# West Bengal State Council of Technical & Vocational Education and Skill Development
# (Technical Education Division)

## Syllabus
## of

## Diploma in Electrical Engineering [EE]

## Part-III (5th Semester)

Revised 2022

| Sl.No | Category of course | Code No | Course Title | Credits | Marks | Total Contact Hours per Week | |
|---|---|---|---|---|---|---|---|
| | | | | | | L | P |
| 1 | Program Core Course | **EEPC301** | Microcontroller and its Applications | 3 | 100 | 3 | 0 |
| 2 | Program Core Course | **EEPC303** | Microcontroller and its Applications Laboratory | 1 | 100 | 0 | 2 |
| 3 | Program Core Course | **EEPC305** | Building Electrification | 3 | 100 | 3 | 0 |
| 4 | Program Core Course | **EEPC307** | Building Electrification Laboratory | 1 | 100 | 0 | 2 |
| 5 | Program Elective course II | | **Any one of the following subjects to be chosen** | 3 | 100 | 3 | 0 |
| | | **EEPE301/1** | 1.IndustrialAutomation & Control | | | | |
| | | **EEPE301/2** | 2. Industrial Drives | | | | |
| 6 | Program Elective course II lab | | **Any one of the following laboratories to be chosen** | 1 | 100 | 0 | 2 |
| | | **EEPE303/1** | 1. Industrial Automation &Control Laboratory | | | | |
| | | **EEPE303/2** | **2.** Industrial Drives Laboratory | | | | |
| 7 | Program Elective course III | | **Any one of the following subjects to be chosen**. | 3 | 100 | 3 | 0 |
| | | **EEPE305/1** | 1. Illumination Practices | | | | |
| | | **EEPE305/2** | 2. Electric Traction | | | | |
| | | **EEPE305/3** | 3. Solar Power Technologies | | | | |
| 8 | Program Elective course III Lab | | **Any one of the following laboratories to be chosen** | 1 | 100 | 0 | 2 |
| | | **EEPE307/1** | 1. Illumination Practices Laboratory | | | | |
| | | **EEPE307/2** | 2. Electric Traction Laboratory | | | | |
| | | **EEPE307/3** | 3. Solar Power Technologies Laboratory | | | | |
| 9 | Internship | | Internship II | 1 | 100 | 0 | |
| 10 | Major Project | **PR301** | | 2 | 100 | 0 | 4 |
| **TOTAL** | | | | **19** | **1000** | **12** | **12** |

- Student **contact hrs./ week =24**
- Theory and practical periods of 60 minutes each
- Abbreviation: L: Lecture class; P: Practical class
- **For Theoretical subjects**: Internal Assessment (40 Marks): Mid semester class test: 20 Marks; Quizzes, viva-voce, Assignment: 10 Marks; Attendance: 10; External Assessment: 60 Marks.
- **For Practical/ Sessional Subjects**: Internal Assessment-60 Marks [Continuous Evaluation:50; Class Attendance:10]; End Semester Assessment-40 Marks [Assignment on the day of Viva-voce and Practical Report submission:20; Viva-voce:20]
- To make the students more familiar with software, effort should be made to prepare laboratory report (like graph; data table etc.) in soft format in addition with traditional hard copy wherever possible.

| | | |
|---|---|---|
| Course Code | : | EEPC301 |
| Course Title | : | MICROCONTROLLER AND IT'S APPLICATIONS |
| Number of Credits | : | 3 (L: 3, T: 0, P: 0) |
| Prerequisites | : | NIL |
| Course Category | : | PC |

## Course Objective

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences –

• Maintain different types of microcontroller-based systems.

| Contents (Theory): | | Hrs./Unit |
|---|---|---|
| **Unit : 1** | Introduction to Microcontrollers<br>1.1. Basic concept of 8085 microprocessor architecture with functional block diagram.<br>1.2. Evolution of Microcontrollers.<br>1.3. Block diagram of Microcomputer, elements of Microcomputer, types of buses.<br>1.4. Von Neuman and Harvard Architecture.<br>1.5. Compare Microprocessor and Microcontrollers.<br>1.6. Need of Microcontroller.<br>1.7. Family of Microcontrollers and their specifications.<br>1.8. Versions of Microcontroller 8951, 89C1051, 89C2051, 89C4051 with their specifications and comparison. | **07** |
| **Unit : 2** | Architecture of Microcontroller 8051<br>2.1 Block diagram of 8051, function of each block.<br>2.2 Pin diagram, function of each pin.<br>2.3 Concept of Internal memory and External memory (RAM and ROM).<br>2.4 Internal RAM structure.<br>2.5 Reset and clock circuit.<br>2.6 Various registers and SFRs of 8051 | **08** |
| **Unit: 3** | 8051 Instruction Set and Programs<br>3.1 Overview of 8051 instruction set.<br>3.2 Various addressing modes.<br>3.3 Classification of instructions.<br>3.4 Data transfer instructions.<br>3.5 Arithmetic and Logical instructions.<br>3.6 Branching instructions.<br>3.7 Bit manipulation instructions.<br>3.8 Stack, subroutine and interrupt related instructions.<br>3.9 Programs based on above instructions such as Addition, Subtraction, Multi-byte addition, Multiplication of two numbers, BCD to Hex conversion, Hex to BCD conversion, HEX to ASCII conversion etc. | **08** |

| | | |
|---|---|---|
| **Unit: 4** | Assembly Language Programming<br>4.1 Software development steps.<br>4.2 Software development tools like Editor, Assembler, Linker, Loader and Hex converters.<br>4.3 Role of various files created at various levels in running an Assembly program using simulators like RIDE or KEIL.<br>4.4 Various directives of Assembly language programming.<br>4.5 Programs using directives. | **11** |
| **Unit: 5** | 8051 Internal Peripherals and Related Programs<br>5.1 I/O ports- List, diagram, read write operation, instructions and related SFRs.<br>5.2 Timers/counters – list, related SFRs, programming modes, operations with diagram.<br>5.3 Serial communication- Basics of serial communication, baud rate, related SFRs, programming modes, operations with diagram.<br>5.4 Interrupts- related SFRs, types, operations with diagram.<br>Power saving operation- modes, related SFR.<br>5.5 Some applications of microcontroller<br>a. Measurement of voltage, current, frequency.<br>b. Generation of square, triangular and staircase waveform.<br>c. Over current Relay operation.<br>d. Speed control of D.C. motor. | **11** |
| | **Total** | **45** |

## References:


1. Mazidi, Mohmad Ali; Mazidi, Janice Gelispe; MckinlayRoline D., The 8051 Microcontroller and Embedded system, Pearson Education, Delhi, ISBN 978-8177589030
2. Pal, Ajit, Microcontroller Principle and Application, PHI Learning, New Delhi,ISBN13:978-81-203-4392-4
3. Kenneth, Ayala, 8051 Microcontroller Architecture Programming and Application, PHI Learning, New Delhi, ISBN: 978-1401861582
4. Deshmukh, Ajay, Microcontroller Theory and Application, McGraw Hill., New Delhi, ISBN- 9780070585959
5. Kamal, Raj, Microcontroller Architecture Programming, Interfacing and System Design, Pearson Education India, Delhi, ISBN: 9788131759905
6. Mathur; Panda, Microprocessors and Microcontrollers, PHI Learning, New Delhi, ISBN:978-81- 203-5231-5
7. Krishna Kant, Microprocessors and Microcontrollers: Architecture programming and System Design, PHI Learning, New Delhi, ISBN:978-81-203-4853-0


## Course Outcomes

The theory and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry-oriented COs associated with the above-mentioned competency:

a) Interpret the salient features of various types of microcontrollers.
b) Interpret the salient features of architype of types microcontrollers IC 8051.
c) Maintain the program features of the Microcontroller based application.
d) Develop assembly language program.
e) Develop programs to interface 8051 microcontrollers with LED/SWITCH/MOTOR.

| Internal Assessment (40 Marks) | | |
|---|---|---|
| Mid Semester Class Test:20 Marks | Quizzes, viva-voce, Assignment: 10 Marks | Attendance: 10 |

| External Assessment (End Semester Examination:60 Marks) | |
|---|---|
| GROUP | UNIT |
| A | 1,2 |
| B | 3,4 |
| C | 5 |

| | | |
|---|---|---|
| Course Code | : | EEPC 303 |
| Course Title | : | MICROCONTROLLER AND IT'S APPLICATIONS LABORATORY |
| Number of Credits | : | 1 (L: 0, T: 0, P: 2) |
| Prerequisites | : | NIL |
| Course Category | : | PC |

## Course Objective

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

• Maintain microcontroller-based systems.

