# SCHEME& SYLABI

**for**

# BACHELOR OF VOCATION

**In**

# ELECTRICAL

***WITH SPECIALIZATION IN***

# (Industrial Automation)

## (w.e.f. session 2026-2027)

**(As per NEP 2020 & UGC Curriculum and Credit Framework for Undergraduate Programmes – CCFUP)**

**(Choice Based Credit System with Multiple Entry & Exit and NSQF/NCrF Alignment)**

**COMMUNITY COLLEGE OF SKILL DEVELOPMENT**

**J.C.BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCA,FARIDABAD**
**SECTOR-6, FARIDABAD, HARYANA-121006**

# J. C. Bose University of Science and Technology, YMCA, Faridabad

*(formerly YMCA University of Science and Technology)*

A State Govt. University established vide State Legislative Act No. 21 of 2009

**SECTOR-6, FARIDABAD, HARYANA-121006**

## VISION

"J.C. Bose University of Science and Technology, YMCA, Faridabad aspires to be a nationally and internationally acclaimed leader in technical and higher education in all spheres which transforms the life of students through integration of teaching, research and character building."

## MISSION

- To contribute to the development of science and technology by synthesizing teaching, research and creative activities.
- To provide an enviable research environment and state-of-the-art technological exposure to its scholars.
- To develop human potential to its fullest extent and make them emerge as world class leaders in their professions and enthuse them towards their social responsibilities.

# Community College of Skill Development (CCSD)

## VISION

"To be a centre of excellence in vocational and skill-based higher education that produces competent, self-reliant and industry-ready professionals with sound technical skills, ethical values and a spirit of innovation and lifelong learning."

## MISSION

- To impart quality vocational education integrating theory, hands-on practice and on-the-job training aligned with NSQF/NCrF and industry standards.
- To strengthen employability and entrepreneurship through competency-based, outcome-oriented and skill-intensive curricula.
- To foster multiple entry and exit pathways that empower learners to progress seamlessly across academic and vocational qualifications.

## ABOUT THE COMMUNITY COLLEGE OF SKILL DEVELOPMENT (CCSD)

The Community College of Skill Development (CCSD) at J.C. Bose University of Science and Technology, YMCA, Faridabad, was established to advance the national skill-development agenda through industry-aligned, competency-based vocational education under the National Skills Qualifications Framework (NSQF) and the National Credit Framework (NCrF). CCSD offers Bachelor of Vocation (B.Voc.), Diploma and Post-Graduate Diploma programmes that blend academic rigour with extensive practical training, workshops and on-the-job training (OJT) in partnership with industry and Sector Skill Councils.

### ABOUT THE COURSE

The B.Voc. Electrical programme is designed in accordance with NEP 2020 and the UGC Curriculum and Credit Framework for Undergraduate Programmes (CCFUP), incorporating a flexible choice-based credit system, multidisciplinary courses, and multiple entry and exit options with appropriate NSQF/NCrF-aligned certifications at each year of study. The programme leverages the University's state-of-the-art electrical engineering laboratories, electrical machines and power systems labs, control and instrumentation facilities, renewable energy and power electronics laboratories, electrical maintenance workshops, and its strong industry linkages to ensure that every graduate is industry-ready and employable at progressively higher levels of competency. The curriculum emphasizes practical training, hands-on skill development, industrial exposure, and emerging technologies in electrical systems, enabling students to meet the evolving requirements of the power, manufacturing, automation, and energy sectors.

**TABLE 1 PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)**

| | |
|---|---|
| **PEO1** | To equip graduates with the practical skills and knowledge needed to excel in electrical installation, maintenance, and troubleshooting roles in the industry. |
| **PEO2** | To install a strong sense of safety awareness and ethical conduct, ensuring that graduates work responsibly and prioritize the well-being of themselves and others. |
| **PEO3** | To prepare graduates to adapt to evolving technologies and industry practices, fostering a commitment to lifelong learning and professional development. |
| **PEO4** | To develop graduates' communication and teamwork skills, enabling them to collaborate effectively with colleagues and professionals in the electrical field. |

**TABLE 2 PROGRAMME OUTCOMES (POs)**

| | |
|---|---|
| **PO1** | Have a strong understanding of electrical systems, circuits, and components, including the ability to analyse, design, and troubleshoot them effectively. |
| **PO2** | Be proficient in electrical installation, maintenance, and repair tasks, applying industry-standard practices and safety protocols. |
| **PO3** | Operate and maintain various electrical equipment and tools, ensuring proper functioning and safety. |
| **PO4** | Be aware of safety regulations and codes related to electrical work, ensuring that their activities adhere to industry standards and legal requirements. |
| **PO5** | Effectively communicate with team members and clients, as well as maintain accurate records and documentation related to electrical projects. |
| **PO6** | Be skilled in diagnosing electrical problems and finding effective solutions, applying critical thinking and troubleshooting techniques. |
| **PO7** | open to learning and adopting new technologies and industry trends as they emerge. |
| **PO8** | Demonstrate professionalism, ethical behaviour, and a strong work ethic in their interactions with clients, colleagues, and employers. |

## TABLE 3 PROGRAMME SPECIFIC OUTCOMES (PSOs)

| | |
|---|---|
| **PSO1** | Apply the principles of electrical engineering to install, operate, maintain, test, and troubleshoot electrical systems, machines, wiring, and associated equipment using industry-standard tools and practices. |
| **PSO2** | Utilize modern electrical equipment, automation technologies, and emerging industry practices to provide sustainable and efficient solutions while exhibiting professional ethics, communication skills, and a commitment to continuous learning. |

## TABLE 4 SUSTAINABLE DEVELOPMENT GOALS (SDGs) ADDRESSED

| | |
|---|---|
| **SDG 4** | Quality Education — inclusive, equitable quality education and lifelong learning. |
| **SDG 8** | Decent Work and Economic Growth — productive employment and decent work for all. |
| **SDG 9** | Industry, Innovation and Infrastructure — resilient infrastructure and sustainable industrialization. |
| **SDG 12** | Responsible Consumption and Production — sustainable production patterns. |
| **SDG 13** | Climate Action — combating climate change through sustainable practices. |

## TABLE 5 COURSE CODES AND DEFINITIONS (UGC CCFUP CATEGORIES)

| | |
|---|---|
| **L** | Lecture |
| **T** | Tutorial |
| **P** | Practical |
| **DSC** | Discipline Specific Course (core vocational/technical) |
| **DSC Lab** | Discipline Specific Laboratory / Workshop |
| **MDC** | Multidisciplinary Course |
| **AEC** | Ability Enhancement Course (language & communication) |
| **VAC** | Value Added Course |
| **SEC** | Skill Enhancement Course |
| **OJT** | On-Job Training / Industrial Training |
| **Project** | Project / Field Work |
| **MOOC** | Massive Open Online Course (SWAYAM/NPTEL) |

**J. C. BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCA, FARIDABAD**
**COMMUNITY COLLEGE OF SKILL DEVELOPMENT (CCSD)**
**SCHEME OF STUDIES & EXAMINATIONS**
**THREE-YEAR BACHELOR OF VOCATION (B.Voc.) PROGRAMME IN**
**Electrical withSpecialization in Industrial Automation**
**SEMESTER I – VI (w.e.f. Session 2026-27) (As per NEP 2020 & UGC CCFUP)**

**TABLE 6**

**B.VOC. Credit Structure**

| SEMESTER | DSC | MIC | AEC | MDC | VAC | SEC | PROJECT | TOTAL |
|---|---|---|---|---|---|---|---|---|
| **I** | 14 | - | - | 3 | 3 | - | - | 20 |
| **II** | 13 | - | 4 | - | 3 | - | - | 20 |
| **III** | 17 | - | - | 3 | - | - | - | 20 |
| **IV** | 16 | - | - | 2 | - | - | 2 | 20 |
| **V** | 3 | - | - | - | - | 17 | - | 20 |
| **VI** | 3 | - | - | - | - | 17 | - | 20 |
| **TOTAL CREDIT** | **66** | **-** | **4** | **8** | **6** | **34** | **2** | **120** |

Note:

a) A student has to earn at least 3 credits during the duration of the degree by passing at least one MOOC course of a minimum 12-week duration (carrying at least 3 credits) through the SWAYAM / NPTEL platform.

b) A student has to earn 1 credit for the Tree Plantation Activity.

## MANDATORY INDUCTION PROGRAMME

When new students enter the institution, they come with diverse thoughts, backgrounds and preparations. It is important to help them adjust to the new environment and inculcate in them the ethos of the institution with a sense of larger purpose. A mandatory Induction Programme for the B.Voc. students entering the institution shall be conducted right at the start. Normal classes will begin only after the Induction Programme is over. There is no fixed time limit prescribed for the programme; its duration may be decided by the College/Department as appropriate. Its purpose is to make students feel comfortable in their new environment, open them up, set a healthy daily routine, create bonding within the batch as well as between faculty and students, and develop awareness, sensitivity and understanding of the self, the people around them, society at large, and nature.

Tentative activities which may be planned in this Induction Programme are as follows:

- Physical Activity
- Creative Arts
- Universal Human Values
- Literary Activities
- Proficiency Modules
- Lectures by Eminent People
- Visits to Local Area / Industry
- Familiarization to the College / Trade & Innovations

## GUIDELINES FOR TREE PLANTATION AND CARE

As approved in the Academic Council, Tree Plantation is a mandatory activity for every student admitted to J. C. Bose University of Science and Technology, YMCA, Faridabad.

**Instructions for Students:**

1. **Tree Plantation:** Each admitted student is required to plant at least 2-5 tree saplings during his/her first or second semester at any place of their choice at/near their home (e.g., parks, grounds, etc.). The student must capture geo-tagged photographs of the planted saplings (with the student present in the photo) and take proper care of their growth.
2. **Submission of Documents:** The student has to submit geo-tagged photographs of the planted saplings on the University ERP platform in the prescribed format, including name of plant, date of plantation and any additional information.
3. **Ongoing Care and Monitoring:** After plantation, every student will take care of these plants and submit updated geo-tagged photos for subsequent years. The plantation document will be submitted once every year for (N-1) times, where N is the total duration of the programme. For example, a student of a 3-year B.Voc. programme has to submit the plantation document for two consecutive years, i.e., up to the pre-final year, indicating the growth and survival of the sapling.
4. **Tree Survival:** The student must ensure the successful survival of at least one tree out of the 2-5 initially planted, to be eligible for the degree.
5. **Verification of Documents:** Verification will be done by the respective teacher-coordinator at each successive year during Practical Examinations towards the end of the semester, as per the notified academic calendar.
6. **Certificate of Achievement:** The certificate for an eligible student will be auto-generated and may be downloaded from the ERP platform after due verification, fulfilling the requirement for degree conferral.

## EXIT CRITERIA

For J. C. Bose University of Science and Technology, YMCA, under the NEP 2020 and UGC CCFUP framework, the exit criteria generally require students to secure a minimum of 40% marks in the end-term examinations, in accordance with the University Examination Ordinance. In addition, students must fulfil the prescribed overall credit requirements to be eligible for the different exit options — UG Certificate, UG Diploma or B.Voc. Degree — aligned with the multiple entry and exit provisions of the National Education Policy, the National Skills Qualifications Framework (NSQF) / National Credit Framework (NCrF), and the guidelines of the University Grants Commission. Each year of study is mapped to a corresponding NSQF level: Year 1 → NSQF 4.5, Year 2 → NSQF 5.0, and Year 3 → NSQF 5.5.

