To prepare a report on specifications of earthing at different substations / different locations & new trends in earthing schemes

Text Books:

Name of Authors	***Title of the book***	***Name of the Publisher***
B. Bhalja, R.P.Maheshwari & N.G. Chothani	Protection and Switchgear	Oxford University Press
S.Rao.	Switch gear & protection	Khanna Publications, New
Badriram & Vishvvakarma P.N.	Power System Protection & Switchgear	TMH, New Delhi
Mason C.R.	The art & science of protective relaying	
V.K. Mehta & R. Mehta	Principles of Power system	S.Chand & Co. Ltd.

Reference Books:

Name of Authors	***Title of the Book***	***Edition***	***Name of the Publisher***
BHEL	Handbook of Switchgears		Tata McGraw Hill

EXAMINATION SCHEME (THEORITICAL)

GROUP	**UNIT**	**ONE OR TWO SENTENCE ANSWER QUESTIONS**				**SUBJECTIVE QUESTIONS**			
		TO BE SET	**TO BE ANSWERED**	**MARKS PER QUESTION**	**TOTAL MARKS**	**TO BE SET**	**TO BE ANSWERED**	**MARKS PER QUESTION**	**TOTAL MARKS**
A	1,2	8	TWENTY	ONE	1X20 = 20	THREE	TWO	TEN	10X5 = 50
B	3,4	12				THREE	TWO		
C	5,6	4				TWO	ONE		

EXAMINATION SCHEME (SESSIONAL)

1.	Continuous Internal Assessment of 25 marks **is to be carried out by the teachers throughout the Fifth Semester.** Distribution of marks: Performance of Job - 15, Notebook - 10.
2.	**External Assessment of 25 marks** shall be held at the end of the Fifth Semester on the entire syllabus. One Experiment per student from any one of the above is to be performed. Experiment is to be set by lottery system. **Distribution of marks: On spot job - 15, Viva-voce - 10.**

Name of the Course: ***DIPLOMA IN ELECTRICAL ENGINEERING (INDUSTRIAL CONTROL)***	
Subject : ***Microprocessor and Microcontroller***	
Course Code: **EEIC/S5/MPMC**	Semester: ***FIFTH***
Duration: ***ONE SEMESTER***	Maximum Marks: ***150***
Teaching Scheme	**Examination Scheme**
Theory : 3 hrs./week	Mid Semester Exam.: **20 Marks**
Tutorial: -- hrs./week	Attendance, Assignment & interaction: **10 Marks**
Practical: 2 hrs./week	End Semester Exam.: **70 Marks**
Credit: 4	Practical: **50 Marks**

Aim:

Sl. No.	
1.	Today microprocessors and microcontrollers have become an integral part of all automatic and semi automatic machines. Therefore there is a growing need of engineers / technicians in this field. Hence, it is necessary to study microcontroller basics, hardware and its programming.
2.	This subject covers microprocessor 8085 and microcontroller 8051 architecture, its instruction set, programming and applications. After completing this subject the student can write and execute programs for microcontroller and microprocessor based applications.

Objective:

Sl. No.	***The student will be able to***
1.	• Describe architecture and operation of microprocessor 8085
2.	• Develop assembly language programs using instruction set of 8085
3.	• Describe architecture and operation of microcontroller 8051
4.	• Develop assembly language programs using instruction set of 8051
5.	• Design and develop microcontroller based systems
6.	• Explain various applications of microcontrollers

Pre-requisite:

Sl. No.	
1.	Knowledge of digital electronics

Unit	Contents (Theory)	Hrs./Unit	Marks
1	***Microprocessor Basics*** 1.1. Generation and evolution of 4 bit microprocessor to latest microprocessor 1.2. Basic Architecture of 8-bit Microprocessor 1.2.1. Hardware features of Intel - 8085 functional Blocks, bus structure. 1.2.2. Arithmetic Logic Unit 1.2.3. Registers (General purpose & Special Purpose) 1.2.4. Interrupts 1.2.5. Pin description. 1.3. Timing cycles of 8085 - Machine cycle, Opcode fetch cycle, execution cycle, instruction cycle.	8	12
2	***Microprocessor Programming*** 2.1. Instruction set of Intel 8085 2.2. Addressing modes 2.3. Introducing to branch and subroutine 2.4. Simple Program such as Addition, Subtraction, Multibyte addition, Multiplication of two numbers, BCD to Hex conversion, Hex to BCD conversion etc. 2.5. Interrupt .	8	13
3	***Application of microprocessor*** 3.1. Review of A/D and D/A converter 3.2. Interfacing – parallel (8255) 3.3. Measurement of voltage, current, frequency. 3.4. Generation of square, triangular and staircase waveform. 3.5. Over current Relay operation.	8	10

Unit	Contents (Theory)	Hrs./Unit	Marks
	3.6. Speed control of D.C. motor.		
4	***Microcontroller Basics*** 4.1. Introduction and applications 4.2. Comparison between microcontrollers and microprocessors 4.3. Evolution of microcontrollers 4.4. Architecture of 8051 4.4.1. Block diagram of 8051 microcontroller 4.4.2. Registers in 8051 4.4.3. General purpose or working registers 4.4.4. Stack Pointer and Program counter 4.4.5. Special function registers (SFR) 4.4.6. Program Status word 4.4.7. Data pointer (DPTR) 4.4.8. Timer resisters 4.4.9. Ports 4.4.10. Control registers	7	10
5	***8051 addressing modes and instructions*** 5.1. 8051 addressing modes 5.2. 8051 instruction set 5.3. 8051 Simple Program such as Addition, Subtraction, Multi-byte addition, Multiplication of two numbers, BCD to Hex conversion, Hex to BCD conversion etc.	6	10
6	***8051 interrupts, timer/counters*** 6.1. Interrupts in 8051 6.2. Initializing 8051 interrupts 6.3. Interrupt priorities 6.4. Timers and counters, timer counter modes	6	7
7	***Application of microcontroller*** 7.1. Measurement of voltage, current, frequency. 7.2. Generation of square, triangular and staircase waveform. 7.3. Over current Relay operation . 7.4. Speed control of D.C. motor.	5	8
	TOTAL:	**48**	**70**

Contents (Practical)	
Sl. No.	***Skills to be developed***
1.	Intellectual Skills: i) Logical development ii) Programming skills
2.	Motor Skills: i) Data entry, Error Correction and Execution of assembly language programms ii) Connection Skills

Suggested list of Laboratory Experiments:

Sl. No.	
I	***Minimum 10 Experiments to be conducted from Sl no. 1-17*** 1. Introduction of 8085 Microprocessor and 8051Microcontroller Kit 2. Addition, Subtraction 3. Multi-byte addition 4. Multiplication of two numbers 5. Finding the maximum value in an array 6. Arranging the given data in Ascending order 7. BCD to Hex conversion 8. Hex to BCD conversion 9. Hex to ASCII 10. ASCII to Binary 11. Square Root of an given data 12. Least Common Multiple 13. Greatest Common Divisor 14. Parity bit generation 15. Program using I/Os in port 1 16. Counter using timer 17. Program using interrupt
II	***To develop, Run & Test Program for the following using 8085 Microprocessor / 8051***

Suggested list of Laboratory Experiments:

Sl. No.	
	microcontroller: (any five) 1. Measurement of dc voltage and currents using suitable potential divider circuit and shunt along with an A/D converter. 2. Measurement of ac voltage, current, frequency and phase angle difference(either between two voltages or between voltage and current) using suitable PT, CT, Zero crossing detectors, A/D converters etc. 3. Generating of square, triangular, staircase wave form using D/A/ converter. 4. Over voltage/Under voltage or over current/under current relay circuit using suitable hardware circuit. 5. Control of a D.C. motor at different speed and to note speed vs Load characteristics at open loop condition. 6. Operation of a stepper motor with a fixed number of steps and to determine the angular displacement per step by measuring the total angular rotation. 7. Operation of a stepper motor continuously at different speed.

