# WEST BENGAL STATE COUNCIL OF TECHNICAL EDUCATION

**TEACHING AND EXAMINATION SCHEME FOR DIPLOMA COURSES**

COURSE NAME: ***DIPLOMA IN ELECTRICAL ENGINEERING (POWER SYSTEM)***

COURSE CODE : ***EEPS***

DURATION OF COURSE : 6 SEMESTERS

SEMESTER: ***FIFTH SEMESTER***

| Sl. No. | SUBJECT | PERIODS | | | EVALUATION SCHEME | | | | | | | CREDITS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | THEORY | L | T | P | INTERNAL EVALUATION | | | ESE | PRACTICAL (SESSIONAL) | | TOTAL MARKS | |
| | | | | | TA | CT | TOTAL | | (INT.) | (EXT.) | | |
| 1 | Analysis of Electrical Power System | 3 | -- | 2 | 10 | 20 | **30** | 70 | 25 | 25 | **150** | 4 |
| 2 | Switch gear & Protection | 3 | -- | 2 | 10 | 20 | **30** | 70 | 25 | 25 | **150** | 4 |
| 3 | Microprocessor & Microcontroller | 3 | -- | 2 | 10 | 20 | **30** | 70 | 25 | 25 | **150** | 4 |
| 4 | Power Quality | 3 | -- | 2 | 10 | 20 | **30** | 70 | 25 | 25 | **150** | 4 |
| 5 | Industrial Project & Enterpreneurship Development | 1 | -- | 2 | | | | | 25 | 50 | **75** | 3 |
| 6 | ***Elective- I*** (Any One)<br>1) Power Plant Instrumentation & Control<br>2) Heating , Ventilation and Air Conditioning<br>3) Energy Conservation & Audit<br>4) Electric Traction | 3 | -- | 2 | 10 | 20 | **30** | 70 | 25 | 25 | **150** | 3 |
| 7 | Electrical Workshop - II | -- | -- | 3 | | | | | 25 | 25 | **50** | 1 |
| 8 | Professional Practices - III | -- | -- | 2 | | | **0** | | 50 | | **50** | 2 |
| | **TOTAL** | ***16*** | ***0*** | ***17*** | ***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 marks for sessional is 40%, and for theory subject 40%.**

| Name of the Course: ***DIPLOMA IN ELECTRICAL ENGINEERING (POWER SYSTEM)***<br>Subject : ***Analysis of Electrical Power System*** | |
|---|---|
| Course Code: **EEPS/S5/EPS** | 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:*** To obtain thorough knowledge in power system for its operation and control requires study and analysis of its performance under various working conditions. This subject deals with the representation of the power system, analysis of its components and determines performance by analytical as well as graphical methods which will be useful in analysis of electrical power system. This subject provides the basic knowledge required to study power system operation & control, Power Quality & deregulation System

.

***Objective:***

| **Sl. No.** | **The students will be able to:** |
|---|---|
| 1. | Identify Power System Components |
| 2. | Draw the different diagrams of given Power System. |
| 3. | Represent power system in per unit system. |
| 4. | Compute line parameters of transmission line. |
| 5. | Simulate short, Medium & long transmission line. |
| 6. | Determine the complex power of power system. |
| 7. | Analyze the system performance analytically &graphically |

**Pre-Requisite:**

| Sl. No. | |
|---|---|
| 1. | Three phase & single phase A.C fundamentals, Electromagnetism |
| 2. | Fundamentals of Power system, Electrical machines. |
| 3 | Fundamentals of Transmission & Distribution of Power. |

## ***Contents (Theory)***

| ***Unit*** | ***Contents*** | ***Hours*** | ***Marks*** |
|---|---|---|---|
| ***1.*** | ***Representation of Power System***<br>➢ Basic Structure of Power System.<br>➢ Equivalent Circuit representation of the System components- Alternator, Transformer, Transmission line: Short, Medium & long .<br>➢ Single line diagram.<br>➢ Impedance diagram.<br>➢ Reactance diagram.<br>➢ Per unit Calculations. .(Numerical)<br>➢ Aspects of Power System analysis.<br>➢ Role of power system Engineer . | ***5*** | ***9*** |
| ***2.*** | ***Transmission Line Parameter***<br>❖ **Resistance *(3Hrs)***<br>➢ Concept of transmission line resistance.<br>➢ Difference between A.C. resistance & D.C. resistance.<br>➢ Influence of skin effect and proximity effect on Line conductors.<br>➢ Effect of temperature on Transmission line resistance.(No derivation)<br>➢ Effect of resistance on line performance .<br>❖ **Inductance *(6 Hrs)*** | ***13*** | ***20*** |