## Practicals

| List of Practical:(at least EIGHT are to be done) | |
|---|---|
| 1. | Interpret details of Hardware kit for Microcontroller and practice to write and execute programs. |
| 2. | Identify different menus available in a simulator software RIDE/KEIL and demonstrate their use. |
| 3. | Develop and execute Assembly language programs using Arithmetic Instructions and demonstrate outcome for a given input data. |
| 4. | Develop and execute Assembly language programs using Logical Instructions and demonstrate outcome for a given input. |
| 5. | Develop and execute an Assembly language program for Addition of series of 8 bit nos, 16 bit result and demonstrate outcome for a given input data. |
| 6. | Develop and execute Assembly language program for addition/subtraction of 16 bit no/multibyte nos. and demonstrate outcome for a given input data. |
| 7. | Develop and execute Assembly language program for Block transfer from and to Internal/External memory using directives and demonstrate outcome for a given input data. |
| 8. | Develop and execute Assembly language program Largest/smallest of given series of no. from Internal/External memory and demonstrate outcome for a given input data. |
| 9. | Develop and execute Assembly language program arrange no in ascending/descending order from Internal/External memory and demonstrate outcome for a given input data. |
| 10. | Develop and execute Assembly language program for LED blinking/LED sequences using delay/timer mode. |
| 11. | Develop and execute Assembly language program to interface LED with microcontroller |
| 12. | Using 8051, develop, run and test Over voltage/under voltage or over current/under current relay circuit with suitable hardware circuit. |
| 13. | Using 8051, Develop, run and test Speed Control of a D.C. motor and note speed vs. Load characteristics at open loop condition. |
| 14. | Using 8051, develop, run and test the operation of a stepper motor with a fixed number of steps and determine the angular displacement per step by measuring the total angular rotation. |
| 15. | Using 8051, develop, run and test Traffic light Control using 8051. |
| 16. | 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. using 8051. |

## Course Outcomes

The theory, practical experiences and relevant soft skills associated with the course are to be taught and implementatecd so that the student demonstrates the following industry-oriented COs associated with the above-mentioned competency:

a) Interpret the salient features of various types of microcontrollers.

b) Interpret the salient features of architype of types microcontrollers IC 8051.

c) Maintain the program features of the Microcontroller based application

d) Develop assembly language program.

e) Develop program to interface 8051 microcontrollers with LED/SWITCH/MOTOR.

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

1. **Continuous Internal Assessment of 60 marks** is to be carried out by the teachers throughout the fourth Semester. **Distribution of marks:** Continuous evaluation:50 Marks; Class Attendance: 10 Marks
2. **External Assessment (end Semester examination) of 40 marks** shall be held at the end of the fourth Semester on the entire syllabus. Assignment on the day of Viva-voce and practical report submission:20; Viva-voce:20

| | | |
|---|---|---|
| Course Code | : | EEPC 305 |
| Course Title | | BUILDING ELECTRIFICATION |
| Number of Credits | : | 3 (L: 3, T: 0, P: 0) |
| Prerequisites | : | NIL |
| Course Category | : | PC |

**Course objectives:**

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Design electrical installation systems in building complexes.

| Contents (Theory): | | Hrs/Unit |
|---|---|---|
| **Unit : 1** | 1.1 Indian Electricity Rules (1956):<br>Rule 28: Voltage level definitions.<br>Rule 30: Service lines & apparatus on consumer premises.<br>Rule 31: Cut-out on consumer's premises.<br>Rule46: Periodical inspection & testing of consumer's installation.<br>Rule 47: Testing of consumer's installation.<br>Rule 54: Declared voltage of supply to consumer.<br>Rule 55: Declared frequency of supply to consumer.<br>Rule 56: Sealing of meters & cut-outs.<br>Rule 77: Clearances above ground of the lowest conductor.<br>Rule 79: Clearances between conductors & trolley wires.<br>Rule 87: Lines crossing or approaching each other.<br>Rule 88: Guarding<br>1.2 Classification of electrical accessories- controlling, holding, safety, outlet<br>BIS symbols of following electrical accessories.<br>1.2.1 **Switch** – Their types according to construction such as surface switch, flush switch, and pull switch, rotary switch, knife switch, pendent switch, Main-switch (ICDP, ICTP). Their types according to working such as single pole, double pole, two-way, two-way centre off, intermediate, series parallel switch<br>1.2.2 **Holders-** Their types such as bayonet cap lamp holder, pendent holder, batten lamp holder, angle holder, bracket holder, tube light holder, screw type Edison and goliath Edison lamp holder, swivel lamp holder.<br>1.2.3 **Socket outlets and plugs**- two pin, three-pin, multi pin sockets, two-pin and three-pin plug.<br>1.2.4 **Others**- Iron connector, adaptor, and ceiling rose, distribution box, neutral link, bus-bar chamber.<br>Wooden/ mica boards, Moulded/ MS Concealed boxes of different sizes.<br>Modular accessories. | **06** |

| | | |
|---|---|---|
| **Unit : 2** | **Electrical Wires and Underground Cables**<br>2.1Conductors: - wire, cable, bus bar, stranded conductor, cable, armored cable, flexible cable, solid conductor, PVC wires, CTS wire, LC wire, FR (Fire retardant) wire.<br>2.2 Size of wire according to BIS. Tools used for measurement of wire size, Wire jointing methods.<br>2.3 Classification of cables: low tension, high tension, and extra high tension cables, solid, oil filled and gas filled type.<br>2.4 Cable insulation materials –Class of Insulation; vulcanized rubber (VIR), polyvinyl chloride (PVC), cross linked polythene (XLPE), impregnated paper.<br>2.5 Selection of suitable cable size and type from standard data.<br>2.6 Cable jointing methods and Cable laying methods. | |
| **Unit: 3** | **Illumination in Residential Installation**<br>3.1. Concept of Luminous flux, Luminous intensity, Lumen, Illumination or illuminance, Lux, Space-height ratio, utilization factor, depreciation factor, luminous efficacy.<br>3.2 Laws of Illumination-Inverse Square Law, Cosine Law (related numerical).<br>3.3 Factors affecting the illumination. Different types of lighting arrangements,<br>3.4 Luminous flux of different types of light sources.<br>3.5 Lux level required for different places as per SP 72: 2010.<br>3.6 Lighting design of a room for estimation of lamps. | 06 |
| **Unit: 4** | **Wiring Methods and wiring layout**<br>**4.1 Classification of wiring methods:**<br>4.1.1 PVC casing-capping wiring- wiring rules according to IS: 732-1983<br>4.1.2 Conduit wiring- Types of conduits, comparison between Metal and PVC conduit, types of conduit wiring (Surface/Concealed). Conduit wiring accessories, BIS rules for Metal and PVC conduit wiring.<br>4.1.3 Factors determining the selection of wiring methods.<br>4.1.4 Comparison of various wiring systems.<br>4.1.6 General BIS rules for domestic installations.<br>**4.2 Design, working and drawing of following electrical circuits:**<br>4.2.1 Simple light and fan circuits<br>4.2.2 Stair case wiring, Go-down wiring circuit<br>4.2.3 Bedroom lighting circuit<br>4.2.4 Corridor lighting circuit<br>4.2.5 Series parallel circuit, Master switch control circuit<br>4.2.6 Different lighting circuit using - Intermediate switch, Call bell circuit using bell indicator, Design of wiring circuits according to user's requirement. | **07** |
| **Unit: 5** | **Residential Building Electrification**<br>5.1 Domestic Dwellings/Residential Buildings: reading of Civil Engineering building drawing, Interpretation of electrical installation plan and electrical diagrams, electrical symbols as per IS: 732.<br>5.2 Electrical installation for residential building as per part I section 9 of NEC-2011<br>5.3 Difference between residential and industrial load, rules/requirements related to lighting load followed in electrical installations, Positioning of equipment.<br>5.4 Lighting and power circuits: Light and fan circuit, Power circuit<br>5.5 Wiring and circuit Schematic diagram according to IS: 2042(Part-I)-1962: multiline and single line representation<br>5.6 Load assessment: Selection of size of conductor, Selection of rating of main switch and protective switch gear. | **12** |

