# 1. SYLLABUS CONTENT WITH TIME STRUCTURE

## 1.1 SYLLABUS CONTENT FOR PROFESSIONAL SKILL & KNOWLEDGE

**First Semester**
**(Semester Code no. ELM - 01)**
**Duration: Six Month**

## LEARNING OBJECTIVES OF 1<sup>ST</sup> SEMESTER

1. Familiarize with basics of electricity, test the cable and measure the electrical parameter
2. Identify and Use different hand tools
3. Identify and test cells/batteries
4. Identify and test passive and active electronic components
5. Practice soldering and de-soldering of various types of electrical and electronic components
6. Assemble a computer system, install OS, Practice with MS office
7. Use the internet, browse, create mail IDs, download desired data from internet using search engines

| Week No. | Professional Skills | Professional Knowledge |
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| | **Trade Practical** | **Trade Theory** |
| 1 | **Trade and Orientation** <br><br> • Visit to the institute and workshops. <br> • Introduction with the principal and other staffs. <br> • Care and safe working habits, safety precautions to be demonstrated to the trainees. <br> • Elementary first aid practice. <br> • Identify different types of fire extinguishers. Do's and Don'ts and standard practices to be followed in the institute | Introduction to NCVT and certification mechanism. <br><br> Semester system and its flexibility for the trainee and to the institute. <br><br> EM trade and its applicability in industries. <br><br> Expectations of the industry from trainees after the completion of the trade. <br><br> The skills to be acquired to become part of industry. <br><br> Introduction to safety, safety signs, and measures to be taken to maintain the standards of safety of personal working and the equipments. <br><br> Different first aid mechanisms to rescue the affected by electric shocks or any physical |

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| 2-3 | **Hand Tools and their uses**<br><br>• Demonstration and uses of hand tools- screw drivers, pliers, tweezers, tester, wire stripper, electrician knife, steel rule, scriber, punches, hack saw, hammer, files, bench vice and drilling machine.<br>• Simple mechanical fixtures<br>• Identification of types of screws, bolts, nuts, washers, rivets, clamps, connectors<br>• Fix screws of different sizes on wooden boards<br>• Cutting of wooden blocks using hand/hack saw<br>• Simple fitting practice and drilling practice<br>• Simple sheet metal works | Identification, specifications, uses and maintenance of commonly used hand tools.<br><br>Riveting of tags and lugs, cutting and bending of sheet metals, chassis and cabinets. |
| 4 - 5 | Basics of AC and Electrical Cables<br><br>• Identify the Phase, Neutral and Earth on power Socket.<br>• Construct a test lamp and use it to check mains healthiness.<br>• Use a Tester to monitor AC power.<br>• Measure the voltage between phase and ground and rectify earthing.<br>• Identify and test different AC mains cables.<br>• Skin the electrical wires /cables using the wire stripper and cutter.<br>• Measure the gauge of the wire using SWG.<br>• Prepare the mains cable for termination.<br>• Crimp the lugs to wire end and Solder the lugs to wire end<br>• Solder/crimp/terminate different types of electrical connectors<br>• Measure AC and DC voltages using multi meter. | Basic terms such as electric charges, Potential difference, Voltage, Current, Resistance. Basics of AC & DC. Terms such as +ve cycle, -ve cycle, Frequency, Time period, RMS, Peak, P-P, Instantaneous value. Single phase and Three phase supply. Terms like Line and Phase voltage/ currents. Insulators, conductors and semiconductor properties. Different type of electrical cables and their Specifications.<br><br>Types of wires & cables, standard wire gauge(SWG).<br><br>Classification of cables according to gauge(core size), number of conductors, material, insulation strength, flexibility etc. |
| 6 | **Cells & Batteries**<br><br>• Identify the primary and secondary cells<br>• Measure and test the voltages of the | **Battery /Cells**: construction, types of |