Text Books:

Name of Authors	*Title of the Book*	*Name of the Publisher*
Ramesh Gaonkar	Microprocessor Architecture, Programming, and Applications with the 8085	Penram International Publishing [India] Pvt. Ltd.
B. Ram	Microprocessor & Microcontroller	Danpat Rai Publication
Kenneth J Ayala,	8051 microcontrollers architecture, Programming and Applications	International Thomson publishing, India
Ajay V Deshmukh	Microcontrollers theory and applications	TMH, New Delhi
N. Senthil Kumar M.Sarvanan S.Jeevananthan	Microprocessors and Microcontrollers	OXFORD University Press

EXAMINATION SCHEME (THEORITICAL)

GROUP	UNIT	ONE OR TWO SENTENCE ANSWER QUESTIONS				SUBJECTIVE QUESTIONS			
		TO BE SET	TO BE ANSWERED	MARKS PER QUESTION	TOTAL MARKS	TO BE SET	TO BE ANSWERED	MARKS PER QUESTION	TOTAL MARKS
A	1, 2, 3	12	TWENTY	ONE	1X20 = 20	FOUR	FIVE, TAKING AT LEAST TWO FROM EACH GROUP	TEN	10X5 = 50
B	4, 5, 6, 7	11				FIVE			

EXAMINATION SCHEME (SESSIONAL)

1. Continuous Internal Assessment of 25 marks is to be carried out by the teachers throughout the Fifth Semester. **Distribution of marks: Performance of Job - 15, Notebook - 10.**
2. External Assessment of 25 marks shall be held at the end of the Fifth Semester on the entire syllabus. One Experiment per student from any one of the above is to be performed. Experiment is to be set by lottery system.
   Distribution of marks: On spot job - 15, Viva-voce - 10.

Name of the Course: ***DIPLOMA IN ELECTRICAL ENGINEERING (INDUSTRIAL CONTROL)*** Subject : **INDUSTRIAL INSTRUMENTATION**	
Course Code: **EEIC/S5/II**	Semester: ***FIFTH***
Duration: ***ONE SEMESTER***	Maximum Marks: ***175***
Teaching Scheme	**Examination Scheme**
Theory : 4 hrs./week	Mid Semester Exam.: **20**
Tutorial: -- hrs./week	Attendance, Assignment & interaction: **10**
Practical: 2 hrs./week	End Semester Exam.: **70**
Credit: 5	Practical: **75 Marks**

UNIT	CONTENTS	HOUR	MARKS
1	**Transducers (2)** Concept of Transducers, Classification of Transducers, Primary and Secondary Transducers, Electrical and Mechanical Transducers, Analog and Digital Transducers, Active and passive Transducers	**2**	**2**
2	**Measurement of force torque, velocity** • Force measure: Load cells – types; Strain gauge load cell, Piezoelectric load cell, Hydraulic load cell, Pneumatic load cell & Other types; Uses & standards • Methods of torque measurement- strain gauge, relative regular twist • Speed measurement: capacitive tacho, drag cup type tacho, D.C and A.C tacho generators – • stroboscope	**6**	**6**
3	**Measurement of acceleration, vibration and density** • Accelerometers – LVDT, piezo-electric, strain gauge and variable reluctance type accelerometers • Mechanical type vibration instruments – seismic instrument as an accelerometer and vibrometer – calibration of vibration pick ups • Measurement of density, definition, units, liquid density, measurement, application and selection. • Density, specific gravity and viscosity used in industries; Baume scale, API scale; • Pressure head type densitometer – float type densitometer – ultrasonic densitometer, Bridge type gas densitometer.	**7**	**8**
4	**Pressure measurement** • Pressure measurement basics, mechanical type instruments, Electro mechanical type, Low-pressure measurement, related accessories, pressure measuring standards, selection and application. • Units of pressure; manometers – different types; • Elastic type pressure gauges : Bourdon type, bellows, diaphragms; • Electrical methods: elastic elements with LVDT and strain gauges, capacitive type pressure gauge, piezo resistive pressure sensor, resonator pressure sensor;	**7**	**8**
5	**Temperature measurement** • Definitions and standards – primary and secondary fixed points – calibration of thermometers • Different types of filled in system thermometer – sources of errors in filled in systems and their compensation; • Bimetallic thermometers • Electrical methods of temperature measurement: Resistance Temperature Detector (RTD), principle, type, construction and measuring circuits. • RTDs and their characteristics –3 lead and 4 lead RTDs, signal conditioning.	**4**	**4**

UNIT	CONTENTS	HOUR	MARKS
6	**Thermocouples, Thermister and pyrometers** • Thermoelectric effects, law of thermocouple, cold junction compensation techniques, thermocouple types, construction, installation and protection, measuring circuits. Thermocouple burnout detection and high temperature measurement methods. • Commercial circuits for cold junction compensation – response of thermocouple – special techniques for measuring high temperature using thermocouples; • Radiation methods of temperature measurement : Radiation thermometers, introduction, definition of terms, general form of radiation measurement system, radiation thermometer types, photo electric radiation thermometers, signal conditioning for radiation thermometers, remote reading thermometers. Temperature sensor selection and application, sensor calibrators and simulators. • Total radiation and selective radiation pyrometers – optical pyrometer – two colour radiation pyrometer. • Thermistors: Principle and sensor types, manufacturing techniques, measuring circuits, linearization methods and application	**8**	**9**
7	**Measurement of viscosity, humidity and moisture** • **Viscosity:** Definition, units, Newtonian and Non-newtonian behavior, measurement of viscosity using laboratory viscometer, industrial viscometers, viscometer selection and application. • Say bolt viscometer, rotameter type viscometer, industrial consistency meters • Humidity: Definition, unit; dry and wet bulb psychrometers, hot wire electrode type hygrometer, dew cell, electrolysis type hygrometer, commercial type dew point meter • Moisture: Definition, unit; different methods of moisture measurement – moisture measurement in granular materials, solid penetrable materials like wood, web type material.	**8**	**9**
8	**Flow Measurements** **Mechanical type flowmeters** • Theory of fixed restriction variable head type flow meters; orifice plate; venturi tube, flow nozzle, dall tube; • Installation of head flow meters – piping arrangement for different fluids – pilot tube. **Quantity meters, area flow meters and mass flow meters** • Inferential meter – turbine flow meter – rotameter – theory and installation • Angular momentum mass flow meter – coriolis mass flow meters – thermal mass flow meter – volume flow meter plus density measurement **Electrical type flow meter** • Principle and constructional details of electromagnetic flow meter, different types of excitation – schemes used; • Different types of ultrasonic flow meters – laser doppler anemometer systems – vortex shedding flow meter – target flow meter – solid flow rate measurement – guidelines for selection of flow meter.	**16**	**18**
9	**Level measurement** • Introduction, float level device, displacer level detectors, Differential pressure type level detector, • Electrical type-resistance and capacitance type level detector • Thermal, Microwave and ultrasonic radar and vibrating type level sensors.	**6**	**6**

UNIT	CONTENTS	HOUR	MARKS
	• Level sensors selection and applications		
	TOTAL	**64**	**70**

Contents (Practical)

SI. No. Skills to be developed

1. Intellectual Skills: i) Knowledge regarding various parameter measuring procedures.
2. Motor Skills: i) Hands on training on measuring different parameters.
   ii) Connection Skills

INDUSTRIAL INSTRUMENTATION LABORATORY *(At least 8(eight) experiments to be performed)*

1. Calibration of pressure gauge by dead weight tester.
2. Study of Thermocouple characteristics and Measurement of temperature with it.
3. Study of RTD characteristics and measurement of temperature with it
4. Measurement of temperature by using Thermistors.
5. Measurement of Viscosity.
6. Measurement of Flow Electrical type flow meter.
7. Measurement of Level by Electrical type(resistance / capacitance type) level detector.
8. Measurement of Humidity by dry and wet bulb psychrometers.
9. Measurement of Force by strain guage load cell / Piezoelectric load cell / Hydraulic load cell / Pneumatic load cell
10. Measurement of speed by tacho.
11. Measurement of Density, specific gravity by float type densitometer.
12. Measurement of Pressure, displacement by LVDT.