| | | |
|---|---|---|
| | 5.7 Design and drawing, estimation and costing of a residential installation having maximum 5 KW load; Sequence to be followed for preparing estimate; Calculation of length of wire and other materials, labour cost.<br>5.8 Testing of wiring installation as per IS: 732-1982: Insulation resistance - between earth and conductors, between conductors, polarity test of single pole switches. Testing of earth continuity path.<br>5.9 Residential building Service Connection- types Underground and overhead. Calculation of Material required for service connection. | |
| **Unit 6** | **Protection of Electrical Installation**<br>6.1 Fuse in electric circuit: Re-wirable, cartridge fuses (HRC and LRC), Fuse material, Selection of fuse and rating.<br>6.2 Miniature circuit Breaker (MCB)-Construction, Principal rating and uses, Earth Leakage Circuit Breaker (ELCB)-Construction, Principal rating and uses.<br>6.3 System and equipment earthing and its requirements, Earth, earth electrode, earth current, earth terminal, earthing wire, earthing lead, fault current, leakage current, Measurement of earth resistance using earth tester, Methods of reducing earth resistance, Methods of earthing as per IS 3043: 1987 and their procedure- Driven pipe, pipe and plate earthing, modern methods of earthing | **06** |
| | **Total** | **45** |

**References:**


1. Raina, K.B. and S.K.Bhattacharya, Electrical Design Estimating and Costing, New Age International Ltd., New Delhi, ISBN978-81-224-0363-3
2. Allagappan,N. S.Ekambarram, Electrical Estimating and Costing, TMH New Delhi, ISBN-13: 9780074624784
3. Singh, Surjit, Electrical Estimating and Costing, Dhanpat Rai and Co. New Delhi, ISBN: 1234567150995
4. Gupta, J B: A Course in Electrical Installation Estimating and Costing, S K Kataria and Sons,New Delhi, ISBN:978-93-5014-279-0
5. Bureau of Indian Standard, IS: 732-1989, Code of practice for electrical wiring installation
6. Bureau of Indian Standard, SP 30 National Electrical Code 2010
7. Bureau of Indian Standard, SP 72 National Lighting Codes 2010
8. E-REFERENCES:-
   - http://nptel.ac.in/courses/108108076/1 , assessed on 18th January 2016
   - http://www.electrical4u.com, assessed on 18th January 2016
   - https://www.youtube.com/watch?v=A9KSGAnjo2U, assessed on 18th January 2016
   - http://www.electricaltechnology.org/2015/09, assesed on 30 Jan 2016
   - www.slideshare.net/bawaparam/made-by-paramassesed on 30 Jan2016
   - www.electricaltechnology.org/2013/09/electrical-wiring.html assessed on 16 March 2016.


**Course outcomes:**

The theory and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a) Understand the functioning of accessories for electrification and significance of IE rules.
b) Selection of wires, cables, wiring systems and cable laying.
c) Design proper illumination scheme for residential unit.
d) Design wiring layouts on wiring board.
e) Design electrical wiring installation system for residential unit.
f) Understand proper earthing and other protection devices for building electrification.

| Internal Assessment (40 Marks) | | |
|---|---|---|
| Mid Semester Class Test:20 Marks | Quizzes, viva-voce, Assignment: 10 Marks | Attendance: 10 |

| External Assessment (End Semester Examination:60 Marks) | |
|---|---|
| GROUP | UNIT |
| A | 1,2 |
| B | 3,4 |
| C | 5,6 |

| | | |
|---|---|---|
| Course Code | : | EEPC307 |
| Course Title | : | BUILDING ELECTRIFICATION LABORATORY |
| Number of Credits | : | 1 (L: 0, T: 0, P: 2) |
| Prerequisites | : | NIL |
| Course Category | : | PC |

**Course objectives:**

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Design electrical installation systems in building complexes.

**Practicals: (At least eight Experiments to be performed)**

1. Prepare series testing board for testing fan or other electrical gadgets.
2. Select the electric wire using measuring and testing instruments for particular applications.
3. Study and Identify cables (PVC, XLPE, and VIR) and catenary cable of different current ratings.
4. Prepare wiring installation on a board from the commencement of supply showing energy meter, MCB, control of one lamp, one fan and one socket from one switch board in PVC surface conduit wiring system.
5. Prepare wiring installation on a board showing control of one lamp, one fan and one socket from one switch board using Batton wiring system.
6. Control one lamp from two different places using PVC surface conduit wiring system.
7. Make a report on design and estimation of lighting load of a class room

8. Design 2 BHK residential installation scheme and estimate the material required. Draw the detail wiring layout for installation and make a chart for the materials required.
9. Test wiring insulation using megger.
10. Draw different types of earthing system and make a chart of materials required.
11. Measure earth resistance using earth megger.
12. Measurement of three phase energy using static energy meter which can show maximum demand, reactive power, TOD in addition to active power.
13. Measurement of energy using CT or CT and PT.
14. Selection of transformer rating and associated equipments for indoor substation of commercial building/ complex.
15. Study of smart meter and associated system for commercial building/ complex.
16. Design electrical installation system of single building complexes.

**Course outcomes:**

The practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a) Select accessories, wires, cables and wiring systems for electrification.
b) Design electrical wiring installation system for residential unit.
c) Design proper illumination scheme for residential unit.
d) Prepare wiring layouts on wiring board.
e) Locate and diagnose faults in electrical wiring installation.
f) Test for proper earthing for building electrification.

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

3. **Continuous Internal Assessment of 60 marks** is to be carried out by the teachers throughout the fourth Semester. **Distribution of marks:** Continuous evaluation:50 Marks; Class Attendance: 10 Marks
4. **External Assessment (end Semester examination) of 40 marks** shall be held at the end of the fourth Semester on the entire syllabus. Assignment on the day of Viva-voce and practical report submission:20; Viva-voce:20

| | | |
|---|---|---|
| Course Code | : | EEPE 301/1 |
| Course Title | : | INDUSTRIAL AUTOMATION AND CONTROL |
| Number of Credits | : | 3 (L: 3, T: 0, P:0) |
| Prerequisites | : | NIL |
| Course Category | : | PE |

**Course objectives:**

Theaimofthiscourseistohelpthestudenttoattainthefollowingindustryidentifiedcompetency through various teaching learning experiences:

| Contents (Theory): | | Hrs/Unit |
|---|---|---|
| **Unit : 1** | **Introduction to Industrial Automation**<br>1.1 Automation: Need and benefits.<br>1.2 Types of automation system: Fixed, Programmable, Flexible<br>1.3 Different systems used for Industrial automation: Magnetic control<br>PLC, SCADA, | **04** |
| **Unit : 2** | **2.1 Magnetic Control Systems:**<br>Operation & Applications of Contactor control circuit components – (i) Switches – Push button type, Selector type, Limit switch, Pressure, Float type, Proximity, (ii) Electromagnetic Contactor (iii) Time delay relays (OFF delay, ON delay).<br><br>**2.2 Magnetic control of ac motor:**<br>Operation of Control circuit & Power circuits of –<br>(i) Reversing the direction of rotation of induction motor with Interlocking systems<br>(ii) Simple ON-OFF motor control circuit,<br>(iii) Automatic Sequential control of motor.<br>(iv) DOL starter,<br>(v) Automatic Star-Delta starter | **10** |
| **Unit: 3** | **PLC Fundamentals**<br>Evolution of PLC. Building blocks of PLC**:** CPU, Memory organization, Input-output modules (discrete and analog), Specially I/O Modules, Power supply ,Fixed and Modular PLC and their types, Redundancy in PLC module, I/O module selection criteria , | **06** |
| **Unit: 4** | **PLC Programming and Applications**<br>4.1 PLC I/O addressing<br>4.2 PLC programming Instructions**:** Relay type instructions, Timer instructions: On delay, off delay, Counter instructions: Up, Down, High speed, Logical instructions, Data handling Instructions, Arithmetic instructions.<br>4.3 PLC programming language**:** Functional Block Diagram (FBD), Instruction List. Structured<br>text, Sequential Function Chart (SFC), Ladder Programming.<br>4.4 Simple Programming examples using ladder logic based on relay, timer counter, logical, comparison, arithmetic and data handling instructions.<br>4.5 PLC Based Applications: Motor sequence control, Traffic light control,<br>Elevator control, Tank Level control, Conveyor system, Stepper motor control. | **10** |
| **Unit: 5** | **Electric Drives and special machines**<br>5.1 Electric drives: Types, functions, characteristics, four quadrant operation.<br>5.2 DC and AC drive controls: V/F control, Parameters, direct torque control.<br>Drives: Specifications, Applications-Speed control of AC motor /DC Motor. | **05** |