**TABLE 7 EXIT OPTION DETAILS**

| S.No. | NSQF Level | Semester | Exit Options | Credits | Additional Credits for Exit | Exit Criteria |
|---|---|---|---|---|---|---|
| 1. | 4.5 | Sem I & II | U.G. Certificate (Electrical withspecialization in Industrial Automation) | 40 | 4 | Minimum 4–6 weeks of Industrial Internship OR online discipline specific skill courses at the relevant NCRF/NSQF level from NSQF/SSC/SWAYAM/NPTEL/any other recognized certifying agency (comprising either two courses of 2 credits each or one course of 4 credits) OR a Technical Project. |
| 2. | 5.0 | Sem III & IV | U.G. Diploma(Electrical withspecialization in Industrial Automation) | 40 | 4 | Minimum 4–6 weeks of Industrial Internship OR online discipline specific skill courses at the relevant NCRF/NSQF level from NSQF/SSC/SWAYAM/NPTEL/any other recognized certifying agency (comprising either two courses of 2 credits each or one course of 4 credits) OR a Technical Project. |

**Exit Option for U.G. Certificate (Level 4.5):** Any student opting for exit after the second semester will get a UG Certificate provided he/she earns 40 credits in the first two semesters and an additional 4 credits based on the exit options as per Table 7. Thus, he/she will be eligible to exit with 44 credits. The Internship Report / Certificate Course / Technical Project would be evaluated by an approved panel of experts.

| EMPLOYMENT PATHWAYS AFTER EXIT | |
|---|---|
| **Exit Qualification** | U.G. Certificate |
| **NSQF / NCrF Level** | 4.5 |
| **Associated Industry Sectors** | Power |
| **Mapped Job Roles** | Industrial Electrician |
| **Further Progression** | Possibility of re-entry into higher semesters through the Academic Bank of Credits (ABC). |

**Exit Option for U.G. Diploma (Level 5.0):** Any student opting for exit after the fourth semester will get a UG Diploma provided he/she earns 40 credits of Semesters I & II, 40 credits of Semesters III & IV, and an additional 4 credits based on the exit options as per Table 7. Thus, he/she will be eligible to exit with 84

credits. The Internship Report / Certificate Course / Technical Project would be evaluated by an approved panel of experts.

| EMPLOYMENT PATHWAYS AFTER EXIT | |
|---|---|
| **Exit Qualification** | U.G. Diploma |
| **NSQF / NCrF Level** | 5.0 |
| **Associated Industry Sectors** | IASC sector skill council |
| **Mapped Job Roles** | Industrial Automation Technician |
| **Further Progression** | Possibility of re-entry into higher semesters through the Academic Bank of Credits (ABC). |

**Criteria for B.Voc. Degree (Level 5.5):** A student completing all six semesters will be awarded the B.Voc. Degree on earning 40 credits of Semesters I & II, 40 credits of Semesters III & IV, and 40 credits of Semesters V & VI (Industrial Training / OJT), subject to the MOOC and Tree-Plantation requirements. The full programme therefore carries Total Credits + 3* (MOOC) + 1# (Tree Plantation) credits.

| EMPLOYMENT PATHWAYS AFTER EXIT | |
|---|---|
| **Exit Qualification** | B.Voc. Degree |
| **NSQF / NCrF Level** | 5.5 |
| **Associated Industry Sectors** | Power / Manufacturing / Industrial Automation |
| **Mapped Job Roles** | Industrial Electrician (Skilled) |
| **Further Progression** | Possibility of progression to higher studies through the Academic Bank of Credits (ABC). |

## NSQF JOB-ROLE & NATIONAL OCCUPATIONAL STANDARDS (NOS) ALIGNMENT

This section maps each year-end NSQF exit point of the B.Voc. Electrical programme to the appropriate Qualification Pack (QP) / Job Role and aligns the relevant National Occupational Standards (NOS) to specific subjects of the scheme, with brief justification.

Year 1 → NSQF 4.5, Year 2 → NSQF 5.0, Year 3 → NSQF 5.5.

### Year-wise NSQF Alignment (Summary)

| Exit Year | NSQF Level | Job Role | QP Code / NQR | Sector / Council | NOS Aligned |
|---|---|---|---|---|---|
| Year 1 (Sem I & II) | 4.5 | Industrial Electrician | PSS/Q1705, v1.0 | Power Sector Skill Council (PSSC) | 7 NOS |
| Year 2 (Sem III & IV) | 5.0 | Industrial Automation Technician | IAS/Q5601 | Instrumentation, Automation, Surveillance & Communication Sector Skill Council (IASC SSC) | 5 Mandatory NOS + Practical/OJT Mapping |
| Year 3 (Sem V & VI) | 5.5 | Industrial Electrician (Skilled) | Institution-defined Composite NSQF 5.5 Exit Role based on cumulative competency and Industrial OJT | Power / Manufacturing / Industrial Automation | 8 NOS |

### YEAR 1 EXIT — NSQF Level 4.5 (Semesters I & II)

| **Job Role: Industrial Electrician** |
|---|
| QP Code: PSS/Q1705, v1.0”<br>NQR / Ref: verify against live NQR<br>PSS/Q1705, v1.0<br>Occupation: Electrical Installation and Maintenance Technician<br>Sector: Power Sector Skill Council |

### NOS - Course Alignment

| NOS Code | NOS Title | Aligned Course(s) | Justification (Brief) |
|---|---|---|---|
| PSS/N1706 | Plan and prepare for pipe and plate earthing | Electrical Installation Practices; Earthing & Protection Systems; Workshop Practice | Covers planning, layout, material selection, installation and testing of pipe and plate earthing systems used for industrial electrical safety. |
| PSS/N1707 | Prepare for industrial wiring operations | Industrial Wiring; Electrical Wiring Practice; Electrical Workshop | Involves interpretation of wiring diagrams, selection of cables/accessories, conduit work, and preparation for industrial wiring installations. |
| PSS/N1708 | Perform installation and testing of switchboard | Switchgear & Protection; Electrical Installation and Maintenance; Testing & Commissioning | Focuses on assembly, installation, inspection, testing and commissioning of industrial switchboards and associated protection devices. |
| PSS/N1709 | Prepare for control panel wiring of industrial AC Motors | Motor Control Circuits; Industrial Automation Basics; Control Panel Wiring & Maintenance | Covers preparation, wiring and testing of motor control panels, starters, contactors, relays and control circuits for industrial AC motors. |

### YEAR 2 EXIT — NSQF Level 5.0 (Semesters III & IV)

| **Job Role: Industrial Automation Technician** |
|---|
| QP Code: IAS/Q5601<br>NQR / Ref: IASC SSC Job Role<br>Occupation: Installation, Commissioning and Maintenance of Industrial Automation Systems<br>Sector: Instrumentation, Automation, Surveillance and Communication (IASC) Sector Skill Council |

### NOS — Course Alignment

| NOS Code | NOS Title | Aligned Course(s) | Justification (Brief) |
|---|---|---|---|
| IAS/N5605 | Install and Commission Control Panel | Industrial Automation Systems; PLC & SCADA; Control Panel Design and Wiring; Industrial Instrumentation; Sensors & Actuators | Covers installation, integration, testing, commissioning and troubleshooting of industrial control panels and automation systems at customer sites. |
| IAS/N9001 | Work Effectively with Teams | Employability Skills; Professional Communication; Project Work; Industrial Training | Develops teamwork, communication, coordination, reporting and professional workplace behaviour required during installation and commissioning activities. |
| IAS/N9002 | Health and Safety in Workplace | Industrial Safety; Electrical Safety; Occupational Health & Environment; Workshop Practice | Addresses safe work practices, hazard identification, risk mitigation, PPE usage and compliance with industrial safety standards. |
| DGT/VSQ/N0102 | Employability Skills | Employability Skills; Entrepreneurship; Digital Literacy; Communication Skills | Focuses on communication, ICT skills, financial literacy, entrepreneurship and workplace readiness |

### YEAR 3 EXIT — NSQF Level 5.5 (Semesters V & VI)

| **Job Role: Industrial Electrician (Skilled)** |
|---|
| QP Code: Institution-defined Composite Exit Role (aligned to cumulative NOS competencies of Year 1–3)<br>NQR / Ref: NSQF Level 5.5 Exit Qualification (to be verified against latest NQR / SSC mapping)<br>Occupation: Industrial Electrical Maintenance, Installation, Automation Integration & Commissioning<br>Sector: Power / Manufacturing / Industrial Automation |

### NOS -Course Alignment

| NOS Code | NOS Title | Aligned Course(s) | Justification (Brief) |
|---|---|---|---|
| IE/N5501 | Perform Advanced Industrial Electrical Maintenance | Industrial Electrical Maintenance; Electrical Machines & Drives | Covers preventive, predictive and breakdown maintenance of industrial electrical equipment and machinery. |
| IE/N5502 | Troubleshoot Industrial Electrical Systems | Fault Diagnosis & Troubleshooting; Maintenance Engineering | Develops skills for identifying, analysing and rectifying electrical faults in industrial installations. |
| IE/N5503 | Install and Commission Industrial Electrical Equipment | Electrical Installation & Commissioning; Industrial Project Work | Covers installation, testing, commissioning and performance verification of industrial electrical systems. |
| IE/N5504 | Configure and Maintain Motor Control & Drive Systems | Power Electronics & Drives; Variable Frequency Drives (VFDs) | Focuses on motor starters, soft starters, VFDs and industrial drive applications. |
| IE/N5505 | Integrate PLC-Based Control Systems | PLC Programming; Industrial Automation & SCADA | Addressescontrol logic implementation, automation integration and industrial process control. |
| IE/N5506 | Ensure Electrical Safety and Regulatory Compliance | Industrial Safety; Electrical Protection & Standards | Covers safe work practices, statutory compliance, protection systems and risk mitigation. |
| IE/N5507 | Supervise Electrical Maintenance Activities | Maintenance Management; Project Management; | Developssupervisory, reporting, planning, documentation and team-coordination |

| NOS Code | NOS Title | Aligned Course(s) | Justification (Brief) |
|---|---|---|---|
| | and Documentation | Employability Skills | competencies expected at NSQF Level 5.5. |

**Rationale for the NSQF 5.5 UG Degree:** The NSQF Level 5.5 qualification in B.Voc. Electrical is awarded after successful completion of a full year of On-the-Job Training (OJT) during Semesters V and VI. The qualification reflects the cumulative competencies acquired through academic learning in Semesters I–IV and extensive workplace training. Students gain practical skills in electrical installation, operation, maintenance, testing, troubleshooting, and safety practices. The year-long industrial exposure enhances their technical proficiency, problem-solving abilities, and workplace readiness.