Reference Books:

1. Ernest O. Doeblin, Measurement systems: Application and design. McGraw- Hill.
2. A.K Sawhney, A course in Mechanical Measurement and Instrumentation. Dhanpat Rai & Co.
3. Nackra and Chaudhry. Instrumentation Measurement and analysis. Tata McGraw-Hill publishing company Ltd.
4. DVS Murthy, Transducers and Instrumentation. PHI.
5. Patranabis, Sensors and Transducers. PHI.

EXAMINATION SCHEME (THEORITICAL)

GROUP	UNIT	ONE OR TWO SENTENCE ANSWER QUESTIONS				SUBJECTIVE QUESTIONS			
		TO BE SET	TO BE ANSWERED	MARKS PER QUESTION	TOTAL MARKS	TO BE SET	TO BE ANSWERED	MARKS PER QUESTION	TOTAL MARKS
A	1, 2, 3,4	8	TWENTY	ONE	1X20 = 20	THREE	FIVE, TAKING AT LEAST ONE FROM EACH GROUP	TEN	10X5 = 50
B	5, 6, 7	7				THREE			
C	8,9	8				THREE			

EXAMINATION SCHEME (SESSIONAL)

1. Continuous Internal Assessment of 50 marks is to be carried out by the teachers throughout the Fifth Semester. **Distribution of marks: Performance of Job - 30 Notebook - 20.**
2. External Assessment of 25 marks shall be held at the end of the Fifth Semester on the entire syllabus. One Experiment per student from any one of the above is to be performed. Experiment is to be set by lottery system.
   Distribution of marks: On spot job - 15, Viva-voce - 10.

Name of the Course: ***DIPLOMA IN ELECTRICAL ENGINEERING (INDUSTRIAL CONTROL)*** Subject : ***INDUSTRIAL PROJECT AND ENTREPRENEURSHIP***	
Course Code: **EEIC/S5/IPED**	Semester: ***FIFTH***
Duration: ***ONE SEMESTER***	Maximum Marks: ***75***
Teaching Scheme	**Examination Scheme**
Theory : 1 hrs./week	Mid Semester Exam.: **NIL**
Tutorial: -- hrs./week	Attendance, Assignment & interaction: **NIL**
Practical: 3 hrs./week	End Semester Exam.: **NIL**
Credit: 3	Practical: **75 Marks**

Aim:

Sl. No.	
1.	It is intended to provide opportunity for students to develop understanding of the interrelationship between different courses learnt in the entire diploma programme and to apply the knowledge gained in a way that enables them to develop & demonstrate higher order skills.

Objective:

Sl. No.	
1.	To ignite the potential of students' creative ability by enabling them to develop something which has Engineering relevance.
2.	To provide a taste of real life problem that a diploma-holder may encounter as a professional.
3.	To Identify entrepreneurship opportunity.
4.	Acquire entrepreneurial values and attitude.
5.	Use the information to prepare project report for business venture.
6.	Develop awareness about enterprise management.

Pre-Requisite:

Sl. No.	
1.	Knowledge of subjects up to 4th Semester of Electrical Engineering.

PART A : Industrial Project

Following activities related to project are required to be dealt with, during this semester

1. Form project batches (Max. 6 students per batch)
2. Each project batch should select topic / problem / work by consulting the guide & / or industry. (One from Group 1 and another from Group 2)
3. Each project batch should prepare action plan of project activities & submit the same to respective guide.
4. At the end of semester, each project batch should submit the action plan and abstract of the project along with list of materials required if project involves fabrication or other facilities required in other kinds of project.
5. Action Plan should be part of the project report.

Actual work of project should be done in sixth semester.

Group	***Projects***		
I	1. Design of Illumination Scheme (Up to 20 KW) for Hospital / Shopping Mall / Cinema Theatre / Commercial Complex / Educational Institute / Industrial Complex. 2. Design of Rural Electrification Scheme for small Village, Colony. 3. Energy Conservation and Audit. 4. Substation Model (Scaled) 5. Wind Turbine Model (Scaled) 6. Pole Mounted Substation Model (Scaled) 7. Conduct load survey to ascertain the total load requirements of a locality / polytechnic. 8. Any other items as may be assigned by the teacher concerned.		
II	(1) Rewinding of Three Phase/Single Phase Induction Motor.		

Actual work of project should be done in sixth semester.

Group	*Projects*		
	(2) Rewinding of Single Phase Transformer. (3) Fabrication of Inverter up to 1000 VA. (4) Fabrication of Battery Charger. (5) Fabrication of Small Wind Energy System for Battery Charging. (6) Fabrication of Solar Panel System for Battery Charging. (7) Fabrication of Water level controller. (8) Fabrication of DC motor speed control circuit by SCRs. (9) Microprocessor/ Micro controller Based Projects. (10) Simulation Projects using Matlab. (11) Any other items as may be assigned by the teacher concerned.		

Part B: Entrepreneurship Development

Following activities related to Entrepreneurship Development is required to be dealt with, during this semester:

1. Students should be taught about the basic idea of following aspects Entrepreneurship Development:

Chapter	Contents
1.	***Entrepreneurship, Creativity & Opportunities*** 03 Hrs 1.1. Concept, Classification & Characteristics of Entrepreneur 1.2. Creativity and Risk taking. 1.2.1. Concept of Creativity & Qualities of Creative person. 1.2.2. Risk Situation, Types of risk & risk takers. 1.3. Intrapreneuring and Entrepreneurship. 1.4. Business Idea: Methods and techniques to generate business idea. 1.5. Transforming Ideas in to opportunities : Transformation involves Assessment of idea & Feasibility of opportunity 1.6. SWOT Analysis
2	***Information And Support Systems*** 05 Hrs 2.1. Industrial Policy reform in West Bengal 2.2. Financial assistance schemes of SIDBI (Small Industries Development Bank of India) 2.3. Financial assistance scheme of NSIC (National Small Industries Corporation) 2.4. Guidance/Assistance available from following organizations: i. National Research Development Corporation (NRDC) ii. Small Industries Service Institute(SISI) iii. State Financial Corporation (SFC) iv. District Industries Centre (DICs) v. v) Chambers of Commerce and Industry and Industrial Association
3	***Forming of Business Organization*** 02 Hrs 3.1. Market Survey 3.2. Advantages and Disadvantages of following types organizations: a) Sole Proprietorship b) Partnership c) Joint stock company i) Private Limited Company ii) Public Limited Company 3.1. Assess yourself-are you an entrepreneur?
4	***Project Report Preparation*** 06 Hrs 4.1. Project Report and its utility 4.2. Preparation of Project Report of any one business. Following statements are required to be prepared: i. Calculation of working capital requirement. ii. Cost of Production. iii. Profitability Statement. iv. Cash Flow statement. v. Mean of Financing. vi. Land and site Development vii. Building viii. Plant and Machinery

Chapter	Contents
	ix. Preliminary and Pre-operative Expenses x. Manpower Estimates Staff and Labour xi. Administrative Overheads. xii. Miscellaneous Assets. xiii. Calculation of Depreciation. xiv. Interest Calculation. xv. Project Implementation Schedule.