| | | |
|---|---|---|
| **Unit 6** | **Supervisory Control and Data Acquisition System (SCADA)**<br>6.1.1 Basic components of Data Acquisition System.<br>6.1.2 Components of a PC-based Data Acquisition System.<br>6.2 Introduction to SCADA:<br>6.2.1 Typical SCADA architecture/ block diagram,<br>6.2.2 Benefits of SCADA.<br>6.2.3 Brief introduction to hardware and software used in SCADA.<br>6.2.4. Applications of SCADA. | **10** |
| | **Total** | **45** |

**References:**


1. Dunning, G., Introduction to Programmable Logic Controllers, Thomson /Delmar learning, New Delhi, 2005,ISBN 13 :9781401884260
2. Jadhav, V. R., Programmable Logic Controller, Khanna publishers, New Delhi, 2017, ISBN : 9788174092281
3. Petruzella,F.D., Programmable Logic Controllers, McGraw HillIndia, NewDelhi, 2010,ISBN: 9780071067386
4. Hackworth ,John; Hackworth,Federic, Programmable Logic Controllers, PHI Learning, NewDel- hi, 2003, ISBN :9780130607188
5. StenersonJon, Industrial automation and Process control, PHI Learning, NewDelhi,2003, ISBN : 9780130618900
6. Mitra, Madhuchandra; Sengupta,Samarjit, Programmable Logic Controllers and Industrial Auto- mation An introduction, Penram International Publication,2015, ISBN:9788187972174
7. Boyar, S. A., Supervisory Control and Data Acquisition, ISA Publication, USA, ISBN: 978- 1936007097
1. BaileyDavid; WrightEdwin, Practical SCADA for industry, Newnes (animprintofElsevier), UK 2003,ISBN: 0750658053


**Course outcomes:**

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented Cos associated with the above mentioned competency:

a) Identify different types of automation systems.

b) Interface I/O devices with the PLC modules.

c) Develop PLC ladder programs for various applications.

d) Select the suitable motor drives for different applications

e) Prepare simple SCADA applications.

| Internal Assessment (40 Marks) | | |
|---|---|---|
| Mid Semester Class Test:20 Marks | Quizzes, viva-voce, Assignment: 10 Marks | Attendance: 10 |

| External Assessment (End Semester Examination:60 Marks) | |
|---|---|
| GROUP | UNIT |
| A | 1,2 |
| B | 3,4 |
| C | 5,6 |

| | | |
|---|---|---|
| Course Code | : | EEPE 303/1 |
| Course Title | : | INDUSTRIAL AUTOMATION AND CONTROL LABORATORY |
| Number of Credits | : | 1 (L: 0, T: 0, P:2) |
| Prerequisites(Course code) | : | NIL |
| Course Category | : | PE |

**Course objectives:**

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Maintain Industrial Automation Systems.

**Practicals:**

1. Testing push button switches, timer and electromagnetic contactor.
2. Make & test the control and power circuit for forward and reverse rotation of sq. cage induction motor using contactor circuit.
3. Make & test the control and power circuit for automatic star-delta starter operation of sq. cage induction motor using contactor control
4. Identify various parts of the given PLC and front panel status indicators.
5. Use PLC to test the START STOP logic using two inputs and one output.
6. Develop/Execute a ladder program for the given application using following:-timer, counter,
   comparison, logical, arithmetic instructions.
7. Use PLC to control the following devices like lamp, motor, pushbutton switches, proximity sensor
8. Measure the temperature of the given liquid using RTD or Thermocouple and PLC.
9. Develop/test ladder program to blink the LED/lamp.
10. Develop/test the Ladder program for sequential control application of lamps/DC motors.
11. Develop ladder program for Traffic light control system.
12. Develop and test ladder program for pulse counting using limit switch/Proximity sensor.
13. Develop/test ladder program for Automated elevator control.
14. Develop/test ladder program for rotating stepper motor in forward and reverse direction at constant speed.
15. Develop/test ladder program for tank water level control.
16. Develop/test ladder program for control of speed of stepper motor with suitable drivers.

17. To study DC chopper circuit using SCR.
18. Identify various front panel controls of VFD (smart drive).
19. Control speed of AC motor using VFD.(VFD-Variable Frequency Drive)
20. Use various functions of SCADA simulation editors to develop simple project.
21. Develop a SCADA mimic diagram for Tank level control.
22. Develop SCADA mimic diagram for Flow control in a given system.
23. Develop a SCADA mimic diagram for traffic light control.

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**Course outcomes:**

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a) Identify different types of automation systems.
b) Interface I/O devices with the PLC modules.
c) Develop PLC ladder programs for various applications.
d) Select the suitable motor drives for different applications.
e) Prepare simple SCADA applications.

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

5. **Continuous Internal Assessment of 60 marks** is to be carried out by the teachers throughout the fourthSemester. **Distribution of marks:** Continuous evaluation:50 Marks; Class Attendance: 10 Marks
6. **External Assessment (end Semester examination) of 40 marks** shall be held at the end of the fourth Semester on the entire syllabus. Assignment on the day of Viva-voce and practical report submission:20; Viva-voce:20

| | | |
|---|---|---|
| Course Code | : | EEPE 301/2 |
| Course Title | : | INDUSTRIAL DRIVES |
| Number of Credits | : | 3 (L: 3, T: 0, P: 0) |
| Prerequisites | : | NIL |
| Course Category | : | PE |

### Course Objective

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences –

• Maintain electric AC and DC Drives.

| Contents (Theory): | | Hrs./Unit |
|---|---|---|
| **Unit : 1** | AC and DC Motors<br>1.1 Need of Electric Drives, Functional Block diagrams of an electric drives.<br>1.2 Load characteristics, Starting method, speed control and braking of<br>a. Series, Shunt and compound DC motors.<br>b. Three phase Induction Motors<br>i) Squirrel cage Induction motor<br>ii) Slip ring Induction Motor<br>c. Single phase AC Motors<br>i) Capacitor run motors<br>ii) Capacitor start motors<br>d. Three phase Synchronous motor.<br><br>1.3 Determination of Motor Rating.<br>1.4 Duty class of motor.<br>1.5 Specification of motors. | **12** |
| **Unit : 2** | Special Motors<br>2.1 Characteristics, Control strategies and application of<br>a. DC servo motor<br>b. AC servomotor<br>c. Stepper motor<br>e. Brushless DC Motors.<br>2.2 Determination of Motor Rating.<br>2.3 Specification of motor. | **07** |
| **Unit: 3** | DC Drives<br>3.1 Speed control and torque control of DC drive (separately excited dc motor) using<br>A. Single phase SCR Drives<br>a) Semi control and Full controlled converter<br>B. Three Phase SCR Drives<br>a) Semi control and Full controlled converter<br>b) Dual converter.<br>3.2 Chopper Controlled DC Drives for dc series motor.<br>3.3 Specification of drives. | **09** |
| **Unit: 4** | AC Drives<br>4.1 Speed control of three phase induction motor:<br>A. Variable Frequency Control of<br>B. Voltage Source Inverter Control<br>C. Current Source Inverter Control<br>D. Rotor Resistance Control<br>E. Slip Power Recovery using static converter.<br>4.2 Synchronos motor drive.<br>4.3 Specification of drives.<br>4.4 Selection of AC and DC drive. | **10** |
| **Unit: 5** | Techniques of Motor Control<br>5.1 **Magnetic control of ac motor:**<br>Operation of Control circuit & Power circuits of –<br>(i) Reversing the direction of rotation of induction motor with Interlocking systems<br>(ii) Simple ON-OFF motor control circuit,<br>(iii) Automatic Sequential control of motor.<br>(iv) DOL starter,<br>(v) Automatic Star-Delta starter. | **07** |

| | | |
|---|---|---|
| | 5.2 AC/DC motor drive using Microcomputer block diagram.<br>5.3 AC/DC motor drive using Microcontroller block diagram.<br>5.4 Concept of Phase locked loop in dc motor speed control using block diagram. | |
| | **Total** | **45** |