## Co-anchor NSQF Roles

| Role / QP | Strongest Scheme Link | Rationale |
|---|---|---|
| Industrial Automation Technician (IAS/Q5601) | PLC, SCADA, Control Panels, Industrial Networks | Graduate possesses competencies in automation installation, commissioning, troubleshooting and industrial control systems. |
| PLC Technician | PLC Programming, Automation Labs, OJT | Demonstrates ability to program, test, modify and maintain PLC-controlled systems. |
| Control Panel Technician | Motor Control, Industrial Wiring, Control Panels | Skilled in assembly, wiring, testing and commissioning of industrial control panels. |
| Robotics Technician | Robotics Labs, Automation Integration, Industrial OJT | Able to install, operate, troubleshoot and maintain industrial robotic cells and automated production systems. |

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**Community College of Skill Development (CCSD)**
**B.Voc. Electrical with specialization in Industrial Automation**
**[NSQF Level 4.5, UG Regular]**

## TABLE 8

## SCHEME FOR SEMESTER – I

| Course Code | Course Title | Teaching Schedule | | | | Teaching Hours | | | Marks for Sessional | Marks for End Term Examination | | Total Marks | Credits | Course Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | L | T | P | Total | L | P | O/A | | Theory | Practical | | | |
| ELV-101-V1 | Electrical Technology | 4 | 0 | - | 4 | 60 | | 60 | 40 | 60 | - | 100 | 4 | DSC |
| ELV-103-V1 | Electrical Wiring | 4 | 0 | - | 4 | 60 | | 60 | 40 | 60 | - | 100 | 4 | DSC |
| ELV-107-V1 | Electrical Workshop-I | - | - | 6 | 6 | | 90 | 0 | 25 | - | 25 | 50 | 3 | DSC Lab |
| ELV-105-V1 | House Wiring & Domestic Appliances Lab | - | - | 6 | 6 | | 90 | 0 | 25 | - | 25 | 50 | 3 | DSC Lab |
| ESU-205-V1 | Environmental Science | 3 | - | - | 3 | 45 | | 45 | 40 | 60 | - | 100 | 3 | VAC |
| AMV-105-V1 | Computer applications and data visualisation | 3 | - | - | 3 | 45 | | 45 | 40 | 60 | - | 100 | 3 | MDC |
| **Total** | | **14** | **0** | **12** | **26** | **210** | **180** | **210** | **210** | **240** | **50** | **500** | **20** | |

**J. C. BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCA, FARIDABAD**
**Community College of Skill Development (CCSD)**
**B.Voc. Electrical with specialization in Industrial Automation**
**[NSQF Level 4.5, UG Regular]**

## TABLE 9

## SCHEME FOR SEMESTER – II

| Course Code | Course Title | Teaching Schedule | | | | Teaching Hours | | | Marks for Sessional | Marks for End Term Examination | | Total Marks | Credits | Course Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | L | T | P | Total | L | P | O/A | | Theory | Practical | | | |
| ELV-102-V1 | Electrical Machine- I | 4 | 0 | - | 4 | 60 | | 60 | 40 | 60 | - | 100 | 4 | DSC |
| ELV-104-V1 | Analog & Digital Electronics | 4 | 0 | - | 4 | 60 | | 60 | 40 | 60 | - | 100 | 4 | DSC |
| ELV-108-V1 | Electrical Workshop-II | - | - | 6 | 6 | | 90 | 0 | 25 | - | 25 | 50 | 3 | DSC Lab |
| ELV-106-V1 | Electrical Engineering Drawing | - | - | 4 | 4 | | 60 | 0 | 25 | - | 25 | 50 | 2 | DSC Lab |
| MRV-101-V1 | Workshop Calculations and Analytical Techniques | 3 | - | - | 3 | 45 | | 45 | 40 | 60 | - | 100 | 3 | VAC |
| AEC-201-V1 | Professional Communication Skills | 4 | - | - | 4 | 60 | | 60 | 40 | 60 | - | 100 | 4 | AEC |
| **TOTAL** | | **15** | **0** | **10** | **25** | **225** | **150** | **225** | **210** | **240** | **50** | **500** | **20** | |

**Exit Option for U.G. Certificate (Level 4.5):** Any student opting for exit after the second semester will get a UGCertificate on earning 40 credits of the first two semesters plus additional 4 credits as per Table 7 (total 44 credits).

**J. C. BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCA, FARIDABAD**
**Community College of Skill Development (CCSD)**
**B.Voc. Electrical with specialization in Industrial Automation**
**[NSQF Level 5.0, UG Regular]**

## TABLE 10

## SCHEME FOR SEMESTER – III

| Course Code | Course Title | Teaching Schedule | | | | Teaching Hours | | | Marks for Sessional | Marks for End Term Examination | | Total Marks | Credits | Course Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | L | T | P | Total | L | P | O/A | | Theory | Practical | | | |
| | Electrical Machine- II | 4 | - | - | 4 | 60 | | 60 | 40 | 60 | - | 100 | 4 | DSC |
| | Power Electronics | 4 | - | - | 4 | 60 | | 60 | 40 | 60 | - | 100 | 4 | DSC |
| | Electrical Workshop-III | - | - | 8 | 8 | | 120 | 0 | 25 | - | 25 | 50 | 4 | DSC Lab |
| | Power System | 3 | - | - | 3 | 45 | | 45 | 40 | 60 | - | 100 | 3 | DSC |
| | Power System Lab | - | - | 4 | 4 | | 60 | 0 | 25 | - | 25 | 50 | 2 | DSC Lab |
| MDC-2 | Indian Knowledge System | 3 | - | - | 3 | 45 | | 45 | 40 | 60 | - | 100 | 3 | MDC |
| **Total** | | **14** | **0** | **12** | **26** | **210** | **180** | **210** | **210** | **240** | **50** | **500** | **20** | |

**J. C. BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCA, FARIDABAD**
**Community College of Skill Development (CCSD)**
**B.Voc. Electrical with specialization in Industrial Automation**
**[NSQF Level 5.0, UG Regular]**

## TABLE 11

## SCHEME FOR SEMESTER – IV

| Course Code | Course Title | Teaching Schedule | | | | Teaching Hours | | | Marks for Sessional | Marks for End Term Examination | | Total Marks | Credits | Course Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | L | T | P | Total | L | P | O/A | | Theory | Practical | | | |
| | Utilisation of Electrical Energy | 3 | - | - | 3 | 45 | | 45 | 40 | 60 | - | 100 | 3 | DSC |
| | Electrical Vehicle | 4 | - | - | 4 | 60 | | 60 | 40 | 60 | - | 100 | 4 | DSC |
| | PLC & Microcontrollers | 4 | - | - | 4 | 60 | | 60 | 40 | 60 | - | 100 | 4 | DSC |
| | PLC Workshop | | - | 6 | 6 | | 90 | 0 | 25 | | 25 | 50 | 3 | DSC Lab |
| | Industrial Electronics and control of drives Lab | - | - | 4 | 4 | | 60 | 0 | 25 | - | 25 | 50 | 2 | DSC Lab |
| MDC-3 | Business management and entrepreneurship essentials | 2 | - | - | 2 | 30 | | 30 | 40 | 60 | - | 100 | 2 | MDC |
| | Project | | | 4 | 4 | | 60 | 0 | 30 | - | 70 | 100 | 2 | Project |
| **Total** | | **13** | **0** | **14** | **27** | **195** | **210** | **195** | **240** | **240** | **120** | **600** | **20** | |

**Exit Option for U.G. Diploma (Level 5.0):** Any student opting for exit after the fourth semester will get a UG Diploma on earning 40 + 40 credits of the first four semesters plus additional 4 credits as per Table 7 (total 84 credits).

**J. C. BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCA, FARIDABAD**
**Community College of Skill Development (CCSD)**
**B.Voc. Electrical with specialization in Industrial Automation**
**[NSQF Level 5.5, UG Regular]**

## TABLE 12

## SCHEME FOR SEMESTER – V

| Course Code | Course Title | OJT Schedule (hours) | Credits | Marks for Sessional | Marks for End Semester Examination | Total Marks |
|---|---|---|---|---|---|---|
| 1. | Industrial Training / On-Job Training (OJT) | 600 | 17 | 150 | 350 | 500 |
| 2. | Program Elective Course-I | 0 | 03 | 40 | 60 | 100 |
| | **Total** | **600** | **20** | **190** | **410** | **600** |

## LIST OF PROGRAM ELECTIVE COURSES

| Course Code | Course Title |
|---|---|
| | Electrical Measurement and Electronic Instruments |
| | Computer Aided Design of Electrical Machine |
| | Non-Conventional Sources of Energy |
| | Mechatronics |
| | Smart Grid Technology |

**Note:**During Semester Vth the student undergoes full-time Industrial Training / OJT in industry, supplemented by a Training Report and a Seminar/Presentation.

**Procedure for Evaluation of Industrial Training:**
**(A) End-Term (350 Marks):** Training Report 100; Training Seminar 100; Training Viva 150.
**(B) Continuous Assessment (150 Marks):** Assessment by Internal Faculty 50; Assessment by Industrial Guide 100.

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## TABLE 13

## SCHEME FOR SEMESTER – VI

| Course Code | Course Title | OJT Schedule (hours) | Credits | Marks for Sessional | Marks for End Semester Examination | Total Marks |
|---|---|---|---|---|---|---|
| 1. | Industrial Training / On-Job Training (OJT) | 600 | 17 | 150 | 350 | 500 |
| 2. | Program Elective Course-II | 0 | 03 | 40 | 60 | 100 |
| | **Total** | **600** | **20** | **190** | **410** | **600** |

## LIST OF PROGRAM ELECTIVE COURSES

| Course Code | Course Title |
|---|---|
| | Energy Conservation and Audit |
| | Installation and Maintenance of Electrical Equipment |
| | Solar Panel Installation and Maintenance |
| | Electrical Traction System |
| | HVDC and Flexible AC Transmission System |

**Note:** During Semesters VI the student undergoes full-time Industrial Training / OJT in industry, supplemented by a Training Report and a Seminar/Presentation. The full-year OJT consolidates NSQF 5.5 competency.

**Procedure for Evaluation of Industrial Training:**
**(A) End-Term (350 Marks):** Training Report 100; Training Seminar 100; Training Viva 150.
**(B) Continuous Assessment (150 Marks):** Assessment by Internal Faculty 50; Assessment by Industrial Guide 100.

# DETAILED SYLLABI

# ELECTRICAL TECHNOLOGY
# Course Code:

**No of Credits: 4Sessional: 40 Marks**

| L | T | P | Total | Theory: 60 Marks |
|---|---|---|---|---|
| 4 | 0 | 0 | 4 | Total: 100 Marks |

**Course Objective:**This course aims to provide students with a foundational understanding of electrical concepts and circuits, covering both direct current (DC) and alternating current (AC) systems. Students will learn the principles and applications of basic electrical components, circuit analysis techniques, and the characteristics and maintenance of electric cells. Through theoretical knowledge and practical applications, the course will prepare students to analyse and solve electrical circuit problems

**Course Outcomes (COs):**At the end of the course, the student shall be able to:

**CO1:**Apply basic electrical concepts and analyse DC circuits using mesh, nodal, and network theorems.
**CO2:**Explain AC generation and characteristics, calculate AC parameters, and represent AC quantities using phasors.
**CO3:**Analyse single-phase AC circuits, determine power and resonance parameters, and evaluate power factor improvement.
**CO4:**Understand electrical measurements, identify measurement errors, and explain the operation of common electrical measuring instruments.

**CO–PO Mapping:**

| Course Outcomes (COs) | PO1 (Voc/Tech) | PO2 (Prob. Solving) | PO3 (Tool Usage) | PO4 (Quality/Safety) | PO5 (Comm/Team) | PO6 (Ethics) | PO7 (Entre/Mgmt) | PO8 (Lifelong) |
|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | – | 1 | – | – | 2 |
| CO2 | 3 | 3 | 2 | 1 | 1 | – | – | 2 |
| CO3 | 3 | 2 | 2 | 3 | 1 | 1 | – | 2 |
| CO4 | 2 | 3 | 3 | 2 | 1 | - | 1 | 3 |

*Correlation levels: 1 = Low, 2 = Medium, 3 = High; "–" = No correlation.*

**CO–PSO Mapping:**

| Course Outcomes (COs) | PSO1 (Electrical Installation, Operation and Maintenance) | PSO2 (Modern Electrical Technology and Professional Competence) |
|---|---|---|
| CO1 | 1 | 1 |
| CO2 | 2 | 1 |
| CO3 | 2 | 1 |
| CO4 | 3 | 2 |

**Course Contents:**

**Unit 1: DC Network Theorems**

History and evolution of electrical, Definition of Charge, Resistance, Voltage, Current, Power, Energy and their units Mesh analysis, Nodal analysis using voltage and current sources, Superposition theorem, Thevenin theorem Norton theorem, Maximum power transfer theorem, Active and passive network, Linear and Non-Linear network

**Unit 2: Generation of alternating Voltage and current**

Difference between AC and DC, Equation of alternating quantity. AC Terminology: waveform, cycle, frequency, time period, amplitude, instantaneous value, alternation, and their important relations (time period and frequency, angular velocity and frequency etc.). Values of alternating voltage and current: Instantaneous value, peak value average value, r.m.s. value, form factor and peak factor, Vector representation of alternating quantities, Concept of phase, phase difference and phasors, Representation of electrical quantities through phasors, Addition of two alternating quantities: parallelogram method, component method

**Unit 3: Single Phase AC Series Circuits**

A.C circuit containing pure Resistance, Inductance, Capacitance with the concept of power consumed, phase Angle, inductive and capacitive reactance etc. AC series circuit: R-L, R-C, R-L-C along with the concept of phasor diagram, phase angle , Impedance, impedance triangle, power, power triangle etc., Concept of True

power, apparent power and reactive power, Power factor and its significance, disadvantages of low power factor, cause of low power factor, improvement of power factor. Active and reactive components of current Resonance in RLC series circuit, Quality (Q) factor

**Unit 4: Introduction to Electrical Measuring Instruments**

Concept of measurement and instruments, Measurement of electrical quantities, Sources of error, Types of electrical measuring instruments – indicating, integrating, and recording type instruments, Essentials of indicating instruments – deflecting, controlling, and damping torque. Concept of ammeter and voltmeter and difference between them, Construction and working principles of moving iron and moving coil instruments, and Applications. Construction, working principle, dynamometer type wattmeter, Construction, Working principle, Merits and demerits of single-phase energy meters.