2. At the end of the semester every student has to prepare Project Report of a business model as mentioned above in chapter 4.

BOOKS

Name of Authors	*Titles of the Book*	*Name of the Publisher*
J.S. Saini B.S.Rathore	A Handbook of Entrepreneurship	Aapga Publication
J.S. Saini B.S.Rathore —	Entrepreneurship Theory and Practice	Wheeler Publisher New Delhi
E. Gorden K.Natrajan	Entrepreneurship Development	Himalaya Publishing. Mumbai
M.Schaper, T Volery, P Weber, K Lewis	Entrepreneurship And Small Business	Wiley
J.B.Patel D.G.Allampally	A Manual on How to Prepare a Project Report	EDI STUDY MATERIAL Ahmadabad (Near Village Bhat , Via Ahmadabad Airport & Indira Bridge), P.O. Bhat 382428 , Gujrat,India P.H. (079) 3969163, 3969153 E-mail: ediindia@sancharnet.in olpe@ediindia.org Website : http://www.ediindia.org
J.B.Patel S.S.Modi	A Manual on Business Opportunity Identification & Selection	
S.B.Sareen H. Anil Kumar	National Derectory of Entrepreneur Motivator & Resource Persons.	
Gautam Jain Debmuni Gupta	New Initiatives in Entrepreneurship Education & Training	
P.C.Jain	A Handbook of New Enterpreneurs	

Video cassette

Sl. No.	Subject	Source
1.	Five success Stories of First Generation Entrepreneurs	EDI STUDY MATERIAL Ahmadabad (Near Village Bhat, Via Ahmadabad Airport & Indira Bridge), P.O. Bhat 382428, Gujrat,lndia P.H. (079) 3969163, 3969153 E-mail: ediindia@sancharnet.in olpe@ediindia.org Website : http://www.ediindia.org
2.	Assessing Entrepreneurial Competencies	
3.	Business Opportunity Selection and Guidance	
4.	Planning for completion & Growth	
5.	Problem solving-An Entrepreneur skill	

EXAMINATION SCHEME (SESSIONAL)

1. Continuous Internal Assessment of 25 marks is to be carried out by the teachers throughout the Fifth Semester. **Distribution of marks: Performance of Job – 15, Notebook – 10.**

2. External Assessment of 50 marks shall be held at the end of the Fifth Semester. **Distribution of marks: On the basis of Action plan of Project and Project Report of Entrepreneurship Development – 35, Viva-voce – 15.**

Name of the Course: ***DIPLOMA IN ELECTRICAL POWER SYSTEM*** Subject : ***Power Plant Instrumentation & Control (Elective)***	
Course Code: **EEIC/S5/PPIC (EL)**	Semester: ***FIFTH***
Duration: ***ONE SEMESTER***	Maximum Marks: ***150***
Teaching Scheme	**Examination Scheme**
Theory : 3 hrs./week	Mid Semester Exam.: **20 Marks**
Tutorial: -- hrs./week	Attendance, Assignment & interaction: **10 Marks**
Practical: 2 hrs./week	End Semester Exam.: **70 Marks**
Credit: 3	Practical: **50 Marks**

AIM

A student of diploma engineering will act as supervisor or involve in operation and control of different power plants. So it is necessary to have knowledge in different instrumentation and control used in different power plant.

Objectives

- To provide an overview of power generation methods
- To give an understanding about the instrumentation systems in different power plant for measurement of different parameters.
- To discuss about the various control loops and their operation in different power plant.
- To familiarize the student with the methods of monitoring and analyzing different parameters.
- To familiarize the student with the methods Data handling

Pre-requisite

- Fundamentals of different Power Plants
- Idea on basic control logic and terminology
- Idea on basic measurements
- Idea on basic electronics

CONTENTS (Theory)

Unit	CONTENTS (Theory)	Hours	Marks
1	***Overview of Power Generation*** • Brief survey of methods of power generation- hydro, thermal, nuclear, solar and wind power • Importance of Instrumentation in power generation • Thermal power plant –building blocks, details of boiler	2	3
2	***MEASUREMENTS IN POWER PLANTS*** • Instrumentation for Generator and Busbar coupling • Electrical measurements – current, voltage, power, frequency, power – factor etc. – • Non electrical parameters – flow of feed water, fuel, air and steam with correction factor for temperature – steam pressure and steam temperature – drum level measurement –radiation detector – smoke density measurement – dust monitor	4	5
3	***ANALYZERS IN POWER PLANTS*** • Flue gas oxygen analyser – • Analysis of impurities in feed water and steam – • Dissolved oxygen analyser – • Chromatography – • PH meter – • Fuel analyser – • Pollution monitoring instruments.	5	8
4	***Control Loops in Boiler*** • Combustion Control	6	9

Unit	CONTENTS (Theory)	Hours	Marks
	• Air/Fuel ratio Control • Furnace draft control • Drum level control • Main steam & reheat steam temperature control • Superheater control • Deaerator control • DCS in power plant • Interlocking in boilers		
5	***Turbine - Monitoring & Control*** • Speed, vibration, shell temperature monitoring & control • Steam pressure control • Lubricant oil temperature control	4	6
6	***Auxiliaries in Power Plants:*** Soot Blowers, Electrostatic Precipitator, Oil Automation System, Water Treatment Plant, Cooling Towers, ID & FD, Economisers, Air Preheaters, Superheaters	4	6
7	***Nuclear power plant instrumentation*** • Piping and instrumentation diagram of nuclear power plant- • Types of reactors in nuclear power plant- • Radiation detection instruments- • Process sensors for nuclear power plants- • Nuclear reactors control systems and allied instrumentation. • Load despatch computer- • Dedicated micro computers for sequencing data logging and alarming.	6	10
8	***Hydel Power Plant*****:** Types - flow rate, Water pressure ***Transformer*****:** Transformer oil, hot spot, moisture detection ***Transmission Lines*****:** Fibre optics meter for high voltage and high current measurement, Transmission line sag measurement using triangulation technique	5	7
9	***Tariff*****:** Objective, Available based tariff, Digital energy meter, Remote terminal unit (RTU)	5	6
10	***Local Dispatch Centre*****:** Data handling – Processing, Logging, Acquisition, Accounting, Display and Storage, SCADA, Techniques of Data acquisition at Central Load Dispatch Centers for coordinated control of the grid.	5	8
11	***IS specification*****:** Introduction, Application and Relevancy of IS specification in perspective of power system instrumentation.	2	2
	TOTAL	48	70

Practicals

Skill to be developed:	
Intellectual Skill;	
1	Operation of different instruments
Motor Skill:	
1	Proper wiring

List of Practical:

SI No.	Experiment
1	Measurement of temperature by thermocouple, RTD
2	Measurement of level by D/P transmitter
3	Measurement of flow by orifice & D/P transmitter
4	Measurement of pressure by pressure transmitter
5	Control of above parameter for suitable process
	Control of temperature, level, flow etc. using PLC
6	Simulation of any power plant