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| | given cells/battery using analog / digital multimeter.<br>• Charging and discharging the battery.<br>• Maintain the secondary battery.<br>• Use a hydro meter to measure the specific gravity of the secondary battery. | primary and secondary cells, materials used, Specification of cells and batteries. Charging process, efficiency, life of cell/battery. Selection of cells / Batteries etc. Use of Hydrometer. Types of electrolytes used in cells and batteries. Series / parallel connection of batteriesandpurposeofsuch connections. |
| 7-9 | **Passive Components**<br><br>• Identify the different types of resistors<br>• Measure the resistor values using colour code and verify the reading by measuring in multi meter<br>• Identify the power rating using size<br>• Verify ohms law<br>• Measure the resistance, Voltage, Current through series and parallel connected networks using multi meter<br>• Identify different inductors and measure the values using LCR meter<br>• Identify the different capacitors and measure capacitance of various capacitors using LCR meter<br>• Make an electro magnet.<br>• Install a solenoid valve in a flow line.<br>• Identify and test the circuit breaker and other protecting devices.<br>• Dismantle and identify the different parts of a relay.<br>• Connect a relay in a circuit and test for its working<br>• Dismantle and identify the different parts of the electrical contactor<br>• Connect a contactor in a circuit and test for its working<br>• Construct and test RC time constant circuit<br>• Construct a RC differentiator circuit and convert triangular wave into square wave<br>• Construct and test series and parallel resonance circuit | Ohm's law and its variables. Resistor-definition, types of resistors, their construction & specific use, color-coding, power rating. Equivalent Resistance of series parallel circuits. Distribution of V & I in series parallel circuits. KVL& KCL with applications.<br><br>Principles of induction, inductive reactance, Types of inductors, construction, specifications and applications (energy storage concept). Self and Mutual induction. Behavior of inductor at low and high frequencies. series and parallel combination, Q factor.<br><br>Capacitance and Capacitive Reactance,<br><br>Impedance. Types of capacitors, construction, specifications and applications. Dielectric constant. Significance of Series parallel connection of capacitors. Capacitor behavior with AC and DC. Concept of Time constant of a RC circuit. Concept of Resonance and its application in RC, RL& RLC series and parallel Types and circuit Properties of magnets and their materials, preparation of artificial magnets, significance of electro |

| | | magnetism, types of cores. |
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| | | Electromagnetic Relays, types, construction, specifications- coil voltage and contact current capacity. |
| 10 | **Transformers**<br>• Identify different types of mains transformers and test.<br>• Identify the primary and secondary transformer windings and test the polarity.<br>• Identify different sizes, shapes of cores used in low capacity transformers.<br>• Measure the primary and secondary voltage of different transformers<br>• Construct a low voltage night lamp<br>• Identify and test the variac | Working principle of a Transformer,<br><br>Transformer construction, Types of cores used. Specifications of a transformer, Step-up, Step down and isolation transformers with applications. Different type of losses in Transformers, Phase angle, phase relations, active and reactive power, power factor and its importance in the industry. |
| 11-12 | **AC & DC measurements**<br>• Identify the meter for measuring AC & DC parameters<br>• Use the multi meter to measure the various functions ( AC V, DC V, DC I, AC I, R)<br>• Replace the fuse, battery for the given multimeter<br>• Identify the different controls on the CRO front panel and observe the function of each controls<br>• Measure DC voltage, AC voltage ,time period using CRO<br>• Identify the different controls on the Function generator front panel and observe the function of each controls<br>• Connect the function generator to CRO and observe the different wave forms | Introduction to electrical measuring instruments, Importance of meter, classification of meters, forces necessary to work a meter. MC and MI meter, range extension, need of calibration, characteristics of meters and errors in meters. Multi meter, use of meters in different circuits. Care and maintenance of meters. Use of CRO, Function generator, LCR meter |
| 13 | **Soldering & De-soldering and switches**<br><br>• Identify different types of soldering guns and practice soldering of different electronic active and passive components and IC bases on lug boards and PCBs<br>• Join the broken PCB track and test<br>• Practice de-soldering using pump and wick | Different types of soldering guns, related to Temperature and wattages, types of tips.<br><br>Solder materials and their grading. Use of flux and other materials. Selection of |