| Unit | Contents | Hours | Marks |
|---|---|---|---|
| | ➢ Concept of Transmission Line Inductance.<br>➢ Significance of inductance.<br>➢ Flux linkage of isolated current carrying conductor due to internal and external flux .(Derivation only)<br>➢ Inductance of single-phase line composed of solid conductors & bundled conductors. (No Numerical)<br>➢ Concept of self G.M.D. and mutual G.M.D. (Numerical)<br>➢ Inductance of single phase line composed of composite conductors. (No derivation) Numerical .<br>➢ Inductance of three phase line (single circuit) composed of solid conductors with symmetrical and asymmetrical spacing.<br>❖ **Capacitance *(4 Hrs)***<br>➢ Concept of Line capacitance.<br>➢ Significance of capacitance.<br>➢ Potential difference between two points due to charged conductors (Gauss's Law.)<br>➢ Potential difference between two conductors in a group of charged conductors .<br>➢ Capacitance of single phase line composed of solid Conductors and duplex bundled conductors. (Numerical)<br>➢ Capacitance of three phase line (single circuit) with symmetrical spacing. (Numerical)<br>➢ Effect of earth field on transmission line capacitance.<br>➢ Capacitance of single phase line with solid conductors considering earth. | | |
| ***3.*** | ***Matlab Concept***<br>➢ Fundamental of Matlab Programming<br>• Variables, arrays, matrices<br>• Matlab operators, graphics, branching, looping, string & input/output functions.<br>➢ Simulink Fundamentals<br>• Commonly used blocks<br>• Power system toolbox<br>➢ Applications in Electrical Engineering<br>• Matlab program to find average, r.m.s., and peak value.<br>• Matlab program for Ohms law, Kirchoff's Law.<br>• Matlab program of series and parallel circuits.<br>• Matlab program of resonance phenomenon. | ***7*** | ***9*** |
| ***4.*** | ***Generalized Circuit***<br>➢ Concept of generalized circuit constants.<br>➢ Generalized circuit constants of short, medium & long transmission line.( No derivation ) Numerical<br>➢ Measurement of Generalized circuit constant.<br>➢ Generalized circuit constants of two networks connected in series & connected in parallel. ( only derivation)<br>➢ Advantages of Generalized circuit representation. | ***8*** | ***10*** |
| ***5.*** | ***Power flow***<br>➢ Concept of Complex Power (S=V*I), Real Power and reactive Power.<br>➢ Derivation of complex power, real power, reactive power for sending end as well as receiving end of the tr. line using GCE(Numerical)<br>➢ Condition for maximum power ( Numerical) | ***7*** | ***9*** |
| ***6.*** | ***Circle Diagram***<br>➢ Concept of circle diagram.<br>➢ Receiving end circle diagram.(procedure and numerical)<br>➢ Determination of ratings of reactive power compensating equipments. (procedure and numerical)<br>➢ Sending end circle diagram. (procedure and numerical)<br>➢ Advantages of circle diagram. | ***8*** | ***13*** |
| | **Total:** | **48** | **70** |

**Practical:**

**Skills to be developed:**

**Intellectual Skills**:

1. Identify power system parameters
2. Understand single line Diagram
3. Know the concept of Circle Diagram

**Motor Skills:**

1. Draw The single line diagram
2. Measure values of line parameters
3. Perform simulation for power system network

## Practicals: *(At least 8(eight) to be performed)*

1. Collect information of structure of power system in Eastern Region Grid & write report of it with details of Generation voltage levels. Transmission & distribution voltage levels .Transformer rating & connections
2. Determine Self & Mutual GMD for various conductor configuration ( min 8 example)
3. Measure Generalized circuit constants for Nominal T model
4. Measure Generalized circuit constants for Nominal Π model
5. Calculation of per unit values by using MATLAB programme .
6. Determination of GCC of Medium Transmission line by using MATLAB programme .
7. Calculate Receiving end complex power by using MATLAB programme
8. Calculate Sending end complex power by using MATLAB programme
9. Draw sending end Circle Diagram by using MATLAB programme
10. Draw Receiving end Circle Diagram by using MATLAB programme

## Books:

| Sl. No. | Author | Title | Publisher |
|---|---|---|---|
| 1 | B.R. Gupta | Power system Analysis and Design | Wheeler Publication |
| 2 | I. J. Nagrath & D. P. Kothari | Modem Power system Analysis | Tata McGraw Hill Publication (Fourth Edition 2011) |
| 3 | T.K.Nagsarkar & M. S. Sukhija | Power system Analysis | OXFORD university Press |
| 4 | Jolm J. Graninger & Wiliam D. Stevenson J.R. | Power system Analysis | Tata McGraw Hill Publication |
| 5 | C.L.Wadhwa | Electrical power systems | New Age International Publishers (Sixth Edition) |

***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 | 1 X 20 = 20 | FIVE | FIVE, TAKING AT LEAST TWO FROM EACH GROUP | 10 (TEN) | 10 X 5 = 50 |
| B | 4, 5, 6 | 11 | | | | FOUR | | | |

***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 (POWER SYSTEM)*** | |
|---|---|
| Subject : ***Switchgear and Protection*** | |
| Course Code: **EEPS/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***<br>1.1 Necessity & functions of protective system.<br>1.2 Normal & abnormal conditions.<br>1.3 Types of faults & their causes.<br>1.4 Use of current limiting reactors & their arrangements.<br>1.5 Short-circuit KVA calculations for symmetrical faults - problems. | 06 | 10 |
| 2 | ***Circuit interrupting devices***<br>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<br>2.1.1. HRC fuses - construction, types, working, characteristics, selection and applications<br>2.2. Isolators- vertical break, horizontal break & pentograph type<br>2.3. Arc formation process, methods of arc extinction, related terms.<br>2.4. Circuit breakers- Concept, Classification, Working principle, Construction, Specification & Applications of<br>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.<br>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.<br>2.1. Selection of MCCB for motor.<br>2.2. Selection and rating of circuit breakers – breaking capacity, making capacity, rated operating duty, rated voltage.<br>2.3. Elementary idea of Auto-reclosing. | 10 | 16 |
| 3 | ***Protective Relaying***<br>3.1. Zones of protection, primary & back-up protection, Essential qualities of protection, classification of protective schemes, basic relay terminology.<br>3.2. CT & PT used in protection: Requirements, Brief idea about CVT and CCVT.<br>3.3. Operating principles and construction (in brief) of: Electromagnetic relays, thermal relays, static relays (with merits and demerits), and Microprocessor based relays, | 15 | 16 |

| Unit | Contents (Theory) | Hrs./Unit | Marks |
|---|---|---|---|
| | Auxiliary switch Flags – conception only.<br>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.<br>3.5. Directional Relay - Introduction, Characteristics: Constant product characteristics, Polar characteristics, Concept of dead zone.<br>3.6. Distance Protection Scheme: Area of applications, Impedance relays, Reactance relay, MHO relay : operating characteristics, effect of arc resistance on their characteristics.<br>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:***<br>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.<br>4.2. **Transformer protection** – Percentage differential protection – problems, Buchholz Relay, rate of rise of pressure relay, over-fluxing protection, O/C protection.<br>4.3. **Protection of Motor**: Abnormalities & faults. Short circuit protection, Overload protection, Single phase preventor.<br>4.4. Protection of Busbar & transmission line | 10 | 16 |
| 5 | ***Over voltage Protection***<br>5.1. Causes of over voltages.<br>5.2. Lighting phenomena & over voltage due to lightning.<br>5.3. Protection of transmission line & substation from direct stroke.<br>5.4. Types of lightning arresters & surge absorbers & their Construction & principle of operation.<br>5.5. Protection against traveling waves.<br>5.6. Insulation co-ordination | 5 | 8 |
| 6 | Neutral Earthing<br>6.1. Introduction & importance.<br>6.2. Types of earthing<br>6.3. Substation earthing | 2 | 4 |
| | TOTAL | 48 | 70 |