7	Visit to any power plant

TEXT BOOKS

Title	Author	Publisher
Principles of Industrial Instrumentation,	D. Patranabis,	TMH
Instrument Engineers Handbook Vol I & II	Liptak,	Butterworth
Power Plant Instrumentation	Krisnaswami, M P Bala	PHI
Power Plant Control & Instrumentation	David Lindsley	Institute of Electrical Engineers
The Control of Boilers	S G Duke low	Instruments Society of America Press
Modern Power Station Practice-Instrumentation, Controls & Testing	A.Sherry et.al (Editors)	Pergamon Press, Oxford
Standard Boiler Operation	S. M. Elonka, A. L. Kohal	TMH
Boiler Control Systems Engineering	G.F. Gilman	ISA Publication.
Power Plant Engineering	P.K.Nag	McGraw Hill.
Power Plant Instrumentation & Control	Philip Kiameh	
Hand book of applied instrumentation	D.M.Considine	McGraw Hill
Power Station Instrumentation	M. J. Jervis	Butterworth Heinemann, Oxford
Boiler Control Systems	D. Lindsley	McGraw Hill
A Course in Power Plant Engineering	Arora and Domkundwar	Dhanpat Rai and Sons, New Delhi

EXAMINATION SCHEME (THEORITICAL)

GROUP	UNIT	ONE OR TWO SENTENCE ANSWER QUESTIONS				SUBJECTIVE QUESTIONS			
		TO BE SET	TO BE ANSWERED	MARKS PER QUESTION	TOTAL MARKS	TO BE SET	TO BE ANSWERED	MARKS PER QUESTION	TOTAL MARKS
A	1, 2, 3	5	TWENTY	ONE	1X20 = 20	TWO	FIVE, TAKING AT LEAST ONE FROM EACH GROUP	TEN	10 X 5 = 50
B	4, 5, 6	8				THREE			
C	7, 8,9,10,11	12				FOUR			

E X A M I N A T I O N S C H E M E (SESSIONAL)

1.	Continuous Internal Assessment of 25 marks **is to be carried out by the teachers throughout the Sixth Semester. Distribution of marks: Performance of Job - 15, Notebook - 10.**
2.	**External Assessment of 25 marks** shall be held at the end of the Sixth Semester on the entire syllabus. One Experiment per student from any one of the above is to be performed. Experiment is to be set by lottery system. **Distribution of marks: On spot job - 15, Viva-voce - 10.**

Name of the Course: ***DIPLOMA IN ELECTRICAL ENGINEERING (INDUSTRIAL CONTROL)***	
Subject : ***Heating, Ventilation & Air Conditioning (Elective)***	
Course Code: **EEIC/S5/HVAC(EL)**	Semester: ***FIFTH***
Duration: ***ONE SEMESTER***	Maximum Marks: ***150***
Teaching Scheme	**Examination Scheme**
Theory : 3 hrs./week	Mid Semester Exam.: **20 Marks**
Tutorial: -- hrs./week	Attendance, Assignment & interaction: **10 Marks**
Practical: 2 hrs./week	End Semester Exam.: **70 Marks**
Credit: 3	Practical: **50 Marks**

Aim

Sl. No.	
1.	This is a technology subject which is an elective subject for third year diploma in Electrical Engineering. Presently the need of Heating Ventilation and Air conditioning (HVAC) is increasing with the growth in IT sector, commercial establishments, hospitals, hotels etc. Therefore there is a growing need of engineers / technicians in this field. Hence, technicians/supervisors from electrical engineering branch are also expected to have some basic knowledge of HVAC systems.
2.	This subject covers installation, testing and maintenance of Heating Ventilation and Air conditioning systems. After completing this subject the student can cany out installation, testing and maintenance of HVAC equipment efficiently and effectively. He can work as service engineer or get self employed.
3.	Student can work with building management system (BMS).

Objective

Sl.No.	The student will be able to:-
1.	• Install HVAC equipment.
2.	• Test the equipment for its performance evaluation.
3.	• Carryout routine and preventive maintenance of HVAC system.
4.	• Troubleshoot and repair HVAC equipment.
5.	• Calculate heat load and approximate capacity of the equipment using thumb rule.
6.	• Select appropriate equipment.

Pre-Requisite:-

Sl.No.	
1.	Basics of electronic instrumentation

Theory

Unit	Content (Theory)	Hours	Marks
1	***Introduction*** 1.1. Laws of thermodynamics 1.2. Comparison between heat engine, heat pump and refrigeration 1.3. Definitions of refrigeration, ton of refrigeration, COP, enthalpy, entropy	2	4
2	***Types of refrigeration systems*** 2.1. Vapour compression system – components used in vapour compression system, operation of vapour compression system, its representation on P – H and T – S diagrams, effect of superheating and under cooling of refrigerant. 2.2. Vapour absorption system – components used in vapour absorption system, its operation, its merits and demerits compared to vapour compression system 2.3. Air refrigeration system – components used in air refrigeration system, its operation and applications	4	4
3	Refrigerants and Lubrication	6	6

Unit	Content (Theory)	Hours	Marks
	3.1. Classification of refrigerants 3.2. Types of refrigerants presently in use 3.3. Desirable properties of refrigerants (Physical, chemical, thermodynamic) 3.4. Applications of important refrigerants 3.5. Eco-friendly refrigerants 3.6. Properties of lubricants 3.7. Lubricants and refrigerant compatibility 3.8. Foaming of oil and crankcase electric heater 3.9. Effect of lubricant flood back to compressor 3.10. Additives used in lubricants 3.11. Necessity of oil separator		
4	***Components of vapour compression system*** 4.1. Various types of compressors – reciprocating (hermetic, semi sealed, open), rotary (centrifugal, lobe type, screw type, blade type), applications of each type. 4.2. Various types of condensers (air cooled, water cooled, evaporative), applications 4.3. Types of cooling towers – natural draft, forced draft 4.4. Types of evaporators – direct expansion type, flooded type, shell and coil type, double tube type, plate surface type 4.5. Throttling devices – hand expansion valve, constant pressure expansion valve, thermostatic expansion valve, high side float valve, capillary tube, electronic expansion valve 4.6. Accessories – receiver, oil separator, drier, strainer, solenoid valve. Note – schematic diagram and brief description only of the above components 4.7. Applications of refrigeration – Ice plant, water cooler, refrigerator, milk dairy, cold storage, breweries, superconductors, transport refrigeration and air conditioning	12	16
5	***Airconditioning*** 5.1. Psychrometry – Definition, psychrometric properties of air, use of psychrometric chart 5.2. Representation of simple air conditioning process on psychrometric chart. 5.3. Sling psychrometer 5.4. Air conditioning systems (Schematic layout, working and application of each of the following) • Central air conditioning system – direct expansion type, chilled water type • Package type air conditioning system • Unitary air conditioning system, split type system • Evaporative cooling 5.5. Applications of airconditioning – comfort airconditioning, industrial. Air conditioning, transport air conditioning	5	10
6	***Components in air supply and distribution system*** 6.1. Fans and blowers (centrifugal, axial flow) – schematic diagram and applications 6.2. Filters – (Dry, viscous, wet, electronic type) – schematic diagram and applications 6.3. Different types of humidifiers and dehumidifiers 6.4. Grills and registers 6.5. Duct system – heat gain or loss in ducts 6.6. Causes of pressure loss through air ducts 6.7. Different methods of duct designing	4	6
7	***Thermal insulation***	2	4

