

ELECTRICAL MATERIAL AND WIRING PRACTICE**Course Code : 313015**

Programme Name/s : Electrical Engineering/ Electrical Power System
Programme Code : EE/ EP
Semester : Third
Course Title : ELECTRICAL MATERIAL AND WIRING PRACTICE
Course Code : 313015

I. RATIONALE

Electrical diploma engineers should be able to select relevant electrical materials and accessories for different applications while carrying out new work or maintenance work. They should be well conversant with the specifications of material as per the applications and wiring practices. This course will enable the students to identify and select the material for a particular application and also take up the wiring related work like, selection of material for wiring, carry out the wiring and testing etc.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Carry out wiring and maintenance activities using relevant materials, tools and safety practices.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Follow safe working practices when undertaking electrical work.
- CO2 - Select relevant conducting, electromagnetic and magnetic materials.
- CO3 - Select relevant insulating materials.
- CO4 - Perform different types of electrical wiring and cabling activities.
- CO5 - Implement relevant earthing systems.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

| Course Code | Course Title | Abbr | Course Category/s | Learning Scheme | | | | | Credits | Paper Duration | Assessment Scheme | | | | | | | | | | Total Marks |
|-------------|---|------|-------------------|--------------------------|-----|-----|-----|-----|---------|----------------|-------------------|-----|-----|------------------|-----|-------|-----|-------------|----|----|-------------|
| | | | | Actual Contact Hrs./Week | | | SLH | NLH | | | Theory | | | Based on LL & TL | | | | Based on SL | | | |
| | | | | CL | TL | LL | | | | | Practical | | | FA-PR | | SA-PR | | SLA | | | |
| | | | | Max | Max | Max | Max | Min | | | Max | Min | Max | Min | Max | Min | Max | Min | | | |
| 313015 | ELECTRICAL MATERIAL AND WIRING PRACTICE | EMW | SEC | 1 | - | 4 | 1 | 6 | 3 | - | - | - | - | - | 50 | 20 | 25@ | 10 | 25 | 10 | 100 |

ELECTRICAL MATERIAL AND WIRING PRACTICE**Course Code : 313015****Total IKS Hrs for Sem. : 0 Hrs**

Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @\$ Internal Online Examination

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

| Sr.No | Theory Learning Outcomes (TLO's)aligned to CO's. | Learning content mapped with Theory Learning Outcomes (TLO's) and CO's. | Suggested Learning Pedagogies. |
|-------|--|--|--|
| 1 | <p>TLO 1.1 State safety rules/ standards applicable for the given electrical systems.</p> <p>TLO 1.2 Describe the use of the given tools in the given electrical engineering situation.</p> <p>TLO 1.3 Describe the use of the given safety accessories in the given electrical engineering situation.</p> <p>TLO 1.4 Describe the functions/applications of the given components of wiring.</p> | <p>Unit - 1 Wiring Components, Tools and Safety Devices</p> <p>1.1 IE rules 1956 (Chapter IV-General safety requirements- No. 29 to 46)</p> <p>1.2 Applications of Tools used in wiring: Pliers, nose pliers, cutter, screw driver, tester, test lamp, crimping tool, continuity tester, outside micrometer, knife.</p> <p>1.3 Applications of safety Accessories: hand gloves, helmet, boots, goggles, rubber mats, types of fire extinguishers.</p> <p>1.4 Components with specifications used in wiring systems: different types of switches (single and double pole), plugs, sockets, DBs, MCBs, MCCBs, RCCBs, holders, wires, cables. (No working only ratings needs to be explained for all these components)</p> | <p>Chalk-Board Presentations</p> <p>Videos</p> <p>Demonstrations,</p> <p>Role play</p> |