**Textbooks & References:**

1. D.P. Kothari and I. J. Nagrath,"Basic Electrical Engineering", Tata Mc Graw Hill, 2010.
2. E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.
3. L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.
4. A.K. Theraja and S.G. Tarnekar, "Electrical Technology", S. Chand, 2000.
5. A.K. Sawhney & Puneet Sawhney; A Course in Electrical and Electronic Measurements and Instrumentation, 7/e, Dhanpat Rai & Co. (P) Ltd., 2005.

**Suggested Tutorial / Sessional Assignments:**

1. Explain the history and evolution of electrical engineering.
2. Define: charge, current, voltage, resistance, power, and energy with SI units.
3. State differences between AC and DC with suitable waveforms.
4. State KCL and KVL with explanation.
5. Solve numerical problems using KCL and KVL.
6. Verify Kirchhoff's laws using simple circuits.
7. Explain star and delta connections with diagrams.
8. Derive conversion formulas.
9. Solve at least 3 numerical problems.
10. Compare primary and secondary cells.
11. Explain construction and working of Lead Acid and Li-ion batteries.
12. Solve numerical problems on series and parallel battery combinations
13. Represent sinusoidal waveform and define peak, average, and RMS values.
14. Solve numerical problems on RMS and average values.

# ELECTRICAL WIRING
# Course Code:

**No of Credits: 4** **Sessional: 40 Marks**
**L T P Total** **Theory: 60 Marks**
**4 0 0 4** **Total: 100 Marks**

**Course Objective:** The objective of this course is to provide students with a comprehensive understanding of electrical wiring systems, including relevant standards, safety regulations, tools, and accessories used in both domestic and industrial settings. The course aims to cover the basics of electrical wiring systems and the National Electrical Code (NEC), develop proficiency in various wiring methods, and impart knowledge of cutting tools and fasteners.

**Course Outcomes (COs):**At the end of the course, the student shall be able to:

**CO1:**Describe the fundamental principles of electrical wiring systems.
**CO2:** Implement domestic and industrial wiring methods, ensuring compliance with safety standards and regulations.
**CO3:** Analyse and diagnose general faults in electrical installations and perform necessary tests as per Indian Electricity Rules.
**CO4:** Evaluate the types and functions of various electrical accessories and choose appropriate tools and fasteners for specific electrical installations.

**CO–PO Mapping:**

| Course Outcomes (COs) | PO1 (Voc/Tech) | PO2 (Prob. Solving) | PO3 (Tool Usage) | PO4 (Quality/Safety) | PO5 (Comm/Team) | PO6 (Ethics) | PO7 (Entre/Mgmt) | PO8 (Lifelong) |
|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | 2 | 1 | – | – | 2 |
| CO2 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 1 | 1 | – | 2 |
| CO4 | 3 | 2 | 3 | 2 | 1 | - | 1 | 2 |

*Correlation levels: 1 = Low, 2 = Medium, 3 = High; "–" = No correlation.*

**CO–PSO Mapping:**

| Course Outcomes (COs) | PSO1 (Electrical Installation, Operation and Maintenance) | PSO2 (Modern Electrical Technology and Professional Competence) |
|---|---|---|
| CO1 | 2 | 1 |
| CO2 | 3 | 1 |
| CO3 | 3 | 2 |
| CO4 | 2 | 1 |

**Course Contents:**

**Unit 1: Introduction:**

Definition, Selection of the wiring system, Material required for wiring, Wiring safety and precautions, Preparation/Planning for wiring, Indian Electricity Rules, Indian Standards for electrical wiring, National Electrical Code (NEC), Scope of the National Electrical Code.
Electrical Tools: Pliers (combination, side cutting, round nose, long nose), screwdrivers, connectors, electrical knife, neon tester, test lamp, symbols used in electrical technology, reading of electrical drawings.

**Unit 2: Domestic and Industrial Wiring:**

Megger, Domestic wiring methods, Advantages, Disadvantages, Uses and precautions regarding various domestic wirings, Tests for wiring as per I.E. Rules before and after supplying mains. Printed Circuit Board: Introduction, types, and testing.

**Unit3:Cutting Tools and Fasteners:**

Gauges, limit gauges and fixed gauges, drilling, uses of drilling machines, safety with drill machines, hand drilling machines, fasteners (threaded and non-threaded), adhesives, fastener safety, hand taps, care in tapping, threads, different types of threads, measuring threads.

**Unit4:Electrical Accessories:**

Switches and their types, wiring switches in series and parallel, bulbs and their types, lamp holders and their types, ceiling rose and their types, pin plug, socket and adapter, fuse outlets and their types.

**Textbooks & References:**

1. Frederic P. Hartwell and H. P. Richter; Practical Electrical Wiring: Residential, Farm, Commercial, and Industrial, Park Publishing, 2014.
2. J. Coker and W. Turner; Electric Wiring Domestic, Newnes, 10th Edition.
3. Mullin and Phil Simmons; Electrical Wiring Commercial, 17E, NEC 2020.
4. Rex Cauldwell; Wiring a House, The Taunton Press, 2002.

**Suggested Tutorial / Sessional Assignments:**

1. Explain the definition of electrical wiring system and discuss the selection criteria for different types of wiring systems.
2. List the materials required for electrical wiring and explain their functions in installation work.
3. Explain wiring safety precautions and preparation/planning required before starting an electrical wiring installation.
4. Describe Indian Electricity Rules (IER), Indian Standards, and National Electrical Code (NEC) in detail.
5. Explain different types of electrical hand tools such as pliers, screwdrivers, and electrical knife with their uses.
6. Describe electrical symbols used in wiring diagrams and explain how to read simple electrical drawings.
7. Explain domestic wiring methods and discuss their advantages and disadvantages.
8. Describe the use of Megger and explain different tests performed on wiring systems as per I.E. Rules.
9. Explain printed circuit board (PCB), its types, and basic testing methods.
10. Describe different cutting tools, gauges, drilling machines, and safety precautions while using them.
11. Explain different types of fasteners, threads, and hand tapping process used in electrical work.
12. Describe electrical accessories such as switches, bulbs, lamp holders, sockets, pin plugs, and fuse outlets with their applications.

# ELECTRICAL WORKSHOP–I
## Course Code:

**No of Credits: 4** **Sessional: 25 Marks**
**L T P Total** **Theory: 25 Marks**
**- - 8 8** **Total: 50 Marks**

**Course Objective:** The objective of this course is to equip students with practical skills in using electrical trade tools, understanding and creating electrical joints, soldering, measuring resistance, verifying fundamental electrical laws, and installing electrical accessories. This hands-on course will prepare students to effectively work with electrical components and circuits in real-world applications.

**Course Outcomes (COs):**At the end of the course, the student shall be able to:

**CO1:** Identify and use various trade hand tools, screws, nuts, bolts, and other electrical components, ensuring proper care, maintenance, and application in practical scenarios.

**CO2:** Perform electrical cable preparation techniques, including skinning, joint practice, and crimping, to ensure effective and safe electrical connections.

**CO3:** Demonstrate and verify the fundamental principles of electrical circuits, including Ohm's Law, Kirchhoff's Laws, and the laws governing series and parallel circuits, using appropriate measuring tools and techniques.

**CO4:** Install and Overhaul common electrical accessories such as switches, holders, and plugs, and understand the concept of wiring and switching in practical applications.

**CO–PO Mapping:**

| Course Outcomes (COs) | PO1 (Voc/Tech) | PO2 (Prob. Solving) | PO3 (Tool Usage) | PO4 (Quality/Safety) | PO5 (Comm/Team) | PO6 (Ethics) | PO7 (Entre/Mgmt) | PO8 (Lifelong) |
|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 1 | 3 | 2 | 1 | – | – | 2 |
| CO2 | 3 | 2 | 3 | 3 | 1 | – | – | 2 |
| CO3 | 3 | 3 | 3 | 2 | 1 | – | – | 2 |
| CO4 | 3 | 2 | 3 | 3 | 2 | 1 | 1 | 2 |

*Correlation levels: 1 = Low, 2 = Medium, 3 = High; "–" = No correlation.*

**CO–PSO Mapping:**

| Course Outcomes (COs) | PSO1 (Electrical Installation, Operation and Maintenance) | PSO2 (Modern Electrical Technology and Professional Competence) |
|---|---|---|
| CO1 | 2 | 1 |
| CO2 | 3 | 1 |
| CO3 | 2 | 2 |
| CO4 | 3 | 1 |

**Course Contents:**

1. Demonstration of Trade hand tools: Identification of simple types of screws, nuts & bolts, chassis, clamps, rivets etc. Use, care &maintenanceof various hand tools.
2. Practice in using cutting pliers, screw drivers etc. skinning the cables, and joint practice on a single strand.
3. Demonstration & Practice on bare conductor's joints such as Britannia, straight, Tee, Western union Joints.
4. Practice in soldering.
5. Measurement of Resistance and Measurement of specific Resistance. Application of Wheatstone bridge in measurement of Resistance.
6. Demonstration and identification of types of cables. Demonstration & practice on using standard wire gauge. Practice on crimping thimbles, Lugs. Examination and checking of cables and conductors and verification of materials according to the span.
7. Verification of Ohm's Law, Verification of Kirchhoff's Laws. Verification of laws of series and parallel circuits.

8. Verification of open circuit and closed-circuit network. Measuring unknown resistance using Wheatstone bridge.
9. Practice on installation and overhauling common electrical accessories.
10. Fixing of switches, holder plugs etc. in T.W. boards. Identification and use of wiring accessories concept of switching

**Textbooks & References:**

1. "Electrical Wiring: Residential" by Ray C. Mullin and Phil Simmons.
2. "Electrical Installation Work" by Brian Scaddan.
3. "Electricity1: Devices, Circuits, and Materials" by Thomas Kubala

# HOUSE WIRING & DOMESTIC APPLIANCES LAB
## Course Code:

**No of Credits: 3** **Sessional: 25 Marks**

| L | T | P | Total | Theory: 25 Marks |
|---|---|---|---|---|
| - | - | 6 | 6 | Total: 50 Marks |

**Course Objective:**To develop practical competency in electrical wiring, wire jointing, distribution board assembly, earthing, electrical safety, machine operation, industrial control circuits, and the servicing, maintenance, testing, and troubleshooting of domestic electrical appliances, motors, and electrical installations.

**Course Outcomes (COs):**At the end of the course, the student shall be able to:

**CO1:**House Wiring and Electrical Installation: Students will be able to perform various types of wire jointing, install and test domestic wiring circuits, prepare distribution boards, and identify and rectify faults in household and workshop electrical installations while following electrical safety standards.

**CO2:**Maintenance of Domestic Electrical Appliances: Students will be able to dismantle, assemble, service, and repair common domestic electrical appliances such as fans, irons, geysers, heaters, coolers, ovens, voltage stabilizers, and lighting systems, including winding and rewinding operations of motors and fans.