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

| *Contents (Practical)* | |
|---|---|
| | 3.5. To test Directional Over Current Relay (DOCR) by Relay Testing Kit.<br>3.6. To simulate Alternator Protection.<br>3.7. To simulate the operation of Distance Relay.<br>3.8. To prepare a report on specifications of lightning arresters of different manufacturers through Brochures / Literature<br>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 (POWER SYSTEM)*** | |
|---|---|
| Subject : ***Microprocessor and Microcontroller*** | |
| Course Code: **EEPS/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***<br>1.1. Generation and evolution of 4 bit microprocessor to latest microprocessor<br>1.2. Basic Architecture of 8-bit Microprocessor<br>1.2.1.Hardware features of Intel - 8085 functional Blocks, bus structure.<br>1.2.2. Arithmetic Logic Unit<br>1.2.3. Registers (General purpose & Special Purpose)<br>1.2.4.Interrupts<br>1.2.5.Pin description.<br>1.3. Timing cycles of 8085 - Machine cycle, Opcode fetch cycle, execution cycle, instruction cycle. | 8 | 12 |
| 2 | ***Microprocessor Programming***<br>2.1. Instruction set of Intel 8085<br>2.2. Addressing modes<br>2.3. Introducing to branch and subroutine<br>2.4. Simple Program such as Addition, Subtraction, Multibyte addition, Multiplication of two numbers, BCD to Hex conversion, Hex to BCD conversion etc.<br>2.5. Interrupt . | 8 | 13 |
| 3 | ***Application of microprocessor***<br>3.1. Review of A/D and D/A converter<br>3.2. Interfacing – parallel ( 8255)<br>3.3. Measurement of voltage, current, frequency.<br>3.4. Generation of square, triangular and staircase waveform.<br>3.5. Over current Relay operation.<br>3.6. Speed control of D.C. motor. | 8 | 10 |
| 4 | ***Microcontroller Basics*** | 7 | 10 |

| Unit | Contents (Theory) | Hrs./Unit | Marks |
|---|---|---|---|
| | 4.1. Introduction and applications<br>4.2. Comparison between microcontrollers and microprocessors<br>4.3. Evolution of microcontrollers<br>4.4. Architecture of 8051<br>4.4.1. Block diagram of 8051 microcontroller<br>4.4.2. Registers in 8051<br>4.4.3. General purpose or working registers<br>4.4.4. Stack Pointer and Program counter<br>4.4.5. Special function registers (SFR)<br>4.4.6. Program Status word<br>4.4.7. Data pointer (DPTR)<br>4.4.8. Timer resisters<br>4.4.9. Ports<br>4.4.10. Control registers | | |
| 5 | ***8051 addressing modes and instructions***<br>5.1. 8051 addressing modes<br>5.2. 8051 instruction set<br>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***<br>6.1. Interrupts in 8051<br>6.2. Initializing 8051 interrupts<br>6.3. Interrupt priorities<br>6.4. Timers and counters, timer counter modes | 6 | 7 |
| 7 | ***Application of microcontroller***<br>7.1. Measurement of voltage, current, frequency.<br>7.2. Generation of square, triangular and staircase waveform.<br>7.3. Over current Relay operation .<br>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<br>ii) Programming skills |
| 2. | Motor Skills: i) Data entry, Error Correction and Execution of assembly language programms<br>ii) Connection Skills |

**Suggested list of Laboratory Experiments:**

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

**Suggested list of Laboratory Experiments:**

| *Sl. No.* | |
|---|---|
| | shunt along with an A/D converter.<br>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.<br>3. Generating of square, triangular, staircase wave form using D/A/ converter.<br>4. Over voltage/Under voltage or over current/under current relay circuit using suitable hardware circuit.<br>5. Control of a D.C. motor at different speed and to note speed vs Load characteristics at open loop condition.<br>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.<br>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<br>M.Sarvanan<br>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 (POWER SYSTEM)***<br>Subject : ***Power Quality*** | |
|---|---|
| Course Code: **EEPS/S5/PQ** | 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:*** Indentify causes of power quality, implement suitable methods to improve power quality, apply IEEE and IEC standards for power quality monitoring

***Objective:***

| Sl. No. | The students will be able to: |
|---|---|
| 1. | Aware of the concepts of power quality problems |
| 2. | Know the impacts of power quality problems on utility and end user. |
| 3. | Know the mitigation techniques for the various power quality problems. |
| 4. | Know the various IEEE and IEC standards related to power quality issues. |
| 5. | Understand the power quality monitoring and assessment tools. |

***Pre-Requisite:***

| Sl. No. | |
|---|---|
| 1. | Three phase & single phase A.C fundamentals, Electromagnetism |
| 2. | Fundamentals of Power systemElectrical machines. |