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|-------|---|---|--|
| 2 | <p>TLO 2.1 Explain the salient features of the given type of conductor with respect to the needed functional properties.</p> <p>TLO 2.2 Explain with justification the applications for the given electrical conductors in specified situations.</p> <p>TLO 2.3 Describe with justification the use of various magnetic materials in the given electrical engineering situation.</p> | <p>Unit - II Conducting and Electromagnetic Materials</p> <p>2.1 Conducting materials: Electrical, Mechanical and Thermal Properties.</p> <p>2.2 Applications of Conducting materials: copper, aluminium, tungsten, brass, bronze, mercury, silver, lead, nickel and tin.</p> <p>2.3 Magnetic materials- silicon Steel (CRGO, HRGO) and Amorphous material: properties and their applications</p> | Chalk-Board, Presentations, Demonstration |
| 3 | <p>TLO 3.1 Explain the properties of the given electrical insulating materials.</p> <p>TLO 3.2 Classify insulating materials based on working temperature</p> <p>TLO 3.3 Describe the failure phenomena in the given type of insulating material(s).</p> <p>TLO 3.4 Suggest relevant insulating material(s) for the given application(s) with justification.</p> | <p>Unit - III Electrical Insulating Materials</p> <p>3.1 Significance and properties of electrical insulating materials: electrical, mechanical and thermal properties.</p> <p>3.2 Classification of insulating materials based on working temperature.</p> <p>3.3 Causes of failure of insulating materials</p> <p>3.4 Applications of insulating materials in electrical machines and devices.</p> | Chalk-Board, Presentations, Video Demonstration, Model Demonstration |
| 4 | <p>TLO 4.1 Explain with justification the criteria for selecting wire/cable and other electrical components for the given type of installation.</p> <p>TLO 4.2 Describe with sketches the installation of wiring systems for the given type of occupancy.</p> <p>TLO 4.3 Describe with sketches the wiring type as per the functional requirements of the given type of occupancy.</p> <p>TLO 4.4 Explain the process of installing the given type of cable(s).</p> | <p>Unit - IV Electrical Wiring</p> <p>4.1 Types of wires and cables, components and accessories of electrical wiring systems.</p> <p>4.2 Electrical Wiring systems (PVC casing-capping, conduit and concealed), panel wiring</p> <p>4.3 Electrical Wiring types (one lamp control, staircase and godown)</p> <p>4.4 Cable laying, Cable joints (terminations), proper size lugs, crimping of joints.</p> | Chalk-Board, Presentations, Demonstration, Videos |

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|-------|--|--|--|
| 5 | <p>TLO 5.1 Recommend with justification the necessity of the type of earthing in the given electrical installation system(s).</p> <p>TLO 5.2 Explain the criteria for recommending the earthing system for the given electrical installation.</p> <p>TLO 5.3 Describe with sketches the installation of the given earthing system.</p> <p>TLO 5.4 Describe the testing procedure for the given earthing systems.</p> | <p>Unit - V Earthing Systems</p> <p>5.1 Types of earthing systems (Rod, pipe, plate, chemical earthing).</p> <p>5.2 Installation of earthing systems.</p> <p>5.3 Measurement of earthing resistance by Earth tester, Earth resistance values for various installations as per IEEE standards</p> <p>5.4 Adverse effects of improper earthing system, methods to reduce the earth resistance</p> | <p>Chalk-Board, Presentations, Videos, Model demonstration</p> |

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

| Practical / Tutorial / Laboratory Learning Outcome (LLO) | Sr No | Laboratory Experiment / Practical Titles / Tutorial Titles | Number of hrs. | Relevant COs |
|---|-------|---|----------------|--------------|
| LLO 1.1 Use different electrical safety accessories and follow safe practices. | 1 | *Use of different electrical safety accessories and follow safe practices. | 2 | CO1 |
| LLO 2.1 Douse the class 'A' type fire with suitable medium. | 2 | *Dousing of class 'A' type fire with suitable medium. | 2 | CO1 |
| LLO 3.1 Rescue a person and apply respiratory methods. | 3 | *Rescue a person and practice artificial respiration. | 2 | CO1 |
| LLO 4.1 Use different types of electrical/electronic tools. | 4 | *Use of different types of electrical/electronic tools. | 2 | CO1 |
| LLO 5.1 Test the working of single pole one way and two way switches and MCB. | 5 | Testing of single pole one way, two way switches and MCB using relevant tools and instruments. | 2 | CO1 |
| LLO 6.1 Operate the MCCB | 6 | Demonstration of MCCB | 2 | CO1 |
| LLO 7.1 Test the working of fuse. | 7 | Testing of rewirable fuse. | 2 | CO1 |
| LLO 8.1 Prepare series lamp test board with 2 m wire extension. | 8 | *Preparation of series lamp test board with 2m wire extension. | 2 | CO1 |
| LLO 9.1 Test the performance of the RCCB. | 9 | Testing of the RCCB. | 2 | CO1 |
| LLO 10.1 Choose the appropriate fuse rating and its location for the given circuit. | 10 | *Selection of fuses in different lighting circuits. | 2 | CO2 |
| LLO 11.1 Measure insulation resistance of cables using insulation tester | 11 | *Measurement of insulation resistance of cables using insulation tester | 2 | CO3 |
| LLO 12.1 Select insulating materials for specific applications. | 12 | Selection of insulating materials for specific applications from given samples (at least five). | 2 | CO3 |
| LLO 13.1 Measure insulation resistance of electrical installation using insulation tester | 13 | *Insulation resistance test on electrical installation. | 2 | CO3 |