**References:**


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2. Saxena, S.B Lal ;Dasgupta, K., Fundamentals of Electrical Engineering, Cambridge university press pvt. Ltd., New Delhi, ISBN: 9781107464353

3. Theraja, B. L. Theraja, A. K., A Text Book of Electrical Technology Vol-II, S. Chand and Co. Ramnagar, New Delhi, ISBN :9788121924405

4. Mittle, V.N. Mittle, Arvind, Basic Electrical Engineering, McGraw Hill Education, Noida, ISBN: 9780070593572

5. Sen P.C., Power Electronics, McGraw-Hill Publishing Company Limited, New Delhi. ISBN:9780074624005

6. Dubey Gopal K., Fundamentals of Electrical Drives, Second Edition, Narosa Publishing House, New Delhi. ISBN :9788173194283

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8. Agrawal , Jai P., Power Electronic Systems Theory and Design, Pearson Education, Inc. ISBN 9788177588859.

9. Deshpande M.V., Design and Testing of Electrical Machines, PHI Publication, ISBN: 9788120336452

10. Pillai, S.K., A first course on Electrical Drives, Wiley Eastern Ltd. New Delhi, ISBN :13: 978- 0470213995


**Course Outcomes**

The theory and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry-oriented COs associated with the above-mentioned competency:

a) Understand the performance of DC and AC motor for various electric drive applications.
b) Understand the performance of special purpose motor for various electric drive applications.
c) Know the operations of DC Drives and its application.
d) Know the operations of AC Drives and its application.
e) Know the operations of microcomputer/micro controller based electric motors its application.

| **Internal Assessment (40 Marks)** | | |
|---|---|---|
| Mid Semester Class Test:20 Marks | Quizzes, viva-voce, Assignment: 10 Marks | Attendance: 10 |

| **External Assessment (End Semester Examination:60 Marks)** | |
|---|---|
| GROUP | UNIT |
| A | 1 |
| B | 2,3 |
| C | 4, 5 |

| | | |
|---|---|---|
| Course Code | : | EEPE 303/2 |
| Course Title | : | INDUSTRIAL DRIVES LABORATORY |
| Number of Credits | : | 1 (L: 0, T: 0, P: 2) |
| Prerequisites | : | NIL |
| Course Category | : | PE |

## Course Objective

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

• Maintain microcontroller-based systems.

## Practicals

| List of Practical:(at least EIGHT are to be done) | |
|---|---|
| 1. | Control the speed of DC Motor using armature voltage control method. |
| 2. | Control the speed of DC Motor using field current control method. |
| 3. | Measure the output voltage of chopper for resistive load by varying the frequency and /or duty cycle of chopper. |
| 4. | Control the speed of three phase squirrel cage induction motor using stator voltage control method. |
| 5. | Effect on speed of given D.C. series motor by varying armature voltage using step down chopper. |
| 6. | Observe the effect on speed of the given D.C. separately excited motor by varying voltage using step down chopper. |
| 7. | Control the speed of the given separately exited motor by changing the firing angle of SCR using single phase full converter and measure the speed |
| 8. | Control the speed of the given three phase induction motor by using constant V/f method and plot the graph between speed and frequency. |
| 9. | Control the speed of the given three phase induction motor by varying frequency and plot the graph between speed and frequency. |
| 10. | Control the speed of the given synchronous motor drives using microcontroller |
| 11. | Demonstrate High power SCR/power device and Heat sink and write their specifications and rating. |
| 12. | Control the speed of single-phase capacitor split phase induction motor using DIAC –TRIAC circuit. |
| 13. | Control the speed of DC motor drives using microcontroller. |
| 14. | Make & test the control and power circuit for forward and reverse rotation of sq. cage induction motor using contactor circuit. |
| 15. | Make & test the control and power circuit for automatic star-delta starter operation of sq. cage induction motor using contactor control. |
| 16. | Dynamic braking of three phase squirrel cage induction motor using contactor control. |

## Course Outcomes

The theory, practical experiences and relevant soft skills associated with the course are to be taught and implementatecd so that the student demonstrates the following industry-oriented COs associated with the above-mentioned competency:

a) Select relevant DC motor for various electric drive applications.

b) Select relevant AC motor for various electric drive applications.

c) Implement DC Drives for various applications..

d) Implement AC Drives for various applications

e) Perform speed control of motor by micro controller based drive.

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

1. **Continuous Internal Assessment of 60 marks** is to be carried out by the teachers throughout the fourth Semester. **Distribution of marks:** Continuous evaluation:50 Marks; Class Attendance: 10 Marks
2. **External Assessment (end Semester examination) of 40 marks** shall be held at the end of the fourth Semester on the entire syllabus. Assignment on the day of Viva-voce and practical report submission:20; Viva-voce:20

| | | |
|---|---|---|
| Course Code | : | EEPE 305/1 |
| Course Title | : | ILLUMINATION PRACTICES |
| Number of Credits | : | 3 (L: 3, T: 0, P: 0) |
| Prerequisites | : | NIL |
| Course Category | : | PE |

**Course objectives:**

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Design illumination schemes and associated electrification of buildings.

**Course contents:**

| Contents (Theory): | | Hrs./Unit |
|---|---|---|
| **Unit : 1** | **Fundamentals of illumination**<br>1.1 Electromagnetic radiation & Light; Electromagnetic spectrum – Ultraviolet, Visible, Infrared spectrum.<br>1.2 Definition of (As per CIE): Light, Luminous Flux, Luminous Intensity, Lumen, Candela, Illuminance, Lux, luminance, brightness, contrast, luminous efficacy.<br>1.3 Glare: Discomfort and disability glare.<br>1.4 Blackbody radiator, Selective radiator, CRI, CCT.<br>1.5 Human eye as an optical system – basic concept. Spectral sensitivity of human eye – Photopic, Scotopic, Mesopic vision.<br>1.6 Laws of illumination: Inverse Square Law; Lambert's Cosine Law; Related numerical. | **09** |
| **Unit : 2** | **Measurement**<br>2.1 Polar curves and its applications.<br>2.2 Construction and working principle of Luxmeter.<br>2.3. Measurement of illuminance by luxmeter; measurement of luminous flux by integrating sphere (concept only).<br>2.4 Application of Polar Photometer & Goniophotometer.<br>2.5. CIE standard source of illuminant. | **05** |