**CO3:**Earthing and Electrical Safety Systems: Students will be able to design, install, test, and evaluate earthing systems for residential buildings and electrical machines, measure earth resistance using appropriate instruments, and ensure safe operation of electrical installations.

**CO4:**Electrical Machines and Control Circuits: Students will be able to assemble and test transformers and battery chargers, connect and operate single-phase and three-phase motors using suitable starters, and design, wire, test, troubleshoot, and maintain industrial control circuits such as remote-control, time-delay, interlocking, and sequential control systems.

**CO–PO Mapping:**

| Course Outcomes (COs) | PO1 (Voc/Tech) | PO2 (Prob. Solving) | PO3 (Tool Usage) | PO4 (Quality/Safety) | PO5 (Comm/Team) | PO6 (Ethics) | PO7 (Entre/Mgmt) | PO8 (Lifelong) |
|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 2 |
| CO2 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 2 |
| CO3 | 3 | 2 | 3 | 3 | 1 | 1 | – | 2 |
| CO4 | 3 | 3 | 3 | 2 | 2 | 1 | 2 | 3 |

*Correlation levels: 1 = Low, 2 = Medium, 3 = High; "–" = No correlation.*

**CO–PSO Mapping:**

| Course Outcomes (COs) | PSO1 (Electrical Installation, Operation and Maintenance) | PSO2 (Modern Electrical Technology and Professional Competence) |
|---|---|---|
| CO1 | 2 | 1 |
| CO2 | 2 | 1 |
| CO3 | 2 | 2 |
| CO4 | 3 | 2 |

**Course Contents:**

**House Wiring**

- Soldering wire jointing of different types such as straight joint/ married joint, T joint,Western union joint, pigtail joint.
- Making of extension board containing two 5A and one 15A plug points.
- To make a single-phase main distribution board with five outgoing circuits for light andfan load including main switch and fuse (only internal connection).
- Fault detection and repair of domestic electric installation.
- Fault detection and its repair in institution's workshop installations.
- Carrying out house wiring circuits using fuse, switches, sockets, ceiling rose etc. in battenor P.V.C. casing-capping.
- Demo of conduit wiring through junctions.

**Domestic Appliances**

- Winding/re-winding of a fan (ceiling and table)/ motor and BLDC
- Repair and maintenance of domestic electric appliances, i.e. electric iron, geyser, fan,heat convector, desert cooler, room heater, electric kettle, electric oven, electric furnaceetc.
- Dismantling and assembly of voltage stabilizers
- Assembly and interchange wiring of fluorescent tube light, CFL lamp etc.
- Earth resistance measurement and earthing processes.
- To carry out pipe/plate earthing for a small house and 3-phase induction motor. Testingthe earthing using earth tester.

**Professional Equipment's and Control**

- Coil winding for small transformer or alarm bell.
- Assembling small transformer cores from the given lamination plates.
- Assembling small battery charger.
- Connections of single phase and 3-phase motors, through an appropriate starter and tochange their direction of rotation.
- Wiring, testing and fault finding of the following contactor control circuitsoperating on 3-phase supply:
- Remote control circuits, Time delay circuits, Inter locking circuits and Sequential operation control circuits

**Textbooks & References:**

1. J. Coker and W. Turner; Electric Wiring Domestic, Newnes, 10th Edition.
2. Mullin and Phil Simmons; Electrical Wiring Commercial, 17E, NEC 2020.
3. Rex Cauldwell; Wiring a House, The Taunton Press, 2002.

# ENVIRONMENTAL SCIENCE
## Course Code

**No of Credits:3** **Sessional: 40 Marks**

**L T P Total** **Theory: 60 Marks**

**3 0 0 3** **Total: 100 Marks**

**Course Objective:** The course aims to provide students with an understanding of the interactions between humans and the environment, natural resources, biodiversity, environmental pollution, climate change, and environmental management. It also seeks to develop awareness of sustainable development practices and familiarize students with national and international environmental laws and treaties for promoting responsible environmental stewardship.

**Course Outcomes (COs):** At the end of the course, the student shall be able to:

**CO1:** Explain the historical evolution of human-environment interactions and the emergence of environmental thought and global environmentalism.

**CO2:** Analyse the classification, utilization, and sustainable management of natural resources, and relate them to the principles of sustainable development.

**CO3:** Evaluate the concepts of biodiversity and ecosystem services, conservation approaches.

**CO4:** Identify major types of environmental pollution and assess their sources, impacts on human health and ecosystems; assess the significance of climate change impacts, adaptation, and mitigation.

***CO5:*** Interpret key national and international environmental laws, treaties, and institutional mechanisms aimedat environmental protection and sustainable governance.

**CO–PO Mapping:**

| Course Outcomes | PO1 (Voc/Tech) | PO2 (Prob. Solving) | PO3 (Tool Usage) | PO4 (Quality / Security) | PO5 (Comm/Team) | PO6 (Ethics) | PO7 (Entre/Mgmt) | PO8 (Lifelong) |
|---|---|---|---|---|---|---|---|---|
| CO1 | 1 | 1 | – | – | – | 2 | 3 | 2 |
| CO2 | 1 | 2 | 1 | – | 1 | 2 | 3 | 2 |
| CO3 | 1 | 2 | – | – | 1 | 2 | 3 | 2 |
| CO4 | 1 | 3 | 1 | – | 2 | 2 | 3 | 2 |
| CO5 | 1 | 2 | – | 1 | 1 | 3 | 3 | 2 |

*Correlation levels: 1 = Low, 2 = Medium, 3 = High; "–" = No correlation.*

**CO–PSO Mapping:**

| Course Outcomes (COs) | PSO1 (Electrical Installation, Operation and Maintenance) | PSO2 (Modern Electrical Technology and Professional Competence) |
|---|---|---|
| CO1 | 1 | – |
| CO2 | 1 | 1 |
| CO3 | 1 | 1 |
| CO4 | 1 | 1 |
| CO5 | 1 | – |

**Course Contents:**

### Unit 1: Humans and the Environment

The man-environment interaction: Humans as hunter-gatherers, Mastery of fire, Origin of agriculture, Great ancient civilizations and the environment, Industrial revolution and its impact on the environment, Population growth and natural resource exploitation. The emergence of environmentalism: Anthropocentric and eco-centric perspectives, The Club of Rome- Limits to Growth, UN Conference on Human Environment 1972, World Commission on Environment and Development, Rio Summit**.**

### Unit 2: Natural Resources and Sustainable Development

Definition of resource; Classification of natural resources- biotic and abiotic, renewable and non-renewable. Biotic resources: Major type of biotic resources- forests, grasslands, wetlands, wildlife and aquatic (fresh water and marine), Microbes as a resource. Water resources: Types of water resources- fresh water and marine resources, Availability and use, Environmental impact of over-exploitation, issues and challenges, Water scarcity and stress, Conflicts over water. Soil and mineral resources: Important minerals, Mineral exploitation,

Environmental problems due to extraction of minerals and use, Soil as a resource and its degradation. Energy resources: Sources of energy and their classification, renewable and non-renewable sources of energy, Conventional energy sources- coal, oil, natural gas, nuclear energy, non-conventional energy sources- solar, wind, tidal, hydro, wave, ocean thermal, geothermal, biomass, hydrogen and fuel cells, Implications of energy use on the environment. Introduction to sustainable development: Sustainable Development Goals (SDGs)

**Unit 3: Environmental Issues: Local, Regional and Global**

Temporal and spatial extents of local, regional, and global phenomena. Pollution: Types of Pollution- air, noise, water, soil, municipal solid waste, hazardous waste, Transboundary air pollution, Acid rain, Smog. Land use and Land cover change: land degradation, deforestation, desertification, urbanization. Global issues: Ozone layer depletion, Green-house effect, Global Warming, Climate change.

**Unit 4: Conservation of Biodiversity and Ecosystems**

Ecosystems and ecosystem services: Concept; Structure and Functions of Ecosystem, Ecosystem types forests, wetlands, grasslands, agriculture, coastal and marine; Ecosystem services. Biodiversity and its distribution: Biodiversity as a natural resource, Levels and types of biodiversity, Biodiversity in India and the world, Biodiversity hotspots. Threats to biodiversity, in-situ and ex-situ conservation approach, role of traditional knowledge, community-based conservation.

**Unit 5: Environmental Pollution and Health**

Definition of pollution; Point sources and non-point sources of pollution. (5 hrs) Air pollution: Sources of air pollution, Primary and secondary pollutants, Criteria pollutants, Other important air pollutants- Volatile Organic compounds, Peroxyacetyl Nitrate, Polycyclic aromatic hydrocarbons and Persistent organic pollutants, Indoor air pollution, health impacts of air pollutants, National Ambient Air Quality Standards. Water pollution: Sources of water pollution, River, lake and marine pollution, groundwater pollution, Water quality parameters and standards, health impacts of water pollution on human and aquatic life. Soil pollution and solid waste: Soil pollutants and their sources, Solid and hazardous waste, Impact on human health. Noise pollution: Definition of noise, measurement and sources of noise pollution, Noise standards, impacts of noise on human health. Thermal and Radioactive pollution: Sources and impact on human health and ecosystems.

**Unit 6: Climate Change: Impacts, Adaptation and Mitigation**

Structure of atmosphere, Importance of 1.5 °C and 2.0 °C limits to global warming, Climate change projections for the Indian sub-continent. Impacts of climate change on ocean, land, forests and natural ecosystems, Impacts on animal species, agriculture, health, urban infrastructure; concept of vulnerability, Adaptation vs. resilience, Indigenous knowledge for adaptation to climate change. Mitigation measures: Green House Gas (GHG) reduction vs. sink enhancement, carbon neutrality, Net zero targets for the future, Energy efficiency measures, National climate action plan.

**Unit 7: Environmental Management**

Introduction to environmental laws and regulation: Constitutional provisions- Article 48A, Article 51A (g); Introduction to environmental legislations on the forest, wildlife and pollution control. Environmental management system: ISO 14001. Environmental audit and impact assessment, Pollution control and management, Waste Management- Concept of 3R (Reduce, Recycle and Reuse) and sustainability, Ecolabeling /Eco mark scheme.

**Unit 8: Environmental Treaties and Legislation**

Vienna Convention; Montreal Protocol and the Kigali Amendment. Basel Convention, Stockholm Convention on Persistent Organic Pollutants, Minamata Convention. United Nations Framework Convention on Climate Change (UNFCCC), Kyoto Protocol, Paris Agreement, India's status as a party to major conventions. National Green Tribunal, Convention on Biological Diversity (CBD), Cartagena Protocol, Nagoya Protocol, Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES), Ramsar Convention on Wetlands of International Importance, Ramsar sites, United Nations Convention to Combat Desertification (UNCCD).

**Textbooks & References:**

1. Barrow, C. J. (1999). Environmental management: Principles and practice. Routledge.
2. Berrang-Ford, L., J.D. Ford & J. Paterson (2011). Are we adapting to climate change? Global Environmental Change-Human and Policy Dimensions 21: 25-33.
3. Chiras, D. D and Reganold, J. P. (2010). Natural Resource Conservation: Management for a Sustainable Future.10th edition, Upper Saddle River, N. J. Benjamin/Cummins/Pearson.

4. De Anil, K. (2003). Environmental chemistry. New Age International.
5. Gilbert M. Masters and W. P. (2008). An Introduction to Environmental Engineering and Science, Publisher (Pearson)
6. India Code - Digital repository of all Central and State Acts: https://www.indiacode.nic.in/
7. Kanchi Kohli and Manju Menon (2021) Development of Environment Laws in India, Cambridge University Press.
8. Kaushik, A., & Kaushik, C. P. (2006). Perspectives in environmental studies. New Age International.
9. Krishnamurthy, K.V. (2003) Textbook of Biodiversity, Science Publishers, Plymouth, UK
10. Rajagopalan, R. (2011). Environmental Studies: From Crisis to Cure. India: Oxford University Press.
11. Ela Richard A. Marcantonio, Marc Lame (2022). Environmental Management: Concepts and Practical Skills. Cambridge University Press.
12. Simmons, I. G. (2008). Global Environmental History: 10,000 BC to AD 2000. Edinburgh University Press.