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| Practical / Tutorial / Laboratory Learning Outcome (LLO) | Sr No | Laboratory Experiment / Practical Titles / Tutorial Titles | Number of hrs. | Relevant COs |
|--|--------------|---|-----------------------|---------------------|
| LLO 14.1 Test insulating oil for its dielectric strength. | 14 | *Dielectric strength test of given insulating oil sample. | 2 | CO4 |
| LLO 15.1 Carry out staircase wiring LLO 15.2 Test the working of staircase wiring. | 15 | Preparation of staircase wiring and its testing. | 2 | CO4 |
| LLO 16.1 Carry out godown wiring. LLO 16.2 Test the working of godown wiring. | 16 | Preparation of godown wiring and its testing. | 2 | CO4 |
| LLO 17.1 Carry out switch board wiring LLO 17.2 Test the working of switch board. | 17 | *Preparation of switch board containing four switch, four socket arrangements (with MCB, indicator etc.). | 4 | CO4 |
| LLO 18.1 Fix and test LED tube. | 18 | LED tube light mounting, testing and fault finding. | 2 | CO4 |
| LLO 19.1 Trace cable laying. | 19 | Power cable tracing. (For machine installation in laboratory) | 2 | CO4 |
| LLO 20.1 Carry out the polarity test of the electrical installation of machine laboratory. | 20 | *Electrical installation testing. | 2 | CO4 |
| LLO 21.1 Draw and trace LT cable. | 21 | LT cable tracing. (from LT substation-transformer of your college to your laboratory.) | 2 | CO4 |
| LLO 22.1 Carry out electrical wire joints. | 22 | *Preparation of electrical wire joints (simple twist, married, Tee and western union joints). | 2 | CO4 |
| LLO 23.1 Carry out electrical wire joints. | 23 | *Preparation of electrical wire joints (britannia straight, Britannia tee and rat tail joints). | 2 | CO4 |
| LLO 24.1 Carry out lug crimping for cable. | 24 | Lug crimping for cable leads. | 2 | CO4 |
| LLO 25.1 Carry out PVC casing-capping and conduit wiring. | 25 | *Preparation of PVC casing-capping, conduit wiring for minimum four points of 3m length. | 4 | CO4 |
| LLO 26.1 Carry out wiring to control lamp from different places. | 26 | One lamp control from three and/or four different places. | 2 | CO4 |
| LLO 27.1 Trace and draw electrical schematic drawings of a panel. | 27 | *Tracing of electrical schematic drawings of a panel of any electrical machine in your laboratory. | 2 | CO4 |
| LLO 28.1 Carry out plate earthing. | 28 | *Plate earthing. | 2 | CO5 |
| LLO 29.1 Carry out chemical earthing. | 29 | Chemical earthing. | 2 | CO5 |
| LLO 30.1 Test / measure earthing resistance of electrical installation. | 30 | Testing and measurement of earthing resistance. | 2 | CO5 |

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)**Assignment**

- Prepare chart about the information of different types of magnetic materials (ferromagnetic, paramagnetic, diamagnetic).
- Draw the sketches of plate/pipe/rod/chemical earthing.
- Draw the wiring diagram of Flat/Bungalow 1BHK/2BHK.
- Prepare chart about the information of different types of magnetic materials (ferromagnetic, paramagnetic, diamagnetic).
- Draw the wiring diagram of electrical panel.
- Draw symbols related to electrical accessories and wiring.
- Draw the hysteresis loops for hard steel, wrought iron and alloyed steel.
- Identify various parts of electrical panel.