| | | |
|---|---|---|
| **Unit: 3** | **Lamps and Luminaires**<br>3.1.1. Principle of incandescence and gaseous discharge lamps.<br>3.1.2. Electromagnetic & Electronic ballast – Operation & comparison; Ignitor – its function in lamps.<br>3.2 Construction, working principle, connection diagram, technical features and application of<br>a) Incandescent lamp and Halogen lamps.<br>b) Low pressure discharge lamps and related : Fluorescent lamp; CFL, sodium vapour lamp.<br>c) High pressure discharge lamps: sodium vapour lamp, mercury vapour lamp, metal halide lamp.<br>d) LED, LASER (concept only), Optical fibre.<br>3.3. Luminaire – Types of luminaires, Design consideration, Ingress protection (IP). | **10** |
| **Unit: 4** | **Illumination Control and Control Circuit**<br>4.1 Lighting control and energy conservation.<br>4.2. Dimmer: resistance type; auto-transformer type.<br>4.3 Electronic Dimmer: working principle and operation of:<br>a. Thyristor operated dimmer<br>b. Triac operated dimmer.<br>4.4.1 Photo cell : Construction and working principle.<br>4.4.2 Occupancy sensor: PIR; Ultrasonic sensors : Range, rating and applications. | **05** |
| **Unit: 5** | **Interior lighting design**<br>5.1. Standard illumination level for various interior application as per IS 3646 (Part-I).<br>5.2 Space height ratio, utilization factor, light loss factor overall uniformity, glare index, CRI, Light power density (LPD); ECBC.<br>5.3 Lighting calculation methods: Watt /$m^2$ method, Lumens or light flux method, Point to point method. (Numerical)<br>5.4. Design considerations for interior lighting of -<br>(a) Residential complex.<br>(b) Commercial complex.<br>(c) Industrial premises. | **08** |
| **Unit 6** | **Exterior lighting design**<br>6.1 Road Lighting:<br>6.1.1 Related terms: Throw, spread and tilt angle, outreach, overhang.<br>6.1.2 Classification of roads according to luminance level.<br>6.1.3. Types of lighting arrangement: Single side, Staggered, opposite and central arrangement.<br>6.1.4. Classification of Luminaires: Symmetrical, Asymmetrical and double asymmetrical.<br>6.2 Flood lighting<br>6.2.1 Related terms: Beam factor, beam angle, waste light factor, NIMA classification.<br>6.2.2 Design of flood lighting; related numerical problems.<br>6.2.3 Selection of lamps and luminaires for application of flood lighting in railway yard, sports ground. | **08** |
| | **Total** | **45** |

**References:**

1. Lindsey, Jack L., Applied Illumination Engineering, The Fairmont Press Inc.
2. Simons, R. H., Bean, Robert; Lighting Engineering: Applied Calculations, Architectural Press. ISBN: 0750650516.
3. Casimer M Decusatis, Handbook of Applied Photometry, Springer, ISBN 1563964163.
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5. Simpson Robert S, Lighting Control Technology and Applications, Focal Press
6. Kao Chen, Energy Management in Illuminating Systems, CRC Press

**Course outcomes:**

The theory and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a. Understand the fundamental concept of illumination.
b. Understand the measurement process of different quantities related to illumination.
c. Identify various characteristics of different lamps and select relevant lamps for various applications .
d. Understand different techniques for illumination control.
e. Design relevant illumination schemes for interior applications.
f. Design relevant illumination schemes for exterior applications.

| **Internal Assessment (40 Marks)** | | |
|---|---|---|
| Mid Semester Class Test:20 Marks | Quizzes, viva-voce, Assignment: 10 Marks | Attendance: 10 |
| **External Assessment (End Semester Examination:60 Marks)** | | |
| GROUP | UNIT | |
| A | 1,2 | |
| B | 3,4 | |
| C | 5,6 | |

| | | |
|---|---|---|
| Course Code | : | EEPE 307/1 |
| Course Title | : | ILLUMINATION PRACTICES LABORATORY |
| Number of Credits | : | 1 (L: 0, T: 0, P: 2) |
| Prerequisites | : | NIL |
| Course Category | : | PE |

**Course objectives:**

The aim of this course is to help the student to attain the following industry identified

competency through various teaching learning experiences:

- Design illumination schemes and associated electrification of buildings.

**Practicals: (At least eight Experiments to be performed)**

1. Verify the laws of illumination.
2. Prepare control circuit of twin fluorescent lamp.
3. Prepare control circuit of HPSV lamp.
4. Prepare control circuit of LED lamp.
5. Prepare light dimmer arrangement using the relevant dimmer type of transformer
6. Prepare light dimmer arrangement using solid state dimmer circuit.
7. Study of PIR and ultrasonic sensors.
8. Conduct illumination level assessment in workplace using lux meter.
9. Fit the given lamps in the selected mounting and calculate space height ratio.
10. Interpret the polar curves of the given type of lamp.
11. Measure the illumination output of different lamps (Incandescent, fluorescent, CFL, LED, HPSV, MH) and calculate their luminous efficacy.
12. Plot the iso-lux contour of indoor lamps.
13. Design an illumination scheme of a conference hall of medium size.
14. Design an illumination scheme of a workshop of your Institute.
15. Prepare an indoor room design using lighting design software.

**Course outcomes:**

The practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a) Verify laws of illumination.
b) Select relevant lamps for various applications
c) Select the lighting accessories required for specific lamps.
d) Select relevant dimmer circuit for various applications.
e) Design relevant illumination schemes for interior applications.
f) Design Illumination schemes for various exterior applications.

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

3. **Continuous Internal Assessment of 60 marks** is to be carried out by the teachers throughout the fourth Semester. **Distribution of marks:** Continuous evaluation:50 Marks; Class Attendance: 10 Marks
4. **External Assessment (end Semester examination) of 40 marks** shall be held at the end of the fourth Semester on the entire syllabus. Assignment on the day of Viva-voce and practical report submission:20; Viva-voce:20

| | | |
|---|---|---|
| Course Code | : | EEPE 305/2 |
| Course Title | : | ELECTRIC TRACTION |
| Number of Credits | : | 3 (L: 3, T: 0, P: 0) |
| Prerequisites | : | NIL |
| Course Category | : | PE |

**Course objectives:**

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Maintain electric traction systems.

**Course contents:**

| Contents (Theory): | | Hrs/Unit |
|---|---|---|
| **Unit : 1** | **Basics of Traction**<br>1.1General description of Electrical Traction system in India : Surface railway and metro railway.<br>1.2 Advantages and Disadvantages of Electric Drive, Diesel Electric Drive, Battery Drive.<br>1.3Problems associated with AC traction System and remedies for it.<br>1.4Voltage balance, current balance, production of harmonics. Metro rail system, features. | **05** |
| **Unit : 2** | **Traction Mechanics:**<br>2.1 Types of Services.<br>2.2 Simplified Speed Time Curve (No Derivation)<br>Average Speed and Schedule Speed; Factors Affecting the Schedule Speed. Related numerical.<br>2.3 Tractive Effort. Related numerical.<br>2.4 Specific Energy Consumption; Factors Affecting Specific Energy Consumption. Related numerical<br>2.5. Mechanics of train movement, Adhesion & coefficient of Adhesion. | **10** |

| | | |
|---|---|---|
| **Unit: 3** | **Power Supply Arrangements**<br>3.1 **Constituents of supply system: -**<br>31.1 Substation: layout, list of equipment and their functions<br>3.1.2 Feeding post: list of equipment and their functions<br>3.1.3 Feeding and sectioning Arrangements<br>3.1.4 Sectioning and paralleling post<br>3.1.5 Sub sectioning and Paralleling post<br>3.1.6 Sub sectioning post<br>3.1.7 Elementary section<br>3.1.8 Protection system for traction transformer 25 kV catenary construction<br>**3.2 Overhead Equipment**<br>3.2.1 Different types of overhead equipments: Pentagonal OHE Catenary Construction.<br>3.2.2 Overhead system- Trolley collector, bow collector; Pantograph Collector Types and construction of pantograph | **10** |
| **Unit: 4** | **Electric Locomotive**<br>4.1 Classification and Nomenclature of Electric Locomotive.<br>4.2 Block diagram of AC locomotive; Power Circuit of AC Locomotive<br>Equipment (List and Function only) used in auxiliary circuit of AC Locomotive<br>4.3 Loco bogie classification according to wheel arrangements.<br>4.4 Maintenance of AC systems. | **06** |
| **Unit: 5** | **Traction Motors and Train Lighting**<br>5.1 Desirable characteristics of traction motor.<br>5.2 Types of AC and DC motors used for traction with their characteristics and features.<br>5.3Control of Traction motors: Series-parallel starting; drum controller; contactor type controller; Thyristor control.<br>5.4 Requirements of braking, types of Electrical braking: Regenerative braking; Plugging; Dynamic breaking.<br>5.5 Systems of train lighting, Single battery, double battery parallel block system Self Generation (SG), Head On Generation (HOG), End on generation (EOG). | **08** |
| **Unit 6** | **Signaling and Supervisory Control**<br>6.1 Requirements of signaling systems.<br>6.2 Types of signals, track circuits.<br>6.3 Advantages of remote control Systems,<br>6.4 Equipment and network Metro rail-supply systems, advantages, schemes in India. | **06** |
| | **Total** | **45** |

**References:**

1. G.C. Garg, Utlization of Electric Power & Electric Traction, Khanna Book Publishing Co., New Delhi (ISBN: 978-93-86173-355) Revised Ed. 2018

2. Gupta J.B., S.K.Kataria and Son, Utilization of Electric power and traction
3. Partab H., Dhanpat Rai and Co,' Art and Science of Utilization of Electrical Energy
4. Partab H., Dhanpat Rai and Co, Modern Electric Traction
5. Suryanarayana N.V., New Age International Publishers, Reprint 2010
6. Open Shaw Taylor, Orient Longman ltd., Utilisation of electrical energy.