***THEORY***

| Unit | Contents | Hours | Marks |
|---|---|---|---|
| 1. | ***Power Quality Problems***<br>➢ Concept and importance of Power quality<br>➢ Concept of transients<br>✓ Impulsive transients- definition, characteristics<br>✓ Oscillatory transients- definition, characteristics<br>➢ Long duration voltage variations<br>✓ Overvoltages- definition, impacts<br>✓ Undervoltages- definition, impacts<br>✓ Sustained Interruptions- definition, impacts<br>➢ Short Duration voltage variations<br>✓ Interruption- definition, impacts<br>✓ Sags and Swells- definition, impacts<br>➢ Waveform Distortion<br>✓ DC offset- concepts, causes, impacts<br>✓ Harmonics and Inter harmonics- concepts, causes, impacts<br>✓ Notching- concepts, causes, impacts<br>➢ Voltage imbalance, voltage fluctuations, power frequency variations- concept, impacts | 7 | 11 |
| **2.** | ***Sags and Interruptions Specific Objectives***<br>➢ Sources of voltage sag and interruptions<br>➢ Equipment sensitivity to voltage sag- concept, classification<br>➢ Methods of improving voltage sag performance<br>✓ Ferro-resonant transformer- working principle, operation<br>✓ Magnetic Synthesizers- operation<br>✓ Active series compensators- operation, special features<br>✓ Online UPS, Standby UPS, Hybrid UPS- block diagram, operation | 8 | 13 |

| Unit | Contents | Hours | Marks |
|---|---|---|---|
| | ✓ Motor Generator switches- diagram, operation | | |
| 3. | ***Transient Overvoltage***<br>➢ Sources of transients<br>✓ Capacitor switching, magnification of capacitor switching transients<br>✓ Lighting and Ferro-resonance- characteristics, impacts<br>➢ Methods of overvoltage protection<br>✓ Surge arrestors, utility surge arrestors, surge suppressors, isolation transformers- operation<br>✓ Low pass filters, low impedance power conditioners- diagram, operation | 10 | 13 |
| 4. | ***Harmonics Specific Objectives:***<br>➢ Concept of total harmonic distortion, harmonic phase 04 marks sequences, inter harmonics<br>➢ Commercial sources of harmonics<br>✓ phase power supplies- characteristics, impacts<br>✓ Fluorescent lighting- characteristics, impacts<br>✓ Adjustable speed drives for HVAC and elevators- characteristics, impacts<br>➢ Industrial sources of harmonics<br>✓ 3-phase converters- characteristics, impacts<br>✓ Arcing and saturable devices- characteristics, impacts<br>✓ DC and AC drives- characteristics, impacts<br>➢ Effects of harmonic distortion on capacitors, transformers, motors, energy and demand metering<br>➢ Methods of controlling harmonics<br>✓ Reducing harmonic currents in loads-Concept, features<br>✓ Filtering- Concept, features<br>✓ Modifying the system frequency response- Concept, features<br>➢ Methods of Controlling harmonic distortion<br>✓ Inline reactors-Concept, operation<br>✓ Zigzag transformers-Concept, operation<br>✓ Active and Passive filters (series and shunt)- Concept, operation | 12 | 18 |
| 5. | ***Power Quality Monitoring Specific Objectives***<br>➢ Objectives of PQ monitoring<br>➢ Procedure of PQ monitoring<br>➢ PQ measuring instruments<br>✓ Multimeters, Oscilloscopes- operation, characteristics<br>✓ Digital cameras- operation, characteristics, special features<br>✓ Spectrum and Harmonic Analysers- operation, characteristics, special features<br>✓ Smart PQ monitors- operation, special features<br>➢ PQ monitoring standards<br>✓ IEC 61000-4-30- details of testing PQ measurement methods<br>✓ IEEE 1159- details, guidelines of PQ monitoring<br>✓ IEEE 519-1992 Details, guidelines of harmonics<br>✓ IEC 61000-2-2, IEC 61000-3-2, IEC 61000-3-4 | 11 | 15 |
| | | 48 | 70 |

***Contents (Practical)***

| Sl. No. | Skills to be developed |
|---|---|
| 1. | Intellectual Skills<br>1. Understand the problems of power quality<br>2. Indentify causes and sources<br>3. Suggest the method of improvement |
| 2. | Motor Skills: |

***Contents (Practical)***

| Sl. No. | Skills to be developed |
|---|---|
| | 1. Collect information from various resources<br>2. Measure parameters and record<br>3. Observe and interpret the waveforms |

**List of Practicals:**

1. Identification of the causes of voltage and frequency fluctuations on different electrical gazettes.
2. Write procedure and precautions of application of any method of improving voltage & frequency sag.
3. Collect the information of transient over voltages and latest methods of overvoltage protection from internet and write a report on it.
4. Collect the details of harmonic distortion controlling devices from various manufacturers and write a report on it.
5. Search case studies on impact of harmonics caused by electrical furnaces, transformers, motors and nonlinear loads and write report on it. Also write the latest methods of controlling these impacts
6. Prepare a PQ monitoring survey report of a area and indentify the locations of PQ monitoring.
7. Collect information on harmonic analysers and write a report on basis of specifications and special features.
8. Collect the details of IEEE 1159 standards for PQ monitoring and write a report mentioning procedure and special features.
9. Collect the details of IEC 61000-4-30 regarding testing and measurement of power quality problems
10. Search for details of latest methods of power quality measuring equipments from different manufactures and write a report on it.
11. Collect standards for harmonics and write a report on procedure and special features.

## Books:

| Sr. No. | Author | Title |
|---|---|---|
| 1 | Heydt | Power quality |
| 2 | IEEE Standard 512 | Recommended practices for power quality |
| 3 | Dugan | Power quality |

***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 | 13 | TWENTY | ONE | 1 X 20 = 20 | FIVE | FIVE, TAKING AT LEAST TWO FROM EACH GROUP | 10 (TEN) | 10 X 5 = 50 |
| B | 4,5 | 10 | | | | FOUR | | | |

***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 (POWER SYSTEM)***<br>Subject : ***INDUSTRIAL PROJECT AND ENTREPRENEURSHIP DEVELOPMENT*** | |
|---|---|
| Course Code: **EEPS/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: 2 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.<br>2. Design of Rural Electrification Scheme for small Village, Colony.<br>3. Energy Conservation and Audit.<br>4. Substation Model (Scaled)<br>5. Wind Turbine Model (Scaled)<br>6. Pole Mounted Substation Model (Scaled)<br>7. Conduct load survey to ascertain the total load requirements of a locality / polytechnic.<br>8. Any other items as may be assigned by the teacher concerned. | | |
| II | (1) Rewinding of Three Phase/Single Phase Induction Motor.<br>(2) Rewinding of Single Phase Transformer. | | |