Unit	Content (Theory)	Hours	Marks
	7.1. Desirable properties of insulating materials for airconditioning purpose 7.2. Different types of insulating materials used for airconditioning 7.3. Selection of insulating materials for walls, ceiling, floor, air ducts, chilled water pipes		
8	***Controls used in airconditioning*** 8.1. High pressure and low pressure cutouts, overload protector, thermostat, oil safety switch, fusible plug, pressure equalizer 8.2. Microprocessor based controls and variable frequency drive 8.3. Fluid flow control devices (simple sketch and wiring diagram is expected)	3	6
9	***Heat load*** 9.1. Definitions – SHF, RSHF, EFSHF 9.2. Factors responsible for heat load 9.3. Conditions of airconditioning and representation of comfort zone on psychrometric chart 9.4. Determination of capacity of airconditioning unit by referring tables only (no calculations)	3	6
10	***Heating and ventilation*** 10.1. Plain heating, electric heating, steam heating, hot water heating, solar heating 10.2. Heating with humidification and heating with dehumidification 10.3. Natural ventilation 10.4. Mechanical ventilation – 1) Air extraction system 2) Air supply system, combined supply and extraction system 10.5. Air distribution system – perimeter system, extended plenum system, upward flow system, downward flow system, ejector system 10.6. Return duct system (only schematic diagrams and brief description of the above system)	7	8
	TOTAL :	**48**	**70**

Contents (Practical)

SI. No.	Skills to be developed
1.	Intellectual Skills: 1. Interpret results 2. Write specifications
2.	Motor Skills:. 1. Conduct trial 2. Read drawing and identify components 3. Carry out Welding

List of Experiments/Reports (Any eight)

SI. No.	List of Experiments/Reports (Any eight)
1.	To carryout trial on vapour compression test rig for finding its performance.
2.	To dismantle and assemble open type and hermetic type compressors, to draw freehand sketches of various parts and to write specifications of compressors.
3.	To carryout copper tube welding
4.	To study and draw block diagram of control panel wiring with respect to L.P. / 11.P. cutouts, oil pressure cutout, thermostat, humidistat, solenoid valve
5.	To troubleshoot the air-conditioning plant in relation to a) High condenser pressure b) Low cooling effect c) Reduced volume of supply of air d) compressor not starting
6.	To prepare maintenance schedule of central air conditioning plant - weekly, quarterly, half yearly, yearly
7.	Demonstration and study of various tools used in refrigeration such as - tube cutter, bending tools, flaring tool (block and yoke type), swaging tool, brazing tool, blow lamp etc.
8.	Demonstration of purging, gas charging, leak testing and pump down of the refrigeration system
9.	Visit to air conditioned hotel or theater to study control panel and various controls, starting and

SI. No.	List of Experiments/Reports (Any eight)
	stopping system, air supply and air return system. Write a detailed report.
10.	Visit to cold storage to study different components of vapour compression system, temperature and humidity conditions required for different food items. Write a detailed report.
11.	Prepare a report (use internet) based on the following points to purchase an air conditioner: i)Manufactures, ii)Technical specifications, iii) Features offered by different manufacturers, iv) Price range. Then select the air conditioner which you would like to purchase. Give justification for your selection in short.
	Note: For visits professional practices periods may be utilized.

Text Books:

Name of Authors	Title of the Book	Name of the Publisher
P. N. Anathanarayanan	Basic Refrigeration and Air-conditioning	Tata Mcgraw Hill, New Delhi
M. Adithan, S.C. Laroyia,	Practical Refrigeration and Air-conditioning	New Age International (P) Ltd.

EXAMINATION SCHEME (THEORITICAL)

GROUP	UNIT	ONE OR TWO SENTENCE ANSWER QUESTIONS				SUBJECTIVE QUESTIONS			
		TO BE SET	TO BE ANSWERED	MARKS PER QUESTION	TOTAL MARKS	TO BE SET	TO BE ANSWERED	MARKS PER QUESTION	TOTAL MARKS
A	1, 2,3,4,5	12	TWENTY	ONE	1X20 = 20	FOUR	FIVE, TAKING AT LEAST TWO FROM EACH GROUP	TEN	10X5 = 50
B	6,7,8,9,10	11				FIVE			

EXAMINATION SCHEME (SESSIONAL)

Continuous Internal Assessment of 25 marks is to be carried out by the teachers throughout the Fifth Semester. **Distribution of marks: Performance of Job - 15, Notebook - 10.**

External Assessment of 50 marks shall be held at the end of the Fifth Semester. Distribution of marks: **On the basis of Experiment Reports - 15, Viva-voce - 10.**

Name of the Course: ***DIPLOMA IN ELECTRICAL ENGINEERING (INDUSTRIAL CONTROL)***	
Subject : ***Energy Conservation and Audit (Elective)***	
Course Code: **EEIC/S5/ECA(EL)**	Semester: ***FIFTH***
Duration: ***ONE SEMESTER***	Maximum Marks: ***150***
Teaching Scheme	**Examination Scheme**
Theory : 3 hrs./week	Mid Semester Exam.: **20 Marks**
Tutorial: -- hrs./week	Attendance, Assignment & interaction: **10 Marks**
Practical: 2 hrs./week	End Semester Exam.: **70 Marks**
Credit: 3	Practical: **50 Marks**

Aim:

SI. No.	
1.	To study causes for limited growth of conventional energy sources and limitations of non conventional sources of energy
2.	To study methods of energy conservation for different load conditions
3.	To Select appropriate tariff system and methods for reducing electricity consumption and energy saving.

Objective:

SI. No.	The students will be able to:
1.	List causes for limited growth of conventional energy sources and limitations of non - conventional sources of energy.
2.	Suggest methods of energy conservation for different load conditions.
3.	Select appropriate tariff system and methods for reducing electricity consumption and energy saving.
4.	Apply Tools for energy audit and recommend measures for energy conservation.

Pre-Requisite:

SI. No.	
1.	Utilization of Electrical Energy
2.	Knowledge of energy sources

Contents (Theory)

Unit	Contents (Theory)	Hours	Marks
1	***Energy*** Review of various energy sources, Need of energy conservation and energy audit.	04	08
2	Energy Conservation: ✓ Lighting energy: methods/Techniques of efficient lighting. ✓ Heating: methods/Techniques of energy Saving in Furnaces, Ovens and Boilers. ✓ Cooling: methods/Techniques of Energy Saving in Ventilating systems and Air Conditioners ✓ Motive power, Energy Efficient Motors, and Efficient use of energy in motors with the help of voltage reducers, automatic star/ delta converters. ✓ Power factor improvement devices and soft starters/Variable Frequency Drives. ✓ Amorphous Core Transformers. ✓ Cogeneration -Types and Advantages.	12	18
3	***Tariff and Energy Conservation in Industries:*** Energy cost and Recent WBSEB tariffs, Application of Tariff System to reduce Energy bill, Energy conservation by improving load factor and power factor.	6	8
4	***Energy Conservation In Transmission and Distribution Systems:*** Reactive power compensation, demand side management, system voltage optimization and phase current balancing, Losses in transmission and distribution system and its minimization.	8	8
5	***Energy and the Environment:*** Environment and social concerns related to energy utilization, The green house effect, Global Warming and its effect , Pollution, Acid Rains, Global Energy and environment Management.	4	8
6	***Energy Audit:*** Procedure of Energy audit, ABC analysis, Energy Flow Diagram and its importance, Measurements in energy audit and various measuring instruments, Questionnaires for the energy audit, internal energy audit checklist, Equipment used for energy conservation, Calculation of payback period for energy conservation equipment. IE rules and regulations for energy audit, Electricity act 2003 (Numerical).	14	20

Unit	Contents (Theory)	Hours	Marks
	TOTAL	48	70

Contents (Practical)

SI. No.	Skills to be developed
1.	Intellectual Skills: 1. Identify different methods used for energy conservation. 2. Understand the importance of energy conservation. 3. Select proper tariff for given industry/institute. 4. Collect technical information regarding electricity act.
2.	Motor Skills: 1. Prepare energy audit report. 2. Write visit report. 3. Use different methods of energy conservation. 4. Use of energy saving devices.