**Course outcomes:**

The theory and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a) Interpret the traction layout and its systems.
b) Understand train movement features.
c) Describe the power supply arrangements and overhead equipment for electric traction.
d) Maintain the different components of the electric locomotive.
e) Understand function of traction motors and train lighting system.
f) Classify signaling and supervisory control systems.

| **Internal Assessment (40 Marks)** | | |
|---|---|---|
| Mid Semester Class Test:20 Marks | Quizzes, viva-voce, Assignment: 10 Marks | Attendance: 10 |

| **External Assessment (End Semester Examination:60 Marks)** | |
|---|---|
| GROUP | UNIT |
| A | 1,2 |
| B | 3,4 |
| C | 5,6 |

| | | |
|---|---|---|
| Course Code | : | EEPE 307/2 LAB |
| Course Title | : | ELECTRIC TRACTION LABORATORY |
| Number of Credits | : | 1 (L: 0, T: 0, P: 2) |
| Prerequisites (Course code) | : | NIL |
| Course Category | : | PE |

**Course objectives:**

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Maintain electric traction systems

**Practicals: (At least eight Experiments to be performed)**

1. Dismantle and Assemble traction motor through watching video.
2. Perform the testing of dc series motor to obtain i) torque vs current; ii) speed vs current; iii) speed vs torque characteristics.
3. Troubleshoot a traction motor.
4. Visit / watching video on electric-traction train lighting system installation, identify components of system and prepare report
5. Visit/ watching video on electric-traction loco shed, investigate working of each section & prepare report
6. Visit to / watching video on Traction Substation or feeding post (for layout and OHE) and write a report
7. Visit to / watching video on Railway Station (for signaling and train lighting) and writing a report on visit
8. Draw traction substation Layout on drawing sheet and prepare report
9. Draw Pentagonal OHE Catenary, different Catenaries according to speed limit, OHE supporting structure on drawing sheet and prepare report
10. Draw Power Circuit of AC Locomotive on drawing sheet and prepare report.

**Course outcomes:**

The practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a) Interpret the traction layout and its systems
b) Maintain the power supply arrangements.
c) Maintain the function of the overhead equipment for electric traction
d) Maintain the different components of the electric locomotive.
e) Maintain the traction motor and train lighting system
f) Maintain the signaling and supervisory control systems.

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

7. **Continuous Internal Assessment of 60 marks** is to be carried out by the teachers throughout the fourth Semester. **Distribution of marks:** Continuous evaluation:50 Marks; Class Attendance: 10 Marks
8. **External Assessment (end Semester examination) of 40 marks** shall be held at the end of the fourth Semester on the entire syllabus. Assignment on the day of Viva-voce and practical report submission:20; Viva-voce:20

| | | |
|---|---|---|
| Course Code | : | EEPE 305/3 |
| Course Title | : | **SOLAR POWER TECHNOLOGIES** |
| Number of Credits | : | 3 (L: 3, T: 0, P:0) |
| Prerequisites | : | NIL |
| Course Category | : | PC |

Course objectives: The aim of this course is to help the student to attain the following industry

identified competency through various teaching learning experiences:
Maintain the efficient operation of various types of renewable energy power plants.

**Course contents:**

| Contents (Theory): | | Hrs/ Unit |
|---|---|---|
| **Unit1** | **Solar Energy:**<br><br>1.1 Solar energy availability in India<br>1.2 Daily Global solar power radiation, beam radiation, diffuse radiation.<br>1.3 Factors affecting the amount of solar energy reaching the earth.<br>1.4 Different types of Solar water heaters: Construction, working,<br>1.5 specifications and installation Solar Heating systems used to provide hot water in a residential building<br>1.6 Different types of Solar cookers and their use.<br>1.7 Solar drying system and its utility<br>1.8 Solar lighting system in residential building<br>1.9 Troubleshooting and preventive maintenance of the above solar powered apparatus. | **8** |
| **Unit2** | **Concentrated Solar Power (CSP):**<br><br>2.1 Concentrated Solar Power (CSP) plants or solar thermal electric systems<br>2.2 Parabolic Trough: Construction, working and specifications<br>2.3 Parabolic trough systems that generate electricity<br>2.4 Parabolic Dish: Construction, working and specifications<br>2.5 Power Tower.<br>2.6 Fresnel Reflectors: Construction, working and specifications<br>2.7 Solar Stirling engine: construction, operation and its use.<br>2.8 Troubleshooting and preventive maintenance of all of the above equipments. | **8** |
| **Unit 3** | **Solar PV Systems:**<br>3.8 Site selection and planning for solar PV power plant.<br>3.2 Solar PV cell: Types, construction, working, Typical specifications of solar cells<br>3.3 Solar PV working principle: Series and parallel connections of solar modules<br>3.4 Solar Photovoltaic (PV) system: components layout and working.<br>3.5 Designing of solar PV installation, Installing solar panel mounting hardware, Formation of solar array, Mounting solar panels at proper place & angle.<br>3.6 Solar modules, arrays and their standard specifications<br>3.7 Electrical wiring between solar panel array, Junction box, Meter, Battery, Charge controller and Inverter<br>3.8 Connection of electrical safety devices, Earthing provision.<br>3.9 Roof top solar PV systems: its components, installation method and working<br>3.10 Streetlight solar PV systems: its components, installation and working | **11** |

| | | |
|---|---|---|
| **Unit 4** | **Solar PV Electronics**<br><br>4.1 Solar Charge controllers: working and specifications, switchgear and cables.<br>4.2 Battery energy storage system – Energy stored, Time remaining to full charge/discharge, Number of charge/discharge cycles, Storage efficiency, Temperature of battery.<br>4.3 Connection of batteries in series and parallel for solar banks.<br>4.4 Solar Inverters: types of inverter, their working and specifications<br>4.5 Signal conditioning systems: working and specifications<br>4.6 Solar Power tracking: construction, working, tilt angle, solar radiation, I-V, P-V characteristics, maximum power point tracking (MPPT)<br>4.7 Troubleshooting and Maintenance of these systems. | **10** |
| **Unit 5** | **Solar PV Off-grid and Grid Tied Systems**<br><br>5.1 Concept of grid and smart grid systems<br>5.2 Solar off grid systems: layout and specifications<br>5.3 Solar Grid tied (on grid) systems: Working principle of grid-tied dc-ac inverter, grid synchronization and active power export.<br>5.4 Net metering: main features and working<br>5.5 Solar-wind Hybrid systems: Layout and specifications. | **8** |
| | Total | **45** |

**References:**

1. Deambi, Suneel: From Sunlight to Electricity: a practical handbook on solar photovoltaic application; TERI, New Delhi ISBN:9788179935736.
2. David M. Buchla, Thomas E. Kissell, Thomas L. Floyd - Renewable Energy Systems, Pearson Education New Delhi , ISBN: 9789332586826
3. Kothari, D.P. et al: Renewable Energy Sources and Emerging Technologies, PHI Learning, New Delhi, ISBN: -978-81-203-4470-9
4. O.P. Gupta, Energy Technology, Khanna Publishing House, New Delhi (ISBN: 978-9386173-683)
5. B H Khan, Non-Conventional Energy Resources; McGraw Hill Education PVT Ltd.
6. Shobh Nath Singh; Non-Conventional Energy Resources; Pearson
7. Solanki, Chetan Singh, - Solar Photovoltaics: Fundamentals, Technologies andApplications, PHI Learning, New Delhi, ISBN: 9788120351110
8. Solanki, Chetan Singh, - Solar Photovoltaic Technology and Systems - A Manual For Technicians, Trainers and Engineers, PHI Learning, New Delhi, ISBN: 9788120347113