***Actual work of project should be done in sixth semester.***

| *Group* | *Projects* | | |
|---|---|---|---|
| | (3) Fabrication of Inverter up to 1000 VA.<br>(4) Fabrication of Battery Charger.<br>(5) Fabrication of Small Wind Energy System for Battery Charging.<br>(6) Fabrication of Solar Panel System for Battery Charging.<br>(7) Fabrication of Water level controller.<br>(8) Fabrication of DC motor speed control circuit by SCRs.<br>(9) Microprocessor/ Micro controller Based Projects.<br>(10) Simulation Projects using Matlab.<br>(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<br>1.1. Concept, Classification & Characteristics of Entrepreneur<br>1.2. Creativity and Risk taking.<br>1.2.1. Concept of Creativity & Qualities of Creative person.<br>1.2.2. Risk Situation, Types of risk & risk takers.<br>1.3. Intrapreneuring and Entrepreneurship.<br>1.4. Business Idea: Methods and techniques to generate business idea.<br>1.5. Transforming Ideas in to opportunities : Transformation involves Assessment of idea & Feasibility of opportunity<br>1.6. SWOT Analysis |
| 2 | ***Information And Support Systems*** 05 Hrs<br>2.1. Industrial Policy reform in West Bengal<br>2.2. Financial assistance schemes of SIDBI (Small Industries Development Bank of India)<br>2.3. Financial assistance scheme of NSIC (National Small Industries Corporation)<br>2.4. Guidance/Assistance available from following organizations:<br>i. National Research Development Corporation (NRDC)<br>ii. Small Industries Service Institute(SISI)<br>iii. State Financial Corporation (SFC)<br>iv. District Industries Centre (DICs)<br>v. v) Chambers of Commerce and Industry and Industrial Association |
| 3 | ***Forming of Business Organization*** 02 Hrs<br>3.1. Market Survey<br>3.2. Advantages and Disadvantages of following types organizations:<br>a) Sole Proprietorship<br>b) Partnership<br>c) Joint stock company i) Private Limited Company<br>ii) Public Limited Company<br>3.1. Assess yourself-are you an entrepreneur? |
| 4 | ***Project Report Preparation*** 06 Hrs<br>4.1. Project Report and its utility<br>4.2. Preparation of Project Report of any one business.<br>Following statements are required to be prepared:<br>i. Calculation of working capital requirement.<br>ii. Cost of Production.<br>iii. Profitability Statement.<br>iv. Cash Flow statement.<br>v. Mean of Financing.<br>vi. Land and site Development<br>vii. Building<br>viii. Plant and Machinery<br>ix. Preliminary and Pre-operative Expenses |

| Chapter | Contents |
|---|---|
| | x. Manpower Estimates Staff and Labour<br>xi. Administrative Overheads.<br>xii. Miscellaneous Assets.<br>xiii. Calculation of Depreciation.<br>xiv. Interest Calculation.<br>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<br>B.S.Rathore | A Handbook of Entrepreneurship | Aapga Publication |
| J.S. Saini<br>B.S.Rathore — | Entrepreneurship Theory and Practice | Wheeler Publisher<br>New Delhi |
| E. Gorden<br>K.Natrajan | Entrepreneurship Development | Himalaya Publishing.<br>Mumbai |
| M.Schaper, T<br>Volery, P Weber,<br>K Lewis | Entrepreneurship And Small Business | Wiley |
| J.B.Patel<br>D.G.Allampally | A Manual on How to Prepare a Project Report | EDI STUDY MATERIAL<br>Ahmadabad (Near Village Bhat , Via Ahmadabad Airport & Indira Bridge),<br>P.O. Bhat 382428 , Gujrat,India<br>P.H. (079) 3969163, 3969153<br>E-mail: ediindia@sancharnet.in<br>olpe@ediindia.org<br><br>Website : http://www.ediindia.org |
| J.B.Patel<br>S.S.Modi | A Manual on Business Opportunity Identification & Selection | |
| S.B.Sareen<br>H. Anil Kumar | National Derectory of Entrepreneur Motivator & Resource Persons. | |
| Gautam Jain<br>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<br>Ahmadabad (Near Village Bhat, Via Ahmadabad Airport & Indira Bridge), P.O. Bhat 382428, Gujrat, lndia<br>P.H. (079) 3969163, 3969153<br>E-mail: ediindia@sancharnet.in<br>olpe@ediindia.org<br>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***<br>Subject : ***Power Plant Instrumentation & Control*** | |
|---|---|
| Course Code: **EEPS/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***<br>• Brief survey of methods of power generation- hydro, thermal, nuclear, solar and wind power<br>• Importance of Instrumentation in power generation<br>• Thermal power plant –building blocks, details of boiler | 2 | 3 |
| 2 | ***MEASUREMENTS IN POWER PLANTS***<br>• Instrumentation for Generator and Busbar coupling<br>• Electrical measurements – current, voltage, power, frequency, power – factor etc. –<br>• 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***<br>• Flue gas oxygen analyser –<br>• Analysis of impurities in feed water and steam –<br>• Dissolved oxygen analyser –<br>• Chromatography –<br>• PH meter –<br>• Fuel analyser –<br>• Pollution monitoring instruments. | 5 | 8 |
| 4 | ***Control Loops in Boiler***<br>• Combustion Control | 6 | 9 |