Visit

- Visit to a nearby construction site and observe the electrification work being carried out and note details of wires, switchgears, earthing practices, safety aspects being followed etc.

Micro project

- Collect the information about distribution substation earthing and submit report on it.
- Collect the sample/information about different types and sizes of wires, cables, and switches available in the market and submit report on it.
- Collect information from internet or otherwise on the different electromagnetic materials along with the forms in which they are available and submit report on it.
- Carry out profile lighting upto 5m length with suitable driver (choke).
- Collect the information about methods of wiring and submit report on it.
- Collect the information about MCBs and MCCBs of different specifications and submit report on it.
- Collect the information about RCCBs of different specifications and submit report on it.

Self learning topics

- Latest tools and techniques in the field of electrical wiring, earthing, materials.

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicious mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

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| Sr.No | Equipment Name with Broad Specifications | Relevant LLO Number |
|-------|---|---------------------|
| 1 | Various fuse mounting units, fuse wire of different rating, ammeter, lamp bank. | 10 |
| 2 | Insulation tester 500V or 1000V | 11,13 |
| 3 | Insulating materials of different classes, electric iron | 12 |
| 4 | Dielectric oil test kit, dielectric oil samples | 14 |
| 5 | Wooden/PVC board, two way switches (6A)- 2 Nos, lamp holder- 1 No., lamp- 1 No. | 15 |
| 6 | Wooden/PVC board, one way switch- 1 No., two way switches (6A)- 2 Nos, lamp holder- 3 No., lamp- 3 No. | 16 |
| 7 | Wooden/PVC board, single pole switches (6A)- 4 Nos., sockets (5 pin-6A), MCB- 2A, red color indicator- 1No. | 17 |
| 8 | 18/20 Watt LED tube with mounting brackets and screws | 18 |
| 9 | Bucket filled with water, sand, Class 'A' type fire extinguisher. | 2 |
| 10 | Electric tester, test lamp, multimeter. | 20 |
| 11 | Electrician's knife, stainless steel rule, diagonal cutting plier, combination plier, wooden mallet, bastard flat file, hard vice, wires of various sizes, bare copper wire, GI wire, sand paper, cotton cloth. | 22,23 |
| 12 | Crimping lugs, crimping tool, combination plier, knife. | 24 |
| 13 | PVC casing capping-3 meter, PVC conduit -3 meter, wires, wooden/PVC board, switches and sockets | 25 |
| 14 | Wooden/PVC board, lamp holder, lamp, 2 way switches(6A)- 2 Nos. | 26 |
| 15 | Copper plate, salt, wood coal, copper or GI wire etc. | 28 |
| 16 | Chemical mixture containing Bentonite, salt, charcoal, chemical electrode, Copper or GI strip/conductor | 29 |
| 17 | Wooden stick, rubber mat, chart or videos of rescue procedure and respiratory methods. | 3 |
| 18 | Earth tester (Analog/Digital) | 30 |
| 19 | Pliers, screw driver set, nose pliers, measuring tape, cutter cum insulation remover, screw driver, tester, test lamp, crimping tool, lugs, continuity tester, outer micrometer, knife, soldering gun | 4 |
| 20 | Single pole one way and two switches (6A) – 1 No. each, MCB 1/2A- 1No. each, MI/Digital type AC Ammeter 0-10 A, Lamp bank- 10A. | 5,7 |
| 21 | MCCB TP- 100A- 1 No. MCCB TPN- 100A- 1No. | 6 |
| 22 | Rewirable Kitkat fuse, fuse wire. | 7 |
| 23 | Wooden/PVC board, lamp holder, lamp, extension wire 2m | 8 |
| 24 | RCCB- 16 A double pole, sensitivity 30mA, lamp bank, switch. | 9 |
| 25 | Safety hand gloves, safety boots, safety goggles, safety rubber mats, safety helmet (All ISI Mark). | All |