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| | • Prepare component for soldering.<br>• Demonstrate soldering and de-soldering using soldering and de-soldering stations<br>• Identify and use SPST, SPDT, DPST, DPDT, tumbler, push button, toggle, piano switches used in electronic industries<br>• Make a panel board using different types of switches for a given application | a soldering gun for specific requirement.<br><br>Soldering and De-soldering stations and their specifications.<br><br>Different switches and their specification, uses. | |
| 14-15 | **Rectifiers**<br>• Identify diodes, diode bridges<br>• Record the specifications of different diodes using data book/ web site<br>• Identify different packaging styles of diodes and heat sinks types<br>• Test the given diode using multi meter<br>• Construct and test Diode as a half wave, full wave and Bridge rectifier.<br>• Construct a rectifier with capacitor filter circuit and measure the output voltage<br>• Use CRO to observe the ripple from rectifiers for different load and filter capacitors<br>• Identify and Test Zener diode.<br>• Construct and test Zener based voltage regulator circuit. | Semiconductor component number coding for different electronic components such as Diodes, Zeners. PN Junction, Forward and Reverse biasing of diodes, Interpretation of diode specifications Forward current and Reverse voltage, packing styles of diodes. Diode Bridge Modules. Rectifier configurations, their efficiencies, Filter components and their role in reducing ripple. Working principles of Zener diode / specifications / applications, Varactor diode /Tunnel diode/ specifications with applications. | |
| 16 | **IC Regulators**<br>• Identify the different types of fixed +ve and –ve regulator ICs and the different current ratings (78/79 series)<br>• Identify the pins<br>• Construct a fixed voltage regulator as a variable one by floating the reference<br>• Identify the different heat sinks for IC based regulators<br>• Observe the output voltage of different IC regulators by varying the input voltage<br>• Construct a dual power supply by using the fixed IC regulators with current limiting and short circuit protection features | Regulated Power supply using 78XX series,<br><br>79XX series, Op-amp regulator, 723 regulator , (Transistorized & IC based) voltage regulation, error correction and amplification etc. | |

| 17-21 | **Computer Hardware, OS, MS office** <br> **Networking** <br><br> • Identification of various indicators, Connectors, ports on the computer cabinet <br> • Identify drives and their capacity. <br> • Identify various connectors and cables inside the cabinet & Identify connections to rear side and front panel of the cabinet <br> • Identify various parts of the system unit and motherboard <br> • Disable certainfunctionalityby disconnecting the concerned cables ( like USB, SERIAL, Flat) <br> • Replace the CMOS battery <br> • Replace/Extend a memory module <br> • Test and Replace the SMPS <br> • Replace the given HDD on the system <br> • Replace the given DVD on the system <br> • Configuring and troubleshooting display applications, Components of desk top <br> • Boot the system from different options <br> • Practice various features of OS <br> • Perform maintenance of the computer using standard tools provided in the OS <br> • Install a Printer driver software and test <br> • Install antivirus software and scan the configuration advance features i.e. highlighting, cut & options in the antivirus software <br> • Install MS office software <br> • Use start menu, check available programs in computer, use search, settings, run and options. Creation of short cuts <br> • Changing screen savers <br> • Create folder and files, Drawing pictures using paint, using menus of paint <br> • Explore different Menu/Tool/ Format/status bars of MS word and practice the options: Editing the text, saving the text, changing the font and size of text. <br> • Creation of broachers and taking the printouts <br> • Practice the Mail merge and Hyperlink | Basic blocks of a computer, Hardware and software, I/O devices, keyboard, types of mouse and their working, Different types of printers, their function and inter-connection and their advantages HDD, CDD, DVD. Various ports in the computer. <br><br> POST Booting concept. <br><br> Windows O.S. <br><br> MS widows: Starting windows and its operation, file management using explorer, Display & sound properties, screen savers, font management, installation of program, setting and using of control panel., application of problems accessories, various IT tools and <br><br> Concept of word processing,: MS word <br><br> – Menu bar, standard tool bar, saving, copying, deleting & retrieving files, for print outs page setting, editing, formatting, system and Explore the paste, subscript & superscript drawing features, mail merging, Hyperlink, tables and borders, printing of document etc. <br><br> Excel – Worksheet basics, data entry and formulae. Moving data in worksheet using tool bars and menu bars, Formatting and calculations, printing worksheet, creating multiple work sheets, creating charts, changing chart types, Adding titles, legends and gridlines, colouring charts, printing charts, placing charts in a word file. <br><br> Introduction to power point Basics of |
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| | options<br>• Prepare a power point presentation on any three known topics with various design features<br>• Prepare a power point presentation with different animation and visual effects.<br> • Invoke excel sheet from MS WORD and vice versa<br> • Convert the given PDF File into WORD File using suitable software. (*use free downloadable software* )<br> • Use of search engines, Creation of email accounts, sending    and receiving the mails                configuration of email clients.<br>• Identify the cables and network components.<br>• Making UTP cross cables   and testing, Making straight cables and testing, Making cable layout drawing | preparing slides, different design aspects of slides, animation with slides etc<br><br>Concept    of Internet,    Browsers, Websites, search engines, email, chatting and messenger service. Downloading the Data and program files etc.<br><br>**Computer Networking:-**<br><br>Network features-Network topologies, protocols- TCP/IP, UDP, FTP, models, types, network components, network medias,<br><br>Specification and standards, types of cables, UTP, STP, Coaxial cables. Network components like hub, Ethernet switch, router, NIC Cards, connectors, media and firewall. Difference between PC & Server.<br><br>Operating system -OS, NOS-features, types etc.<br><br>Identify physical topology of a network and members of the network, Internet search engines and applications. |
| 22-23 | **(i)   Project work**<br>**(ii)   Industrial visit (optional)** | |
| 24-25 | **Examination** | |
| 26 | Semester Gap | |