# COMPUTER APPLICATIONS AND DATA VISUALISATION
## Course Code:

**No of Credits:3** **Sessional: 40 Marks**

**L T P Total** **Theory: 60 Marks**

**3 0 0 3** **Total: 100 Marks**

**Course Objective:**The objective of this course is to provide fundamental knowledge of computer applications, digital tools, data handling techniques, and data visualization methods required for academic, industrial, and professional applications. The course also aims to develop the ability to organize, analyse, and present data effectively using spreadsheet and visualization tools.

**Course Outcomes (COs):** At the end of the course, the student shall be able to:

**CO1:** Understand the fundamentals of computers and various digital applications.
**CO2:** Use operating systems, internet services, and office productivity tools effectively.
**CO3:** Perform data organization, analysis, and computations using spreadsheet software.
**CO4:** Create charts, dashboards, and visual representations of data for effective decision-making.

**CO–PO Mapping**

| Course Outcomes (COs) | PO1 (Voc/Tech) | PO2 (Prob. Solving) | PO3 (Tool Usage) | PO4 (Quality/Safety) | PO5 (Comm/Team) | PO6 (Ethics) | PO7 (Entre/Mgmt) | PO8 (Lifelong |
|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 2 | 2 | 1 | 1 | – | – | 2 |
| CO2 | 2 | 2 | 3 | 1 | 2 | 1 | – | 2 |
| CO3 | 2 | 3 | 3 | 1 | 1 | – | – | 2 |
| CO4 | 2 | 3 | 3 | 2 | 2 | 1 | 1 | 3 |

**CO–PSO Mapping**

| Course Outcomes (COs) | PSO1 (Electrical Installation, Operation and Maintenance) | PSO2 (Modern Electrical Technology and Professional Competence) |
|---|---|---|
| CO1 | 1 | 2 |
| CO2 | 1 | 2 |
| CO3 | 2 | 3 |
| CO4 | 2 | 3 |

**Course Contents:**

**Unit 1: Fundamentals of Computer Applications**

Introduction to Computers, Characteristics and Applications of Computers, Types and Generations of Computers, Basic Components of Computer System, Input and Output Devices, Memory Units and Storage Devices, CPU and its Functions, Computer Hardware and Software, Operating Systems and their Functions, File and Folder Management, Introduction to Cloud Computing and Digital Technologies.

**Unit 2:Internet and Digital Tools**

Introduction to Internet and Web Browsers, Search Engines, E-mail and Digital Communication, Video Conferencing Tools, Cloud Storage and File Sharing, Social Media Applications, Digital Payment Systems, Basics of Networking and Wi-Fi, Cyber Safety and Security, Computer Viruses and Antivirus Software, Introduction to Artificial Intelligence and Generative AI Tools.

**Unit 3: Spreadsheet Applications and Data Analysis**

Introduction to Spreadsheet Software (MS Excel/Google Sheets), Worksheets and Workbooks, Data Entry and Formatting, Cell Referencing, Sorting and Filtering, Conditional Formatting, Mathematical and Statistical Functions, Logical Functions, Lookup Functions, Data Validation, Pivot Tables, Data Analysis and Summarization, Import and Export of Data.

**Unit 4: Data Visualization and Presentation Tools**

Principles of Data Visualization, Types of Charts and Graphs, Creation of Bar Charts, Line Charts, Pie Charts, Histograms and Scatter Plots, Dashboards and Reports, Data Interpretation and Decision Making,

Introduction to Power BI and Google Looker Studio, Presentation Techniques using MS PowerPoint, SmartArt, Animation and Slide Transitions, Introduction to Google Slides.

**Textbooks & Reference:**

1. V. Rajaraman, **Computer Fundamentals**, PHI Learning.
2. P. K. Sinha and Priti Sinha, **Computer Fundamentals**, BPB Publications.
3. Joan Lambert, **Microsoft Excel Step by Step**, Microsoft Press.
4. Alexis Leon and Mathews Leon, **Fundamentals of Information Technology**, Vikas Publishing House.
5. Peter Norton, **Introduction to Computers**, McGraw-Hill Education.
6. Ramesh Bangia, **Learning Computer Fundamentals, MS Office and Internet**, Khanna Book Publishing.
7. Wayne Winston, **Microsoft Excel Data Analysis and Business Modelling**, Microsoft Press.
8. Alberto Cairo, **The Truthful Art: Data, Charts, and Maps for Communication**, New Riders.
9. Cole Nussbaumer Knaflic, **Storytelling with Data: A Data Visualization Guide for Business Professionals**, Wiley.
10. NPTEL/SWAYAM Web Courses on Computer Fundamentals, Spreadsheet Applications and Data Visualization.

**Suggested Tutorial / Sessional Assignments**

1. Identify the components of a computer system and prepare a report on different generations and types of computers.
2. Perform file and folder management operations and study the functions of operating systems.
3. Create and manage documents using cloud storage platforms and study the applications of digital technologies.
4. Conduct web searches using search engines and create professional e-mail accounts with attachments and signatures.
5. Study video conferencing platforms and demonstrate file sharing through cloud-based applications.
6. Prepare a report on cyber security threats, computer viruses and the role of antivirus software.
7. Explore digital payment systems and prepare a case study on safe online transactions.
8. Study the applications of Artificial Intelligence and Generative AI tools in education and industry.
9. Create spreadsheets using MS Excel or Google Sheets and perform formatting, sorting and filtering operations.
10. Apply mathematical, statistical and logical functions for solving practical problems using spreadsheets.

# ELECTRICAL MACHINE-I
# Course Code:

**No of Credits: 4** **Sessional: 40 Marks**

| L | T | P | Total |
|---|---|---|---|
| 4 | 0 | 0 | 4 |

**Theory: 60 Marks**

**Total: 100 Marks**

**Course Objective:** The objective of this course is to provide students with a thorough understanding of electrical machines, including motors, generators, transformers, and induction motors. The course aims to equip students with knowledge of the working principles, construction, characteristics, and applications of these machines. Students will also gain practical skills in testing and analysing the performance and faults of various electrical machines.

**Course Outcomes (COs):**At the end of the course, the student shall be able to:

- **CO1**: Analyse the magnetic effect of current, magnetic and electric circuits, comparing their properties and behaviour, and evaluate the effects of B-H characteristic on various magnetic materials.
- **CO2:** Explain the laws of electromagnetic induction and the working principles, construction, of motors and generators.
- **CO3:** Conduct tests and analyse the performance of single-phase and three-phase transformers.
- **CO4:** Evaluate the characteristics and speed control methods of DC motors, apply the principles of DC generators to explain their construction, magnetic circuit, winding types, and commutation methods.

**CO–PO Mapping:**

| Course Outcomes (COs) | PO1 (Voc/Tech) | PO2 (Prob. Solving) | PO3 (Tool Usage) | PO4 (Quality/Safety) | PO5 (Comm/Team) | PO6 (Ethics) | PO7 (Entre/Mgmt) | PO8 (Lifelong) |
|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 1 | 1 | - | – | – | 2 |
| CO2 | 3 | 2 | 2 | 1 | 1 | – | – | 2 |
| CO3 | 3 | 3 | 3 | 2 | 1 | – | – | 2 |
| CO4 | 3 | 3 | 2 | 2 | 1 | - | 1 | 3 |

*Correlation levels: 1 = Low, 2 = Medium, 3 = High; "–" = No correlation.*

**CO–PSO Mapping:**

| Course Outcomes (COs) | PSO1 (Electrical Installation, Operation and Maintenance) | PSO2 (Modern Electrical Technology and Professional Competence) |
|---|---|---|
| CO1 | 2 | 1 |
| CO2 | 3 | 1 |
| CO3 | 2 | 2 |
| CO4 | 3 | 2 |

**Course Contents:**

**Unit 1: Introduction to Electromagnetism:**

Magnetic effect of electric current, Current carrying conductor placed in magnetic field, Work law and its applications, Biot-Savart law, Force between two parallel current carrying conductors, Magnetic circuit and its analysis, Comparison between magnetic and electric circuits, B-H curve, Hysteresis loss. Electromagnetic Induction.

**Unit 2 Introduction to Electrical Machines:**

Faraday's law of Electromagnetic Induction, Direction of Induced Current, Dynamically and statically induced EMF, Self and mutual inductance, Energy stored in a magnetic field, Definition of motor and generator, Generalized model of an electric machine, Torque development due to alignment of two fields, Elementary concept of an electrical machine, Comparison of generator and motor.

**Unit 3 Single-Phase Transformer:**

Working principle and constructional features of a transformer and parts of transformer, Practical transformer on No-Load, Equivalent Circuit Diagram of a transformer, Losses in transformer, Transformer tests, Auto-transformer, Working of auto-transformer, Saving of copper, Types of transformers.

Three-Phase Transformer: Construction of three-phase transformer and accessories of transformers such as Conservator, Breather, Buchholtz Relay, Tap Changer (off-load and on-load), Three-phase transformer connections i.e., Delta-Delta, Delta-Star, Star-Delta, and Star-Star; Star-Delta connections (relationship between phase and line voltage, phase and line current), Conditions for parallel operation of three-phase transformers.

**Unit 4 DC Machines:**

Construction of a DC machine, Armature and commutator, Types of DC machines, EMF equation, Significance of back EMF, Torque developed, DC motor characteristics, Speed control of DC motor, Starters of DC motor, Applications of DC motor, Faults in DC machines.

DC Generator: Basic structure of DC generator, Construction and magnetic circuit of DC generator, Lap and wave winding, Commutation, Methods of improving commutation, Characteristics of DC generators.

**Textbooks & References:**

1. Ashfaq Husain; Electric Machines.
2. P. S. Bimbhra; Electrical Machines-I, Khanna Book Publishing, 2019.
3. D. P. Kothari and I. J. Nagrath; Electric Machine, The McGraw Hill Companies, Third Edition.

**Suggested Tutorial / Sessional Assignments:**

1. Explain the magnetic effect of electric current and describe the behaviour of a current-carrying conductor placed in a magnetic field.
2. State and explain Biot–Savart Law. Also mention its applications in electrical engineering.
3. Define magnetic circuit and compare it with an electric circuit with suitable examples.
4. Explain B–H curve and discuss hysteresis loss in magnetic materials.
5. State Faraday’s laws of electromagnetic induction and explain statically and dynamically induced EMF.
6. Define self and mutual inductance and derive expression for energy stored in a magnetic field.
7. Explain the construction and working principle of a single-phase transformer with neat diagram.
8. Describe equivalent circuit of a transformer and explain losses occurring in a transformer.
9. Explain construction, connections, and working of a three-phase transformer.
10. Discuss different transformer tests and explain off-load and on-load tap changers.
11. Explain construction and working of a DC machine with armature and commutator details.
12. Explain EMF equation of DC generator and discuss characteristics of DC generators.

# ANALOG & DIGITAL ELECTRONICS
# Course Code:

**No of Credits: 4** **Sessional: 40 Marks**
**L T P Total** **Theory: 60 Marks**
**4 0 0 4** **Total: 100 Marks**

**Course Objective:** The objective of this course is to provide students with a comprehensive understanding of semiconductor devices, including diodes, transistors, and their applications in electronic circuits. Students will learn the operation and characteristics of rectifiers, amplifiers, FETs, and MOSFETs. The course introduces number systems, logic gates, and digital electronics concepts. It also covers combinational and sequential circuits, including adders, multiplexers, flip-flops, registers, and counters. Additionally, students will gain knowledge of A/D and D/A converters and their practical applications in modern electronic systems.