List of Experiments/Reports:

SI. No.	Laboratory Experiments
1.	Energy saving by using electronic ballast as compared to conventional choke.
2.	Collect the Standard tariff rates and suggest suitable tariff for given industry/Lab/lnstitute/ Commercial establishment.
3.	Make a survey of one establishment to identify different methods used for energy conservation.
4.	Prepare Energy audit report for Industry/workshop/ Institute.
5.	Search on the website of power ministry and collect the information regarding role of energy manager, energy auditor and prepare power point presentation/report.
6.	List energy saving equipments for domestic and commercial applications
7.	List the different equipments used in energy auditing

Text Books:

Name of Authors	Title of the Book	Name of the Publisher
Siemens	Power Factor Correction	New Age Vol.38 2005
T.Gonen	Electric Power Distribution System Eng".	Tata McGraw Hill
M.j. Steinburgand T.H. Smith	Economy Loading of Power plant and Electric system	john Willey and sons
C.L. Wadhawa	Generation Distribution and Utilization of Electrical Energy	New Age 2004
Steven R. Patrick, Dale R. Patric, Stephen W. Fardo	Energy conservation Guide book	Fairmont Press
Giovanni Petrecca	Industrial Energy Management: Principles and applications	Kluwer Academic Publisher

EXAMINATION SCHEME (THEORITICAL)

GROUP	UNIT	ONE OR TWO SENTENCE ANSWER QUESTIONS				SUBJECTIVE QUESTIONS			
		TO BE SET	TO BE ANSWERED	MARKS PER QUESTION	TOTAL MARKS	TO BE SET	TO BE ANSWERED	MARKS PER QUESTION	TOTAL MARKS
A	1, 2,3	12	TWENTY	ONE	1X20= 20	FOUR	FIVE, TAKING AT LEAST TWO FROM EACH GROUP	TEN	10X5= 50
B	4,5,6,	11				FIVE			

EXAMINATION SCHEME (SESSIONAL)

Continuous Internal Assessment of 25 marks is to be carried out by the teachers throughout the Fifth Semester. **Distribution of marks: Performance of Job - 15, Notebook - 10.**
External Assessment of 50 marks shall be held at the end of the Fifth Semester. Distribution of marks: **On the basis of Experiment Reports - 15, Viva-voce - 10.**

Name of the Course: ***DIPLOMA IN ELECTRICAL ENGINEERING (INDUSTRIAL CONTROL)*** Subject : **Illumination Engineering(Elective)**	
Course Code : **EE/S5/ILE (EL)**	Semester: Fifth
Duration : One Semester	Maximum Marks : 150
Teaching scheme :	Examination scheme :
Theory: 3 Hrs./Week	Mid Semester Exam:20 Marks
Practical: 2 Hrs./Week	Assignment & Quiz:10 Marks
	End Semester Exam:70 Marks
	Practical:50 Marks
Credit: 3	

Aim:	
SI. No.	
1.	To measure the level of illumination.
2.	To study various types of lamps.
3.	To design illumination schemes for various applications in residential, commercial & industrial locations.
Objective:	
SI. No.	Student will be able to:
1.	Measure the level of illumination.
2.	Differentiate between various types of lamps.
3.	Identify & list of various lighting accessories and components.
4.	Design a control circuit for illumination.
5.	Design and execute illumination schemes for various applications in Residential, Commercial & Industrial locations.

Pre-Requisite:	
1.	Knowledge of Optics and light sources.
2.	Wiring, switching and control circuits.

Contents (Theory):		**Hrs/ Unit**	**Marks**
Unit: 1	1. Fundamentals of Light: 1.1 Electromagnetic radiation & Light. 1.2 Electromagnetic spectrum - Ultraviolet, Visible, Infrared spectrum. 1.3 Human eye as an optical system - basic concept. 1.4 Spectral sensitivity of human eye - Photopic, Scotopic, Mesopic vision. 1.5 Visual characteristics - Brightness, Contrast, Glare, Flicker. 1.6 Visual performance - Visibility level, Contrast rendering factor. 1.7 Colorimetry - Visual basis, Source colour, Object colour. 1.8 Colorimetric instrument - Colorimetry of light source and materials, Colour rendering index.	07	10
Unit: 2	2. Measurements: 2.1 Photometry - Basic concept, Fundamentals of detector. 2.2 Photometric measurements - Methods to measure Luminous intensity, Luminous flux, Luminance, Illuminance. 2.3 Application of Polar Photometer & Goniophotometer. 2.4 Luxmeter-Working principle & Application. 2.5 CIE standard source of illuminant. 2.6 Radiation of energy - Black body radiation, Full radiator, Thermal	07	12

Contents (Theory):		Hrs/ Unit	Marks
	radiation, Radiation from incandescent lamps.		
Unit: 3	3. Lamps & Accessories : 3.1 Lamp materials - glass, filament, phosphor coating, ceramics, electrodes, gases, capping cement etc. 3.2 Theory & basic properties of low & high pressure gas discharge. 3.3 Theory of operation, Life, Characteristics and Application of- a) High & Low pressure sodium vapour. b) High & Low pressure mercury vapour. c) Metal halide. d) Fluorescent lamp. e) LED. f) LASER. 3.4 Optical fiber - its construction as light guide, characteristics, application in lighting. 3.5 Luminaire - Types of luminaire, Design consideration, Indian standard recommendation.	10	12
Unit: 4	4. Illumination Control & Control circuits : 4.1 Purpose of lighting control - Energy conservation. 4.2 Electromagnetic & Electronic ballast - Operation & comparison in light control. 4.3 Ignitor - its function in lamps. 4.4 Control circuits & operation of- a) Fluorescent lamp circuit. b) Low pressure sodium vapour lamp circuit. c) High pressure sodium vapour lamp circuit.	08	12
Unit: 5	5. Interior Lighting : 5.1 National standards of interior lighting calculation. 5.2 Lighting calculations of interior lighting. (Numerical) 5.3 Design considerations for interior lighting of - (a) Residential complex. (b) Commercial complex. (c) Industrial premises. 5.4 Design with Lighting design software. 5.5 Daylighting - Sky luminance pattern, Daylight factor, estimation of average daylight factor, window design considerations for maximum daylighting, Application of daylight in interior lighting. 5.6 Use of photocell, occupancy sensor in lighting controls. 5.7 Concept of Isolux contour in lighting design.	10	12
Unit: 6	6. Exterior Lighting : 6.1 Lighting calculations of exterior lighting. (Numerical) 6.2 Calculation of lighting & design considerations for exterior lighting of - (a) Road lighting. (b) Flood lighting - Industrial complex, Commercial complex, Sports complex. 6.3 National & CIE standards of exterior lighting calculation.	06	12
	Total	**48**	**70**

Practical:
Skills to be developed:

Intellectual Skills:
1. To select appropriate equipment.
2. Apply different lighting designing skills.
Motor Skills:
1. Ability to draw the circuit diagrams.
2. Ability to measure illuminance properly.
List of practical: (At least Eight Experiments are to be performed)
1. To measure illuminance (daylight & artificial light) at different points of a classroom by Luxmeter & draw - (i) Variation of Illuminance characteristics with distance and (ii) Isolux plot.
2. To study the technical data of different types of lamps available in the market & draw their connection diagram.
3. To study the different lighting accessories, ignitor & electronic ballasts required for different types of lamps - Sodium vapour, Mercury vapour, Metal halide, CFL, Fluorescent lamp.
4. To study the different luminaries available in the market for various types of lamps with their technical specifications, their design consideration, Indian standard recommendation.
5. To study of - (i) Photocell, (ii) Occupancy sensor in artificial lighting control.
6. To design an illumination scheme of a conference hall of medium size.
7. To design an illumination scheme for a workshop in your institute.
8. To design an illumination scheme for a playground of medium size.
9. To design an illumination scheme for a shopping complex of medium size.
10. To visit a standard lamp manufacturing industry and make a report on lamp manufacturing process.
11. A case study of optimum lighting design with lighting design software.