## Second Semester
### (Semester Code no. ELM - 02)
### Duration: Six Month

## LEARNING OBJECTIVES OF 2<sup>nd</sup> SEMESTER

1. Construct and test amplifier, oscillator and wave shaping circuits
2. Identify and test power electronic components
3. Identify and test opto electronic devices
4. Practice SMD Soldering and De-soldering of Simple SMD components
5. Identify and verify the truth tables of various digital ICs using Data book
6. Practice circuit simulation software to simulate and test various the circuits
7. Identify and test various types of LEDs and LED displays
8. Construct and test various circuits using linear ICs 741 & 555

| Week No. | Professional Skills | Professional Knowledge |
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| | **Trade Practical** | **Trade Theory** |
| 1 | **Transistor**<br><br>• Identify PNP and NPN Transistors<br>• Record the different specification of transistors using data book/web site<br>• Identify different transistors with respect to different packaging styles, power, switching transistor, heat sinks<br>• Measure E-B, C-B & C-E terminal resistances and infer.<br>• Construct and test a transistor based switching circuit to control a relay (use Relays of different coil voltages and Transistors of different $\beta$ )<br>• Construct a Transistorized amplifier vary the gain by changing the circuit components | Construction, Working of a PNP and NPN Transistors. Purpose of E, B & C Terminals. Flow of currents into and out of terminals of PNP/ NPN Transistors and their relations. Significance of $\beta$ of a Transistor Need for Biasing of Transistor junctions, Interpretation of main parameters of a Transistor. $V_{BE}$, $V_{CB}$, $V_{CE}$, $I_C$, $I_B$, Junction Temperature, junction capacitance, Frequency of operation, Discuss a Transistor application as a switch. Discuss a Transistor application as an amplifier. Define input impedance and output impedances<br><br>Transistor power ratings & packaging styles, use of different heat sinks. |
| 2-3 | **Amplifier**<br>• Construct and test voltage divider bias<br>• Construct and Test a common emitter amplifier with and without bypass capacitors<br>• Construct and Test common base amplifier<br>• Construct and Test common | Transistor (CB, CE & CC) configurations and their characteristics and applications<br><br>Transistor biasing circuits and stabilization Techniques. |