| Unit | CONTENTS (Theory) | Hours | Marks |
|---|---|---|---|
| | • Air/Fuel ratio Control<br>• Furnace draft control<br>• Drum level control<br>• Main steam & reheat steam temperature control<br>• Superheater control<br>• Deaerator control<br>• DCS in power plant<br>• Interlocking in boilers | | |
| 5 | ***Turbine - Monitoring & Control***<br>• Speed, vibration, shell temperature monitoring & control<br>• Steam pressure control<br>• Lubricant oil temperature control | 4 | 6 |
| 6 | ***Auxiliaries in Power Plants:***<br>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***<br>• Piping and instrumentation diagram of nuclear power plant-<br>• Types of reactors in nuclear power plant-<br>• Radiation detection instruments-<br>• Process sensors for nuclear power plants-<br>• Nuclear reactors control systems and allied instrumentation.<br>• Load despatch computer-<br>• Dedicated micro computers for sequencing data logging and alarming. | 6 | 10 |
| 8 | ***Hydel Power Plant*:** Types - flow rate, Water pressure<br>***Transformer*:** Transformer oil, hot spot, moisture detection<br>***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 (POWER SYSTEM)*** | |
|---|---|
| Subject : ***Heating, Ventilation & Air Conditioning (Elective)*** | |
| Course Code: **EEPS/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***<br>1.1. Laws of thermodynamics<br>1.2. Comparison between heat engine, heat pump and refrigeration<br>1.3. Definitions of refrigeration, ton of refrigeration, COP, enthalpy, entropy | 2 | 4 |
| 2 | ***Types of refrigeration systems***<br>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.<br>2.2. Vapour absorption system – components used in vapour absorption system, its operation, its merits and demerits compared to vapour compression system<br>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<br>3.2. Types of refrigerants presently in use<br>3.3. Desirable properties of refrigerants (Physical, chemical, thermodynamic)<br>3.4. Applications of important refrigerants<br>3.5. Eco-friendly refrigerants<br>3.6. Properties of lubricants<br>3.7. Lubricants and refrigerant compatibility<br>3.8. Foaming of oil and crankcase electric heater<br>3.9. Effect of lubricant flood back to compressor<br>3.10. Additives used in lubricants<br>3.11. Necessity of oil separator | | |
| 4 | ***Components of vapour compression system***<br>4.1. Various types of compressors – reciprocating (hermetic, semi sealed, open), rotary (centrifugal, lobe type, screw type, blade type), applications of each type.<br>4.2. Various types of condensers (air cooled, water cooled, evaporative), applications<br>4.3. Types of cooling towers – natural draft, forced draft<br>4.4. Types of evaporators – direct expansion type, flooded type, shell and coil type, double tube type, plate surface type<br>4.5. Throttling devices – hand expansion valve, constant pressure expansion valve, thermostatic expansion valve, high side float valve, capillary tube, electronic expansion valve<br>4.6. Accessories – receiver, oil separator, drier, strainer, solenoid valve. Note – schematic diagram and brief description only of the above components<br>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***<br>5.1. Psychrometry – Definition, psychrometric properties of air, use of psychrometric chart<br>5.2. Representation of simple air conditioning process on psychrometric chart.<br>5.3. Sling psychrometer<br>5.4. Air conditioning systems (Schematic layout, working and application of each of the following)<br>• Central air conditioning system – direct expansion type, chilled water type<br>• Package type air conditioning system<br>• Unitary air conditioning system, split type system<br>• Evaporative cooling<br>5.5. Applications of airconditioning – comfort airconditioning, industrial. Air conditioning, transport air conditioning | 5 | 10 |
| 6 | ***Components in air supply and distribution system***<br>6.1. Fans and blowers (centrifugal, axial flow) – schematic diagram and applications<br>6.2. Filters – (Dry, viscous, wet, electronic type) – schematic diagram and applications<br>6.3. Different types of humidifiers and dehumidifiers<br>6.4. Grills and registers<br>6.5. Duct system – heat gain or loss in ducts<br>6.6. Causes of pressure loss through air ducts<br>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<br>7.2. Different types of insulating materials used for airconditioning<br>7.3. Selection of insulating materials for walls, ceiling, floor, air ducts, chilled water pipes | | |
| 8 | ***Controls used in airconditioning***<br>8.1. High pressure and low pressure cutouts, overload protector, thermostat, oil safety switch, fusible plug, pressure equalizer<br>8.2. Microprocessor based controls and variable frequency drive<br>8.3. Fluid flow control devices (simple sketch and wiring diagram is expected) | 3 | 6 |
| 9 | ***Heat load***<br>9.1. Definitions – SHF, RSHF, EFSHF<br>9.2. Factors responsible for heat load<br>9.3. Conditions of airconditioning and representation of comfort zone on psychrometric chart<br>9.4. Determination of capacity of airconditioning unit by referring tables only (no calculations) | 3 | 6 |
| 10 | ***Heating and ventilation***<br>10.1. Plain heating, electric heating, steam heating, hot water heating, solar heating<br>10.2. Heating with humidification and heating with dehumidification<br>10.3. Natural ventilation<br>10.4. Mechanical ventilation – 1) Air extraction system 2) Air supply system, combined supply and extraction system<br>10.5. Air distribution system – perimeter system, extended plenum system, upward flow system, downward flow system, ejector system<br>10.6. Return duct system (only schematic diagrams and brief description of the above system) | 7 | 8 |
| | **TOTAL :** | **48** | **70** |

## *Contents (Practical)*

| Sl. No. | Skills to be developed |
|---|---|
| 1. | Intellectual Skills: 1. Interpret results<br>2. Write specifications |
| 2. | Motor Skills:. 1. Conduct trial<br>2. Read drawing and identify components<br>3. Carry out Welding |

## *List of Experiments/Reports (Any eight)*

| Sl. 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.<br>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 (POWER SYSTEM)*** | |
|---|---|
| Subject : ***Energy Conservation and Audit (Elective)*** | |
| Course Code: **EEPS/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***<br>Review of various energy sources, Need of energy conservation and energy audit. | 04 | 08 |
| 2 | Energy Conservation:<br>✓ Lighting energy: methods/Techniques of efficient lighting.<br>✓ Heating: methods/Techniques of energy Saving in Furnaces, Ovens and Boilers.<br>✓ Cooling: methods/Techniques of Energy Saving in Ventilating systems and Air Conditioners<br>✓ Motive power, Energy Efficient Motors, and Efficient use of energy in motors with the help of voltage reducers, automatic star/ delta converters.<br>✓ Power factor improvement devices and soft starters/Variable Frequency Drives.<br>✓ Amorphous Core Transformers.<br>✓ Cogeneration -Types and Advantages. | 12 | 18 |
| 3 | ***Tariff and Energy Conservation in Industries:***<br>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:***<br>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:***<br>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:***<br>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:<br>1. Identify different methods used for energy conservation.<br>2. Understand the importance of energy conservation.<br>3. Select proper tariff for given industry/institute.<br>4. Collect technical information regarding electricity act. |
| 2. | Motor Skills:<br>1. Prepare energy audit report.<br>2. Write visit report.<br>3. Use different methods of energy conservation.<br>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 (POWER SYSTEM)*** | |
|---|---|
| Subject : ***Electric Traction (Elective)*** | |
| Course Code: **EEPS/S5/ET(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. | One of the practical applications of electricity, which enters into the everyday life of many of us, is its use in service of mass transport - the electric propulsions of vehicles - electric trains, trolley buses, tram cars and in the latest developments such as metro and sky bus. |
| 2. | In view of the growing importance and technological developments, which have come about in this area in the recent past; for Electrical Engineering students, it is desirable to study the course dealing with electric traction. |