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

| Sr.No | Unit | Unit Title | Aligned COs | Learning Hours | R-Level | U-Level | A-Level | Total Marks |
|-------|------|---|-------------|----------------|---------|---------|---------|-------------|
| 1 | I | Wiring Components, Tools and Safety Devices | CO1 | 3 | 0 | 0 | 0 | 0 |
| 2 | II | Conducting and Electromagnetic Materials | CO2 | 3 | 0 | 0 | 0 | 0 |
| 3 | III | Electrical Insulating Materials | CO3 | 3 | 0 | 0 | 0 | 0 |

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| Sr.No | Unit | Unit Title | Aligned COs | Learning Hours | R-Level | U-Level | A-Level | Total Marks |
|--------------------|------|-------------------|-------------|----------------|----------|----------|----------|-------------|
| 4 | IV | Electrical Wiring | CO4 | 3 | 0 | 0 | 0 | 0 |
| 5 | V | Earthing Systems | CO5 | 3 | 0 | 0 | 0 | 0 |
| Grand Total | | | | 15 | 0 | 0 | 0 | 0 |

X. ASSESSMENT METHODOLOGIES/TOOLS**Formative assessment (Assessment for Learning)**

- For formative assessment of laboratory learning 50 marks. Each practical will be assessed considering appropriate % weightage to process and product and other instructions of assessment.

Summative Assessment (Assessment of Learning)

- End semester summative assessment of 25 marks for laboratory learning.

XI. SUGGESTED COS - POS MATRIX FORM

| Course Outcomes (COs) | Programme Outcomes (POs) | | | | | | | Programme Specific Outcomes* (PSOs) | | |
|-----------------------|--|-----------------------|---------------------------------------|------------------------|--|-------------------------|-------------------------|-------------------------------------|-------|-------|
| | PO-1 Basic and Discipline Specific Knowledge | PO-2 Problem Analysis | PO-3 Design/ Development of Solutions | PO-4 Engineering Tools | PO-5 Engineering Practices for Society, Sustainability and Environment | PO-6 Project Management | PO-7 Life Long Learning | PSO-1 | PSO-2 | PSO-3 |
| CO1 | 3 | 2 | 2 | 3 | 3 | 1 | 3 | | | |
| CO2 | 3 | 2 | 3 | 1 | 1 | 1 | 2 | | | |
| CO3 | 3 | 2 | 3 | 1 | 1 | 1 | 2 | | | |
| CO4 | 3 | 3 | 2 | 3 | 1 | 2 | 2 | | | |
| CO5 | 3 | 1 | 1 | 2 | 2 | 2 | 2 | | | |

Legends :- High:03, Medium:02,Low:01, No Mapping: -
*PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

| Sr.No | Author | Title | Publisher with ISBN Number |
|-------|----------------------|---|--|
| 1 | Bhattacharya S. K. | Electrical Engineering Drawing | New Age International, New Delhi, ISBN: 978-81-224-0855-3. |
| 2 | Uppal S.L; Garg G.C. | Electrical Wiring, Estimating and Costing | Khanna Publishers, New Delhi, ISBN-13: 978-81-7409-240-3. |
| 3 | Singh R.P. | Electrical Workshop: Safety, commissioning, maintenance and testing of electrical equipment | I.K. International Publishing House , Pvt. Ltd. New Delhi, ISBN:978-9389447057 |
| 4 | Gupta J. B. | Electrical Estimating and Costing | S. K. Kataria & Sons, New Delhi, ISBN:978-93-5014-279-0 |

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| Sr.No | Author | Title | Publisher with ISBN Number |
|--------------|----------------------------------|---|-------------------------------------|
| 5 | Indulkar C.S. & Thiruvengadam S. | An introduction to electrical engineering materials | S Chand & Co., ISBN :978-8121906661 |

XIII . LEARNING WEBSITES & PORTALS

| Sr.No | Link / Portal | Description |
|--------------|---|--|
| 1 | www.bharatskills.gov.in | Directorate general of training - central repository for skills in NSQF curriculum |
| 2 | https://www.osha.gov/sites/default/files/publications/osha3075.pdf | Controlling Electrical Hazards |
| 3 | https://nsc.org.in/ | National safety council of India |
| 4 | https://www.esfi.org/ | Electrical safety foundation |

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

MSBTE Approval Dt. 02/07/2024**Semester - 3, K Scheme**