**Course outcomes:**

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

1. Know about the solar energy and its use in the operation of solar powered equipments.
2. Know the components and operations of CSP plants.
3. Know solar PV systems and its components to generate electricity from solar energy.
4. Know the electronic components required for solar PV systems and MPPT systems.
5. Know about smart grid power systems and differentiate between off-grid and on-grid solar power plants and power transmission.

| **Internal Assessment (40 Marks)** | | |
|---|---|---|
| Mid Semester Class Test:20 Marks | Quizzes, viva-voce, Assignment: 10 Marks | Attendance: 10 |

| **External Assessment (End Semester Examination:60 Marks)** | |
|---|---|
| GROUP | UNIT |
| A | 1,2 |
| B | 3 |
| C | 4,5 |

| | | |
|---|---|---|
| Course Code | : | EEPE 307/3 |
| Course Title | : | SOLAR POWER TECHNOLOGIES LABORATORY |
| Number of Credits | : | 1 (L: 0, T: 0, P: 2) |
| Prerequisites | : | NIL |
| Course Category | : | PE |

**Course objectives:**

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

1. Extract solar power using PV system and apply solar power technology for various applications.
2. Maintain the efficient operation of CSP plant and its accessories.
3. Measure different parameters of solar PV system and analyse them.

**Practical: (At least Eight experiments are to be performed)**

| Sl. No. | Item |
|---|---|
| **1.** | Experiment to plot V-I Characteristics of solar panel/cell and determine the fill factor. |
| **2.** | Perform experiment to study the effect of shading on solar cell current when PV cells are connected in Series-Parallel combination. |
| **3.** | Perform experiment to study the effect of tilt angle on solar cell parameters (Voc, Vmp, Isc, Imp, Mpp, Fill factor, Efficiency). |
| **4.** | Determination of the rating of accessories (preparation of solar panel from solar module, charge controller, battery, inverter) of Solar PV system to generate electricity. |
| **5.** | Experiment to determine efficiency measurement of standalone solar PV system. |
| **6.** | Experiment to measure beam and diffuse solar radiation using Pyranometer. |
| **7.** | Experiment to generate electricity from parabolic dish CSP plant. |
| **8.** | Study of off-grid solar inverter and its troubleshooting. |
| **9.** | Study of solar smart metering system and its troubleshooting. |
| **10.** | Troubleshoot solar PV MPPT system and identify its remedy. |
| **11.** | Study of solar-wind hybrid systems. |
| **12.** | Study and troubleshoot solar off-grid systems. |
| **13.** | Assemble solar power heaters and implement it for heating. |
| **14.** | Identify and Troubleshoot solar signal conditioners. |
| **15.** | Assemble different components of solar street lighting system for AC supply and implement it for lighting. |
| **16.** | Troubleshoot solar PV panel and arrays and identify its remedy. |
| **17.** | Assemble the components of solar home lighting system & implement it for lighting. |
| **18.** | Experiment to run water pumping system using solar power. |
| **19.** | Application of Solar Simulator for designing solar PV power system. |

**Course outcomes:**

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

1. Identify different components of solar PV system and their applications.
2. Identify and maintain different components of CSP plant.
3. Identify different components of solar powered equipments and their applications.
4. Measure solar radiation and analyse its components.
5. Maintain off-grid and on-grid solar power plants.
6. Maintain solar PV electronics and MPPT systems

# Internship-II

**Course Objectives:** Following are the objectives of this course:

- To learn industrial activities and apply accordingly.
- To get exposure to field level works.

During the summer vacation after 4th semester, students are ready for industrial experience. Therefore, they may choose to undergo Internship / Innovation / Entrepreneurship related activities. Students may choose either to work on innovation or entrepreneurial activities resulting in start-up or undergo internship with industry/ NGO's/ Government organizations/ Micro/ Small/ Medium enterprises to make themselves ready for the industry. In case student wants to pursue their family business a declaration by a parent may be submitted directly to the TPO.

In addition to above students may execute training activities with different Institute like workshop of ITI, Other Polytechnics and Technical Institutions; Soft skill training / free online technical courses/ industrial visit organized by Training and Placement Cell/ respective department of the respective institutions.

After completion of Internship, the student should prepare a comprehensive report to indicate what he/she has observed and learnt in training period. The student may contact Industrial Supervisor/Faculty Mentor/ TPO for assigning topics and problems and should prepare the final report on the assigned topics. The training report should be signed by the Industrial Supervisor/ Internship Faculty Mentor, TPO and HOD.

- **Activities may be conducted continuously for stipulated period of time or may be arranged in a staggered fashion.**

**Course outcome**

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry-oriented COs associated with the above-mentioned competency:

- To learn new skills from industrial visit/ industrial training and supplement knowledge.
- To improve communication skill and teamwork.
- To learn strategies like time management, multi-tasking etc. in an industrial setup.
- To meet new people and learn networking skills with industry personnel.

The Internship Report will be evaluated on the basis of following criteria (as applicable)

| Sl. No. | Criteria for evaluation of Internship Report |
|---|---|
| 1 | Originality |
| 2 | Adequacy and purposeful write up |
| 3 | Organizations, format, drawing, sketches, style, language |
| 4 | Practical applications and relationships with basic theory |
| 5 | Concept taught in the course outcome |
| 6 | Practical applications, relationships with basic theory and concept taught in the course |
| 7 | Attendance record, daily diary, quality of Internship Report. |

Seminars must be arranged for the student based on his/her training report, before an Internal Committee constituted by the concerned department of the Institute. The evaluation will be based on the following criteria:

| Sl. No. | Criteria for evaluation of Internship Seminar |
|---|---|
| 1 | Quality of content presented |
| 2 | Proper Planning for presentation |
| 3 | Effectiveness of presentation |
| 4 | Depth of knowledge and skills |
| 5 | Viva voce |

**E X A M I N A T I O N S C H E M E (for Internship- II):** Evaluation will be based on internal assessment.

| | | |
|---|---|---|
| Course Code | : | PR301 |
| Course Title | : | Major Project |
| Number of Credits | : | 2 (L: 0, T: 0, P: 4) |
| Prerequisites | : | Knowledge of subjects up to 4th Semester of Electrical Engineering. |
| Course Category | : | PR |

**Course Objective:**

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Design and development of small electrical and electronics device/equipment.

**Project group**:

1. Formation of project group: Maximum **6 students per batch**.
2. Each project group should select work by consulting the guide.

**Activity (atleast one of the following):**

1. Load survey of your institute.
2. Fabrication of inverter.
3. Fabrication of battery charger.
5. Fabrication of Electrical circuit using Solar panel.
6. Fabrication of water level controller.
7. Simulation project using SCILAB/ MATLAB or any other simulation software.
8. Drawing based on following topics using AutoCAD
    i. Control and power circuit for electrical machines.
    ii. Single line diagram of power transmission/ distribution network.
    iii. Single line diagram of Substation.
    iv. Single line diagram of Generating station.
9. Any other topics suggested by concern teacher.

References:
1. A K Sawhney; A course in Electrical Machine Design; Dhanpat Rai & Co.
2. Raina Bhattacharya; Electrical Design, Estimating and Costing; New Age International Publishers
3. V. Rajini and V.S. Nagarajan; Electrical Machine Design; Pearson
4. Bhattacharya Chatterji; Projects in Electrical, Electronics, Instrumentation and computer Engineering.

**Course outcome:**

i. Develop proper planning to achieve the project goal.
ii. Collect relevant information and resources.
iii. Identify and apply proper techniques.
iv. Analyse the performance of project output.
v. Organize the Written documentation of the project work

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

**1. Continuous Internal Assessment of 60 marks** is to be carried out by the teachers throughout the fourth Semester. **Distribution of marks:** Continuous evaluation: 30 Marks; Project report:20 Class Attendance: 10 Marks

**2. External Assessment (end Semester examination) of 40 marks** shall be held at the end of the fourth Semester on the entire syllabus. Project and project report:20; Viva-voce:20