List of Text Books:

SI. No.	Name of Author	Title of the Books	Name of Publisher
1.	Jack L. Lindsey	Applied Illumination Engineering	The Fairmont Press Inc.
2.	R.H. Simons, Robert Bean	Light Engineering Applied calculations	Architectural Press
3.	Casimer M Decusatis	Handbook of Applied Photometry	Springer

EXAMINATION SCHEME (THEORETICAL)

GROUP	UNIT	ONE OR TWO SENTENCE ANSWER QUESTIONS				SUBJECTIVE QUESTIONS			
		TO BE SET	TO BE ANSWERED	MARKS PER QUESTION	TOTAL MARKS	TO BE SET	TO BE ANSWERED	MARKS PER QUESTION	TOTAL MARKS
A	1,2,3	12	TWENTY	ONE	1X20 = 20	FOUR	FIVE, TAKING AT LEAST TWO FROM EACH GROUP	TEN	10X5 = 50
B	4,5,6,	11				FIVE			

EXAMINATION SCHEME (SESSIONAL)

1. Continuous Internal Assessment of 25 marks is to be carried out by the teachers throughout the Fifth Semester. Distribution of marks: Performance of Job- 15. Notebook - 10.
2. External Assessment of 25 marks shall be held at the end of the Fifth Semester on the entire syllabus. One Experiment per student from any one of the above is to be performed. Experiment is to be set by lottery system. Distribution of marks: On spot job - 15. Viva-voce - 10.

Name of the Course: ***DIPLOMA IN ELECTRICAL POWER SYSTEM*** Subject : ***Professional Practices III***	
Course Code: **EEIC/S5/PF III**	Semester: ***FIFTH***
Duration: ***ONE SEMESTER***	Maximum Marks: ***50***
Teaching Scheme	**Examination Scheme**
Theory : -- hrs./week	Mid Semester Exam.: **NIL**
Tutorial: -- hrs./week	Attendance, Assignment & interaction: **NIL**
Practical: 2 hrs./week	End Semester Exam.: **NIL**
Credit: 1	Practical: **50 Marks**

Aim:

SI. No.	
1.	To acquire information from different sources
2.	To present a given topic in a seminar, discuss in a group discussion
3	To prepare report on industrial visit, expert lecture.

Objective:

SI. No.	The student will be able to
1.	Acquire information from different sources
2.	Prepare notes for given topic
3.	Present given topic in a seminar
4	Interact with peers to share thoughts
5	Prepare a report on industrial visit, expert lecture

Pre-Requisite:

SI. No.	
1.	Survey of different electrical industries

Activities

Sl. No.	Activities	Hours
1.	***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 anv TWO from the list below (should not have completed in earlier semester): i. A thermal power generating station ii. A Hydel power generating station iii. A Wind mill and / or Hybrid power station of wind and solar iv. An electrical substation v. A switchgear manufacturing / repair industry vi. An Electrical machine manufacturing industry vii. A large industry to study protection system viii. Any Industry having Automation for manufacturing processes ix. A transformer repair Workshop x. Industry of power electronics devices xi. Maintenance department of a large industry. xii. A Loco shed xiii. Railway / metro railway signaling system xiv. Transmission tower project area xv. Any contemporary industry under MSME sector to understand detail of operation and starting of a new venture. xvi. Any other technical field area as may be found suitable alternative to above list.	
2	***Guest Lecture by professional / industrial expert:***	

Activities		
Sl. No.	**Activities**	**Hours**
	Lectures by Professional / Industrial Expert to be organized from any TWO of the following areas (not covered in earlier semesters): i. Modern trends in AC machine ii. Automotive wiring and lighting iii. Modern techniques in Power Generation iv. New trends in power electronics devices v. TQM vi. Recent modification in IE rules vii. Role of power factor improvement as a tool in reducing cost of generation viii. Digital metering ix. Hydro power generation x. Functioning of Electricity regulatory Commission. xi. Introduction and application areas for MEMS (Micro Electromechanical System) xii. Interview techniques xiii. Career opportunities for diploma engineers xiv. Cyber crime & Cyber laws xv. Social networking – effects & utilities xvi. Ethical Hacking. xvii. Industrial Dispute and Labour Laws xviii. Entrepreneurship development and oppurtunities xix. Role of micro, small and mediun enterprise. In Indian economy. *Individual report of the above lecture should be submitted by the students.*	
3	***Seminar / Poster presentation:*** Students should either present in seminar or prepare poster on ANY ONE topic as suggested below (should not be already done in earlier semester): Students (Group of 4 to 5 students) have to search / collect information about the topic through literature survey/ internet search / visit and discussion with expert or concerned persons. 1. Magnetic Levitation system 2. Recent development in electrically operated vehicles for mass 3. development 4. Alternative fuel and energy options 5. Schemes of power generation in coming five years 6. Impact of load shedding on rural population 7. Embedded system 8. Computer security 9. Bio – technology 10. Scheme for setting up a new venture in MSME sector 11. Comparative study of Metro railway in Kolkata and Delhi 12. Brushless commutation of DC motors 13. 12. Any other topic of present techno economic relevance as may be decided by concerned teacher.	
4	***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 – 1. Role of Electrical Engineer in Disaster management 2. CNG Vs LPG as fuel 3. Load shedding and remedial measures 4. Rain water harvesting 5. Trends in energy conservation	

Activities		
Sl. No.	**Activities**	**Hours**
	6. Safety in day to day life 7. Energy saving in the institute 8. Pollution control ***9.*** viii) Any other common topic related to electrical field as directed by concerned teacher.	
5	***Students' Activities / mini project (any one):*** i. Develop a website for your institute ii. Prepare a report on comprehensive information regarding guideline for setting up a small scale industrial unit in your locality, possible locations, possible options for such ventures, rules and regulations, cost involved, techno commercial feasibility study, marketing strategy, availability of funds, various govt. schemes and norms for such industries etc. Students may visit district industries centers for such purpose. iii. The students in a group of 3 to 4 will collect information from market regarding specification, cost, frame size of motors produced by different manufacturers as available in the market for household pump motors, industrial motors etc. They will submit individual report on the same. iv. Prepare a report on Tariff structure for different types of consumers related to various electricity boards of our state and make a comparison. *Also write a report on Energy conservation Act, energy efficiency, BEE Star Rating for different domestic appliances and their meaning.*	

EXAMINATION SCHEME (SESSIONAL)

1. **Continuous internal assessment of 50 marks** is to be carried out by the teachers throughout the Fifth semester.

Distribution of marks: Performance of job / project and attendance in guest lecturer = 35, Report = 15.