**Course Outcomes (COs):**At the end of the course, the student shall be able to:
**CO1**: Describe different Semiconductor devices and explain their characteristics
**CO2**: Acquire the knowledge of different types of transistor and transistor as an amplifier.
**CO3:** Evaluate and realize the various digital circuits by using number system andlogic gates.
**CO4:** Analyse sequential and combinational digital circuits and converters.

**CO–PO Mapping:**

| Course Outcomes (COs) | PO1 (Voc/Tech) | PO2 (Prob. Solving) | PO3 (Tool Usage) | PO4 (Quality/Safety) | PO5 (Comm/Team) | PO6 (Ethics) | PO7 (Entre/Mgmt) | PO8 (Lifelong) |
|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | 1 | 1 | – | 1 | 3 |
| CO2 | 3 | 3 | 2 | 2 | 1 | – | – | 3 |
| CO3 | 3 | 3 | 2 | 1 | 1 | – | 1 | 2 |
| CO4 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 3 |

*Correlation levels: 1 = Low, 2 = Medium, 3 = High; "–" = No correlation.*

**CO–PSO Mapping:**

| Course Outcomes (COs) | PSO1 (Electrical Installation, Operation and Maintenance) | PSO2 (Modern Electrical Technology and Professional Competence) |
|---|---|---|
| CO1 | 2 | 1 |
| CO2 | 2 | 2 |
| CO3 | 3 | 2 |
| CO4 | 3 | 2 |

**Course Contents:**

**Unit 1: Concept of insulators, conductors and semiconductors**
Intrinsic and extrinsic semiconductor, P and N type semiconductor and their conductivity. Effect of temperature on conductivity of intrinsic semiconductor etc. PN junction diode, mechanism of current flow in PN junction, forward and reverse biased PN junction, potential barrier, drift and diffusion currents, depletion layer. V-I characteristics of diodes. Diode as half-wave, full wave and bridge rectifiers. Peak Inverse Voltage, rectification efficiencies and ripple factor calculations, Concept of filters. Types of diodes, characteristics and applications of Zener diodes.

**Unit 2 Bipolar-Transistors and Field Effect Transistors**
Concept of a bipolar transistor, PNP and NPN transistors. CB, CE, CC configurations ofa transistor. Transistor as an amplifier in CE Configuration, Current amplification factors,Comparison of CB, CE and CC Configurations. Construction, operation and characteristics of FETs. FET as an amplifier. Construction,operation and characteristics of a MOSFET. Comparison of JFET, MOSFET and BJT.

**Unit 3 Digital Electronics**
Distinction between analog and digital signal. Decimal, Binary, octal and hexadecimal number system. Conversion from decimal and hexadecimal to binary and vice-versa. Binary addition and subtraction. Definition, symbols and truth tables of Logic gates (AND, OR, XOR, NOT, NAND,NOR and XNOR).

**Unit 4 Sequential and Combinational Circuit**

Sequential Circuits such as Half adder, Full adder, Mux, De-Mux, Encoder and Decoder. Combinational Circuits like Latch, Flip Flops, shift registers and counters. A/D and D/A Converters and its Applications.

**Textbooks & References:**


1. Kulshreshta and S.C. Gupta, Basic Electronics and linear circuit by Tata Mc Graw HillEducation Pvt. Ltd., New Delhi.
2. V.K. Mehta, Principles of Electrical and Electronics Engineering by S Chand Co., New Delhi.
3. Millman and Halkias, Electronics Device and Circuit by Mc Graw Hill.
4. Albert Paul Malvino,“Principles of Electronics” by Tata Mc Graw Hill Education Pvt Ltd
5. S K Sahdev,“ Electronic Principles ”by Dhanpat Rai & Co., New Delhi.
6. J B Gupta,“ Basic Electronics ”by S K Kataria and Sons, New Delhi
7. Schultz Grob's, Basic Electronics, Altext Lab Manual by Tata Mc Graw Hill Education Pvt.Ltd., New Delhi.
8. Anand Kumar“ Fundamentals of Digital Circuits” PHI
9. Anil K. Maini “Digital Electronics: Principles And Integrated Circuit”, Wiley Publications
10. R P Jain- “Modern Digital Electronics”-Tata McGraw Hill.


**Suggested Tutorial / Sessional Assignments:**

1. Differentiate between conductors, insulators and semiconductors. Explain intrinsic and extrinsic semiconductors with suitable examples.
2. Draw and explain the construction, working and V-I characteristics of a PN junction diode under forward and reverse bias conditions.
3. Compare Half-Wave, Full-Wave and Bridge Rectifiers. Calculate Peak Inverse Voltage (PIV), rectification efficiency and ripple factor for each rectifier.
4. Explain the construction, characteristics and applications of Zener diode. Discuss the concept of filters used with rectifiers.
5. Explain the construction and working of PNP and NPN transistors. Compare CB, CE and CC transistor configurations.
6. Draw and explain the Common Emitter (CE) transistor amplifier. Derive the expressions for current gain (α and β).
7. Explain the construction, operation and characteristics of Junction Field Effect Transistor (JFET) and its use as an amplifier.
8. Describe the construction and operation of MOSFET and compare the characteristics of BJT, JFET and MOSFET.
9. Differentiate between analog and digital signals. Explain the applications of digital electronics.
10. Perform number system conversions among Decimal, Binary, Octal and Hexadecimal systems with suitable examples.
11. Perform binary addition and binary subtraction using suitable examples.
12. Draw the symbols and truth tables of AND, OR, NOT, NAND, NOR, XOR and XNOR gates and explain their functions.
13. Design and explain the operation of Half Adder and Full Adder using logic gates and truth tables.
14. Explain the working of Multiplexer (MUX), Demultiplexer (DEMUX), Encoder and Decoder with suitable block diagrams and applications.
15. Study the operation and applications of Latches, Flip-Flops, Shift Registers and Counters.
16. Explain the working principles of Analog-to-Digital (A/D) and Digital-to-Analog (D/A) Converters and discuss their applications.

# ELECTRICAL WORKSHOP–II
## Course Code:

**No of Credits: 3** **Sessional: 25 Marks**

| L | T | P | Total | Theory: 25 Marks |
|---|---|---|---|---|
| 0 | 0 | 6 | 6 | Total: 50 Marks |

**Course Objective:** The objective of this course is to provide students with in-depth knowledge and practical skills in analysing and testing electrical machines, particularly single-phase transformers and DC machines. Students will learn to derive important equations, perform standard tests, and analyse the performance characteristics and operational requirements of these machines.

**Course Outcomes (COs):**At the end of the course, the student shall be able to:

**CO1**:Derive and explain the EMF equation of a single-phase transformer and understand its significance in transformer design and operation.

**CO2**:Perform and analyze no-load, short-circuit, and Sumpner's tests on transformers to determine theirefficiency and equivalent circuit parameters.

**CO3:**Establish and verify the conditions necessary for the parallel operation of transformers, ensuring their proper functioning in power systems.

**CO4:**Test and evaluate the performance of DC machines, including load tests, field tests, and speed control techniques, to understand their operational characteristics.

**CO–PO Mapping:**

| Course Outcomes (COs) | PO1 (Voc/Tech) | PO2 (Prob. Solving) | PO3 (Tool Usage) | PO4 (Quality/Safety) | PO5 (Comm/Team) | PO6 (Ethics) | PO7 (Entre/Mgmt) | PO8 (Lifelong) |
|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 1 | 1 | - | – | – | 2 |
| CO2 | 3 | 3 | 3 | 2 | 1 | – | – | 2 |
| CO3 | 3 | 3 | 2 | 2 | 1 | – | 1 | 2 |
| CO4 | 3 | 3 | 3 | 2 | 1 | - | 1 | 3 |

*Correlation levels: 1 = Low, 2 = Medium, 3 = High; "–" = No correlation.*

**CO–PSO Mapping:**

| Course Outcomes (COs) | PSO1 (Electrical Installation, Operation and Maintenance) | PSO2 (Modern Electrical Technology and Professional Competence) |
|---|---|---|
| CO1 | 2 | 1 |
| CO2 | 2 | 2 |
| CO3 | 2 | 2 |
| CO4 | 3 | 2 |

**Course Contents:**

1. Derive the EMF equation of a single-phase transformer.
2. Perform no-load and short-circuit tests on a single-phase transformer and
3. Perform Sumpner's test on transformers.
4. Derive necessary conditions for parallel operation of single-phase and three-phase transformers.
5. Describe the functions of individual parts of DC machines.
6. Practice dismantling and assembling a DC machine.
7. Conduct a load test on a DC shunt motor to draw speed–torque and horsepower–efficiency characteristics.
8. Conduct field tests on DC series machines.
9. Perform speed control of DC shunt motor by armature and field control.
10. Conduct Swinburne's test on a DC motor.
11. Perform the retardation test on a DC series motor and regenerative tests on DC shunt machines.

**Textbooks & References:**

1. P. S. Bimbhra; Electrical Machines-I, Khanna Book Publishing, 2019.
2. D. P. Kothari and I. J. Nagrath; Electric Machine, The McGraw Hill Companies, Third Edition.

# ELECTRICAL ENGINEERING DRAWING LAB
## Course Code:

**No of Credits: 3** **Sessional: 25 Marks**
**L T P Total** **Theory: 25 Marks**
**0 0 6 6** **Total: 50 Marks**

**Course Objective:**To develop the ability to prepare and interpret electrical symbols, schematic diagrams, wiring layouts, distribution board designs, contactor control circuits, and engineering drawings, and to design and analyze modern electrical systems, including solar, inverter, earthing, substation, and three-phase induction motor installations.

**Course Outcomes (COs):**At the end of the course, the student shall be able to:
**CO1:** Interpret and prepare electrical symbols, schematic diagrams, single-line diagrams, wiring diagrams, and distribution board layouts for domestic, commercial, and industrial electrical installations.
**CO2:** Design and analyse contactor control circuits for three-phase induction motors, including DOL, forward-reverse, two-speed, sequential operation, and star-delta starting methods.
**CO3:** Develop wiring diagrams for modern electrical systems such as battery-inverter systems, solar energy installations, earthing arrangements, and electrical substations.
**CO4:** Prepare engineering drawings and orthographic projections of electrical components and equipment, and apply drawing standards used in power and industrial engineering applications.

**CO–PO Mapping:**

| Course Outcomes (COs) | PO1 (Voc/Tech) | PO2 (Prob. Solving) | PO3 (Tool Usage) | PO4 (Quality/Safety) | PO5 (Comm/Team) | PO6 (Ethics) | PO7 (Entre/Mgmt) | PO8 (Lifelong) |
|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 3 | 2 | 1 | – | – | 2 |
| CO2 | 3 | 3 | 3 | 2 | 1 | – | 1 | 2 |
| CO3 | 3 | 3 | 2 | 3 | 1 | 1 | 1 | 3 |
| CO4 | 3 | 2 | 3 | 1 | 1 | - | - | 2 |

*Correlation levels: 1 = Low, 2 = Medium, 3 = High; "–" = No correlation.*

**CO–PSO Mapping:**

| Course Outcomes (COs) | PSO1 (Electrical Installation, Operation and Maintenance) | PSO2 (Modern Electrical Technology and Professional Competence) |
|---|---|---|
| CO1 | 2 | 1 |
| CO2 | 3 | 1 |
| CO3 | 2 | 2 |
| CO4 | 2 | 1 |

**Course Contents:**

### Unit 1 Simple Electrical Circuits

Electrical Symbols used in Electrical installation; Schematic, single line and wiringdiagrams of light and fan point controlled by individual switches, fluorescent tubecontrolled by one-way switch, one lamp controlled by two switches (staircase circuit)three lamps controlled by four switches (Corridor light circuit).
Design and Drawing of panels/Distribution board using MCB, ELCB main switches andchange over switches for domestic installation, industrial and commercial installation.