| ***Objective:*** | |
|---|---|
| **SI. No.** | **The students will be able to:** |
| 1. | Identify and explain use of components of the power supply arrangements for electric traction. |
| 2. | Maintain different overhead equipments. |
| 3. | Differentiate the various types of current collecting systems and current collecting gears based on utility. |
| 4. | Differentiate the various types of current collecting systems. |
| 5. | Explain special requirements of train lighting and various systems of train lighting. |
| 6. | Describe the recent trends in Electric traction, such as LEM propelled traction |
| Pre-requisite: | |
| **SI. No.** | |
| 1. | Utilization, traction & Heating in 4th Semester. |
| 2. | A.C and D.C. Motors and Power Supply |

| Unit | Contents (Theory) | Hours | Marks |
|---|---|---|---|
| 1 | 1.1. - Nomenclature used For Electric Locomotives<br>1.2. - Types of Electric Locomotives by Nomenclature.<br>1.3. - AC Locomotive:<br>1.3.1. Equipments of AC Electric Locomotive: Power Circuit Equipments and Auxiliary Circuit Equipments.<br>1.3.2. Equipments in Power Circuit and their Functions: Power Circuit Diagram of AC Locomotive: Pantograph, Circuit breaker, Tap Changer, Traction Transformer, Rectifier, Smoothing, Choke, Traction Motor.<br>1.3.1. Equipments in Auxiliary Circuit & their Functions: Head Light, Flasher Light, Horn, Marker Light, Batteries, Arno Converter, Blowers, Exhausters, Compressors, Selsyn transformer. | 12 | 18 |
| 2 | 2.1. Constituents of Supply System: Substations, Feeding Posts, Feeding and Sectioning Arrangements, Sectioning and Paralleling Post, Sub sectioning and Paralleling Post, Sub sectioning Post, Elementary Section, Miscellaneous Equipments at Control Post or Switching Stations.<br>2.2. List of Major Equipments at Substation.<br>2.3. Location and spacing of substation. | 08 | 10 |

| Unit | Contents (Theory) | Hours | Marks |
|---|---|---|---|
| 3 | Overhead Equipments:<br>3.1. Overhead Equipments (OHE).<br>3.2. Principles of Design of OHE: Composition of OHE, Height of Contact Wire,<br>Contact Wire Gradient, Encumbrances, Span Length.<br>3.3. Automatic Weight Tension and Temp. Compensation.<br>3.4. Uninsulated Overlaps.<br>3.5. Insulated Overlaps.<br>3.6. Neutral Section.<br>3.7. Section Insulator.<br>3.8. Isolator.<br>3.9. Polygonal OHE: Single Catenary Construction, Compound Catenary Construction, Stitched Catenary Construction, Modified Y Compound Catenary.<br>3.10. Effect of Speed on OHE.<br>(No derivation and No numerals) | 09 | 12 |
| 4 | Current Collecting Equipments:<br>4.1. Introduction.<br>4.2. Systems of Supplying Power in Electric Traction: Overhead System, Third Rail or Conductor Rail System.<br>4.3. Current Collectors for Overhead System:<br>• Trolley Collector or Pole Collector, Bow Collector, Pentograph Collector.<br>4.4. Types of Pentographs: Diamond Pentograph and Faiveley Type.<br>4.5. Methods of raising and lowering of Pentograph | 06 | 10 |
| 5 | Train Lighting:<br>5.1. Systems ofTrain Lighting.<br>5.2. Special Requirements ofTrain Lighting.<br>5.3. Method of obtaining Unidirectional Polarity.<br>5.4. Method of obtaining Constant Output.<br>5.5. Single Battery System.<br>5.6. Double Battery Parallel Block System. | 05 | 8 |
| 6 | LEM Propelled Traction:<br>6.1. - Introduction.<br>6.2. - Linear Electric Motor (LEM)<br>6.3. - Linear Induction Based Traction System:<br>• Moving Primary Fixed Secondary Single Sided LIM.<br>• Moving Secondary Fixed Primary Single Sided LIM.<br>• Moving Primary Fixed Secondary Double Sided LIM.<br>6.4. - Strengths/Weaknesses of LIM Propelled Railway Traction:<br>• Strengths of LIM Propelled Railway Traction System.<br>• Weaknesses of LIM Propelled Railway Traction System.<br>6.5. - LIM Propelled Underground Metro Rail System:<br>• Factors Influencing Adoption of LIM for Metro Rail.<br>• International Scenario.<br>6.6. - Wheel Less Traction: Levitation Schemes, Present Scenario. | 08 | 12 |
| | Total | 48 | 70 |

## *Contents (Practical)*

| **List of Practical Work:** | |
|---|---|
| **Sl. No.** | **Nature of work (students are expected to identify and explain function of each item related to their work)** |
| 1. | Study of Electric AC Locomotives. |
| 2 | Study of Different types of Relays, Contactors used in AC Locomotive |
| 3 | Computer Aided Locomotive Designs |
| 4 | Drawing (on half Imperial sheet) for Power Circuit of any type of Electric Locomotive |