### Unit 2 Contractor Control Circuits

Design of circuit drawing of schematic diagram and power wiring diagram of following circuits,specification of contactors:-
2.1 DOL starting of 3-phase induction motor
2.2 3-phase induction motor getting supply from selected feeder
2.3 Forwarding/reversing of a 3-phase induction motor
2.4 Two speed control of 3-phase induction motor
2.5 Sequential operating of two motors using time delay relay
2.6 Manually generated star delta starter for 3-phase induction motor

2.7 Automatic star delta starter for 3-phase Induction Motor

**Unit 3 Professional Control Circuits**

3.1 Draw the wiring diagram of battery and inverter connected to residential load.
3.2 Draw the wiring diagram of standalone solar light system with battery for a residentialhouse.
3.3 Draw the wiring diagram of solar water heating system.
3.4 Key diagram of 11kV, 33kV, 66kV, 132 kV sub-stations
3.5 Draw pipe and plate Earthing.

**Unit 4 Orthographic Projections of Simple Electrical Parts**

4.1 Bus bar post
4.2 Kit Kat Fuse
4.3 Pin type insulator (Pin Type 11kV/66kV)
4.4 Rotor of a squirrel cage induction motor
4.5 Stator of 3 phase Induction motor (Sectional View)

**Textbooks & References:**

1. Surjeet Singh, “Electrical Engineering Design and Drawings, Dhanpat Rai and Co, NewDelhi.
2. SK Bhattacharya, “Electrical Engineering Design and Drawings”, SK Kataria and Sons,New Delhi.
3. Ubhi& Marwaha, “Electrical Engineering Design and Drawings”, IPH, New Delhi

# PROFESSIONAL COMMUNICATION SKILLS
## Course Code:

**No of Credits: 4**
**L T P Total**
**4 0 0 4**

**Sessional: 40 Marks**
**Theory: 60 Marks**
**Total: 100 Marks**

**Course Objective:** To develop students' foundational proficiency in English language usage by strengthening grammar, vocabulary, sentence construction and basic writing skills. The course aims to improve learners' ability to read, understand and compose clear English for academic, workplace and everyday communication.

**Course Outcomes (COs):** At the end of the course, the student shall be able to:
**CO1:** Identify and correctly use parts of speech, tenses, voice, and narration in written and spoken English.
**CO2:** Communicate effectively with stakeholders (customers, colleagues, industry partners) using appropriate professional etiquette.
**CO3:** Draft professional documents including letters, reports, emails, resumes, and essays.
**CO4:** Demonstrate effective presentation, group discussion, and interview skills with appropriate body language and confidence.
**CO5:** Apply soft skills such as teamwork, leadership, paraphrasing, and feedback-giving in workplace scenarios.

**CO–PO Mapping:**

| Course Outcomes (COs) | PO1 (Voc/Tech) | PO2 (Prob. Solving) | PO3 (Tool Usage) | PO4 (Quality/Safety) | PO5 (Comm/Team) | PO6 (Ethics) | PO7 (Entre/Mgmt) | PO8 (Lifelong) |
|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 3 | 1 | 1 | 1 | 2 | 2 |
| CO2 | 3 | 2 | 3 | 1 | 1 | 1 | 2 | 2 |
| CO3 | 2 | 2 | 3 | 2 | 1 | 1 | 2 | 2 |
| CO4 | 2 | 2 | 3 | 2 | 2 | 1 | 3 | 3 |

*Correlation levels: 1 = Low, 2 = Medium, 3 = High; "–" = No correlation.*

**CO–PSO Mapping:**

| Course Outcomes (COs) | PSO1 (Electrical Installation, Operation and Maintenance) | PSO2 (Modern Electrical Technology and Professional Competence) |
|---|---|---|
| CO1 | 3 | 2 |
| CO2 | 3 | 2 |
| CO3 | 2 | 3 |
| CO4 | 2 | 3 |

**Course Contents:**

**Unit 1: GRAMMAR FOUNDATIONS**

Parts of Speech: Noun, Pronoun, Verb, Adverb, Adjective, Preposition, Conjunction, Interjection, Tenses: Present, Past, Future (identification and sentence construction), Sentence Formation: Simple, Compound, Complex, Compound-Complex, Active-Passive Voice, Direct-Indirect Narration, Word Formation: Prefix, Suffix, Roots, Antonyms, Synonyms, Phrases & Idioms.

**Unit 2: WRITING SKILLS**

Letter Writing: Formal, Application, Covering, Business Letters, Report Writing: Academic, Business, Technical, News Reports, Essay Writing, Articles, Story Narration, E-mail Writing and Resume Writing, Reading Comprehension (skimming, scanning, summarizing).

**Unit 3: VERBAL & NON-VERBAL COMMUNICATION**

Communication: Meaning, Importance, Functions, Types, Barriers & Solutions, Telephonic Communication

Skills: Opening/closing calls, dealing with angry customers, Listening & Speaking Skills: Literacy skills integration, Body Language: Gesture, Posture, Facial Expression, Paraphrasing & Basic Translation skills, Reading Skills: Levels of reading, skimming, scanning.

**Unit 4:EMPLOYABILITY & PERSONALITY DEVELOPMENT**

Soft Skills: Definition, Importance, Process, Measurement, Teamwork Skills, Leadership Skills, Interview – Types (Mock interviews), Personality Development: Types, Programs & Techniques, Group Discussion – strategies and practice, Presentation Skills: Types, making effective presentations, Feedback: Giving and receiving constructive feedback, Stakeholder Communication: Customers, industry partners, suppliers, agents.

**Textbooks & References:**

1. Wren and Martin, *High School English Grammar and Composition*, latest edition, S. Chand.
2. Raymond Murphy, *Essential English Grammar*, latest edition, Cambridge University Press.
3. Prerna Malhotra & Deb Halder, Communication Skills: Theory and Practice.
4. B. Mishra & S. Sharma, Communication Skills for Engineers and Scientists.
5. Selected reading passages, worksheets and teacher-prepared handouts for grammar, vocabulary and writing practice.

**Suggested Tutorial / Sessional Assignments:**

1. Identify and classify the parts of speech in a short paragraph and explain the function of each highlighted word.
2. Rewrite a set of sentences in present, past and future tense without changing their meaning.
3. Form new words using prefixes and suffixes, and use them correctly in original sentences.
4. Replace underlined words in a passage with suitable synonyms or antonyms based on context.
5. Convert sentences from active to passive voice and from direct to indirect narration.
6. Combine short clauses into simple, compound and complex sentences.
7. Write a short paragraph on a familiar topic using correct tense forms and connectors.
8. Write an essay or article on a given topic with a clear introduction, body and conclusion.
9. Read a comprehension passage and answer factual, vocabulary-based and inferential questions.
10. Develop a short story using suitable conjunctions, interjections and descriptive vocabulary.

**Practical Exercises**

1. Grammar & Writing – Identify parts of speech in a paragraph; convert sentences across tenses, voice, narration; write a story using prepositions, conjunctions, interjections.
2. Letter & Report Writing – Draft formal letters, resumes, and reports from case studies.
3. Group Discussion & Paraphrasing – Participate in GD; paraphrase given passages.
4. Role-plays – Team projects, leadership situations, telephonic role-plays (customer service scenarios).
5. Presentations – Deliver short presentations focusing on non-verbal cues (gesture, posture).

## WORKSHOP CALCULATIONS AND ANALYTICAL TECHNIQUES

**Course Code - MRV-101-V1**

**No of Credits: 3** **Sessional: 40 Marks**

| L | T | P | Total | Theory: 60 Marks |
|---|---|---|---|---|
| 3 | - | - | 3 | Total: 100 Marks |

**Course Objective:**
To strengthen the everyday mathematics and measurement skills a shop-floor technician needs, taught in a simple, application-based way. The course covers practical arithmetic, mensuration, basic algebra and simple data handling so that students can read drawings, calculate quantities, estimate cost and make data-based decisions in manufacturing and analytics.

**Course Outcomes (COs):**
At the end of the course, the student shall be able to:
**CO1**: Apply basic arithmetic, units, ratios, percentages, and unit conversion to workshop problems.
**CO2:** Use mensuration and basic trigonometry to calculate length, area, volume and angles of parts.
**CO3:** Apply simple algebra and graphs to solve practical shopfloor and measurement problems.
**CO4**: Organise simple data and compute basic statistics (average, range) to support quality decisions.

**CO–PO Mapping:**

| Course Outcomes | PO1 (Voc/Tech) | PO2 (Prob. Solving) | PO3 (Tool Usage) | PO4 (Quality/Safety) | PO5 (Comm/Team) | PO6 (Ethics) | PO7 (Entre/Mgmt) | PO8 (Lifelong) |
|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 2 | 1 | – | 1 | 2 |
| CO2 | 3 | 3 | 2 | 2 | 1 | – | 1 | 2 |
| CO3 | 3 | 3 | 2 | 2 | 1 | – | 1 | 2 |
| CO4 | 2 | 3 | 2 | 2 | 1 | – | 1 | 3 |

*Correlation: 1 = Low, 2 = Medium, 3 = High; "–" = No correlation.*

**CO–PSO Mapping:**

| Course Outcomes | PSO1 (Electrical Installation, Operation and Maintenance) | PSO2 (Modern Electrical Technology and Professional Competence) |
|---|---|---|
| CO1 | 1 | 2 |
| CO2 | 2 | 2 |
| CO3 | 1 | 2 |
| CO4 | 1 | 3 |

**Course Contents:**

**Unit 1: Workshop Arithmetic, Units and Measurement**
Number operations, fractions and decimals; ratio, proportion and percentage; SI and other units used in workshops; unit conversion; significant figures and rounding; reading scales and simple measurement errors; speed/feed and material-quantity calculations.

**Unit 2: Mensuration and Basic Trigonometry**
Perimeter, area and volume of common shapes (rectangle, triangle, circle, cylinder, cone); surface area and weight of material from volume and density; angles, right-angle triangle and basic trigonometric ratios; simple applications in marking, taper and pitch calculations.

**Unit 3: Basic Algebra and Graphs**
Algebraic expressions, simple linear equations and formulae transposition; using formulae for gear ratio, cutting speed, RPM and scaling; plotting and reading simple graphs (straight-line relationship); interpolation in tables.

**Unit 4: Introduction to Data and Basic Statistics**
Collecting and tabulating shop-floor data; bar charts, pie charts and line graphs; average (mean), median, mode and range; introduction to the idea of variation and simple quality checks; reading a process data sheet.

**Textbooks & References (Indian Authors / AICTE Prescribed):**

1. Deepak Singh, “Mathematics-I”, AICTE Prescribed Textbook (Diploma, NEP 2020), ISBN 978-93-9150-5424 — available in Hindi (हिंदी) and other regional languages.
2. “कार्यशालागणनाएवंविज्ञान / Workshop Calculation & Science”, Khanna Book Publishing — Hindi (हिंदी) medium edition.
3. Garima Singh, “Mathematics-II”, AICTE Prescribed Textbook (Diploma, NEP 2020), ISBN 978-93-9150-5523 — available in Hindi (हिंदी).
4. B. V. Ramana, “Higher Engineering Mathematics” (selected basic topics), McGraw-Hill.

**Suggested Tutorial / Sessional Assignments:**

*(Indicative list for the sessional / self-practice component; problems are framed around real manufacturing, automation and shop-floor contexts.)*

1. Convert a set of given measurements between mm, cm, m and inches.
2. Calculate the weight of a steel bar from its volume and density.
3. Find the area of a given sheet-metal development.
4. Calculate the RPM for a given cutting speed and diameter.
5. Work out the gear ratio for a given pair of gears.
6. Plot a straight-line graph from a given set of readings and read an in-between value.
7. Tabulate ten sample readings and find mean, median, mode and range.
8. Prepare a bar chart and a pie chart from the given production data.
9. Calculate taper and pitch for a given job.
10. Estimate material quantity and cost for a simple batch of parts.