***Contents (Practical)***

| List of Practical Work: | |
|---|---|
| **Sl. No.** | **Nature of work (students are expected to identify and explain function of each item related to their work)** |
| 5 | Drawing (on half Imperial sheet) for Protection of Electric Locomotive. |
| 6 | Drawing on half Imperial sheet for Traction Substation Layout or Feeding Post |
| 7 | Drawing on half Imperial sheet for Pentagonal OHE Catenary, Different Catenary according to speed limit, Cantilever assembly, OHE Supporting structure, Pentograph, Cross section of Contact Wire. |
| 8 | Visit to Traction Substation (for substation layout and OHE) and writing a report. Also write a report on OHE maintenance schedule. |
| 9 | Visit to Railway Station (for signaling and train lighting) and writing a report |
| 10 | **Mini Project:** Collection of information using Internet on any two topics related to electric traction and submission of printouts |

***Books***

| SI No. | Name of Authors | Titles of the Book | Name of Publisher |
|---|---|---|---|
| 1 | H. Partab | Modern Electric Traction | Dhanpat Rai & Sons |
| 2 | \|. Upadhyay<br>S. N. Mahendra | Electric Traction | Allied Publishers Ltd. |
| 3 | Andreas Steimel | Electric Traction –Motive Power and Energy supply | Oldenbourg-indstrieverlag |

***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, | 5 | TWENTY | ONE | 1X20 = 20 | TWO | FIVE, TAKING AT LEAST ONE FROM EACH GROUP | TEN | 10X5 = 50 |
| B | 2,3 | 7 | | | | FOUR | | | |
| C | 4,5 | 5 | | | | TWO | | | |
| D | 6 | 3 | | | | TWO | | | |

***<u>EXAMINATION SCHEME (SESSIONAL)</u>***

**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 Practical work done throughout the semester.

**Distribution of marks: Mini Project work - 5, Sessional work – 5, Viva-voce - 15.**

| Name of the Course: ***DIPLOMA IN ELECTRICAL ENGINEERING (POWER SYSTEM)*** | |
|---|---|
| Subject: **Electrical Workshop II** | |
| Course Code: **EEPS/S5/WSII** | Semester: SIXTH |
| Duration: one Semester | Maximum Marks: 50 |
| Teaching Scheme | Examination Scheme |
| Theory: | Practical : 50 Marks |
| Tutorial: | |
| Practical: 3 hrs./week | |
| Credit: 1 (One) | |

| **Aim:** | |
|---|---|
| SI. No. | |
| 1. | A technician should carry out routine & preventive maintenance of electrical machines & possesses knowledge of Indian Electricity Act, safety rules, safety of machines & persons, prevention of accident. He/She should also able to repair various appliances. |
| **Objective:** | |
| SI. No. | |
| 1. | • Identify / Locate common troubles in electrical machines & switch gear. |
| 2. | • Plan & carry out routine & preventive maintenance. |
| 3. | • Ascertain the condition of insulation & varnishing if necessary. |
| 4. | • Identify faults & measures to repair faults. |
| **Pre-Requisite:** | |
| SI. No. | |
| 1. | Knowledge of electrical equipments and accessories. |

| **Contents (Practical)** | |
|---|---|
| Suggested list of Practicals/Exercises: | |
| SI. No. | Practicals/Exercises |
| 1. | To Demonstrate various components of D.O.L., Star-Delta and Auto Transformer Starter. |
| 2. | To prepare a report on specifications of earthing at different substations/different locations & new trends in earthing schemes. |
| 3. | To observe & carry out periodic maintenance of D.C & A.C. motor in your workshop or laboratories & prepare its report |
| 4. | To prepare trouble-shooting chart & carry out maintenance of a single and three phase transformers |
| 5. | To prepare trouble-shooting chart & carry out maintenance of single and three phase induction motors |
| 6. | To prepare trouble-shooting chart for HV and LV Switch Gear |
| 7. | To carry out filtration of insulating oil and measure Break Down Voltage. |
| 8. | Dismantling, assembly, testing, preparation of list of components, parts for: (any four)<br>i] D.C. compound motor<br>ii] 3 phase Induction motor.<br>iii] Geyser.<br>iv] UPS / Inverters / battery chargers<br>v] Microwave Ovens<br>vi] Semi automatic & fully automatic washing machine |

**EXAMINATION SCHEME (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, Laboratory Notebook - 10.
2. External Assessment of 25 marks shall be held at the end of the Sixth Semester on the entire Sessional 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: **EEPS/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: 2 | 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:***<br>Structured Field visits be arranged and report of the same should be submitted by the individual student, to form part of the term work.<br>Visits to anv TWO from the list below (should not have completed in earlier semester):<br>i. A thermal power generating station<br>ii. A Hydel power generating station<br>iii. A Wind mill and / or Hybrid power station of wind and solar<br>iv. An electrical substation<br>v. A switchgear manufacturing / repair industry<br>vi. An Electrical machine manufacturing industry<br>vii. A large industry to study protection system<br>viii. Any Industry having Automation for manufacturing processes<br>ix. A transformer repair Workshop<br>x. Industry of power electronics devices<br>xi. Maintenance department of a large industry.<br>xii. A Loco shed<br>xiii. Railway / metro railway signaling system<br>xiv. Transmission tower project area<br>xv. Any contemporary industry under MSME sector to understand detail of operation and starting of a new venture.<br>xvi. Any other technical field area as may be found suitable alternative to above list. | |
| 2 | ***Guest Lecture by professional / industrial expert:***<br>Lectures by Professional / Industrial Expert to be organized from any TWO | |

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

| ***Activities*** | | |
|---|---|---|
| **Sl. No.** | **Activities** | **Hours** |
| | 7. Energy saving in the institute<br>8. Pollution control<br>***9.*** viii) Any other common topic related to electrical field as directed by concerned teacher. | |
| 5 | ***Students' Activities / mini project (any one):***<br>i. Develop a website for your institute<br>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.<br>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.<br>iv. Prepare a report on Tariff structure for different types of consumers related to various electricity boards of our state and make a comparison.<br>*Also write a report on Energy conservation Act, energy efficiency, BEE Star Rating for different domestic appliances and their meaning.* | |

***<u>EXAMINATION SCHEME (SESSIONAL)</u>***

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.**