| | | collector/emitter follower amplifier<br>• Construct and Test Darlington amplifier<br>• Construct and test a two stage RC Coupled amplifier<br>• Construct and test a Class B complementary push pull amplifier<br>• Construct and test class C Tuned amplifier | Classification of amplifiers according to frequency, mode of operation, methods of coupling, Voltage amplifiers- voltage gain, loading effect. Configuration of common emitter, common base, common collector transistor, their definition characteristics and applications. Single stage CE amplifier, (CC amplifier) emitter follower circuit and its advantages RC coupled amplifier, Distinguish between voltage and power amplifier, Push pull amplifier and class C tuned amplifier Alpha, beta, voltage gain, Concept of dB dBm. Feedback and its types. |
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| 4 | | • Demonstrate Colpitts oscillator, Hartley oscillator circuits<br>• Construct and test a RC phase shift oscillator circuits<br>• Construct and test a crystal oscillator circuits<br>• Demonstrate Astable, monostable, bistable circuits using transistors. | Introduction to positive feedback and requisites of an oscillator, Study of Colpitts, Hartley, Crystal and RC oscillators.<br><br>Types of multi vibrators and study of circuit diagrams |
| 5 | | **Wave shaping circuits**<br>• Construct and test shunt clipper<br>• Construct and test series and dual clipper circuit using diodes<br>• Construct and test clamper circuit using diodes<br>• Construct and test Schmitt trigger circuit using transistors | Diode shunt clipper circuits and Clamping /limiting circuits and their applications.<br><br>Schmitt trigger circuits |
| 6-7 | | **Power Electronic Components**<br><br>• Identify FET transistors and record main parameters from the Data book<br>• Test the given FET using multi meter<br>• Construct and test a FET Amplifier<br>• Identify SCRs of different ratings and the packages<br>• Test different SCRs using a Multi meter and component tester<br>• Construct a test circuit to test SCRs<br>• Construct a test circuit of SCR using UJT triggering<br>• Identify different heat sinks used with SCRs.<br>• Construct a snubber circuit for protecting SCR use freewheeling diode to reduce back emf.<br>• Construct and test solid state relay. | Construction of FET, differentiate it with BJT. Purpose of Gate, Drain and source terminals and voltage / current relations between them,<br><br>Impedances between various terminals. Interpret the main parameters of the FET. Suitability of FET amplifiers in measuring device applications. Working of power electronic components such as SCR, TRIAC, DIAC and UJT. |

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| | | • Construct a jig circuit to test DIAC<br>• Identify and test a TRIAC using multi meter<br>• Construct a simple dimmer circuit using TRIAC<br>• Identify and Test a UJT using multi meter<br>• Construct UJT based free running oscillator and change its frequency. | |
| 8 | | **MOSFET & IGBT:**<br>• Identify MOSFET by its number<br>• Identify different heat sinks used with various power MOSFET devices.<br>• Construct MOSFET test circuit with a small load<br>• Identify IGBT by its number<br>• Construct IGBT test circuit with a small load | Working of MOSFET, Power MOSFET and IGBT - their types, characteristics, switching speed, power ratings and protection. Differentiate FET with MOSFET, differentiate a Transistor with IGBT |
| 9 | | **Opto Electronics:**<br>• Identify different types of LEDs<br>• Test LEDs using DC supply and measure voltage drop and current using multimeter<br>• Identify and test LDR, Identify photo voltaic cell<br>• Construct a circuit to test a photo voltaic cell<br>• Construct a circuit to switch a lamp load using photo diode<br>• Construct a circuit to switch a lamp load using photo transistor.<br>• Identify Opto coupler input and output terminals and measure the quantum of isolation between i/o terminals (Opto Transistor, TRIAC and SCR) and operate a Relay by connecting a switch | Working and application of LED, IR LEDs, Photo diode ,photo transistor, its characteristics and application, optical sensor, opto-couplers, circuits with opto isolators, characteristics of LASER diodes |
| 10 | | **Basic SMD (2,3,4 terminal components):**<br>• Identification of 2,3,4 terminal SMD components<br>• De-solder the SMD components from the given PCB<br>• Solder the SMD components in the same PCB<br>• Check for cold continuity of PCB<br>• Identification of loose /dry solder, broken tracks on printed wired assemblies | Introduction to SMD technology<br><br>Identification of 2,3,4 terminal SMD components, advantages of SMD components over conventional lead components<br><br> Introduction to solder paste and machine.<br><br>Soldering of SM assemblies - Reflow soldering<br><br>Tips for selection of hardware, Inspection of SM. |

| 11 | **Basic Gates:**<br>• Identify different Logic Gates (AND, OR, NAND, NOR, X-OR, X-NOR, NOT ICs) by the number printed on them and draw I/O pin-out numbers.<br>• Verify the truth tables of all Logic Gate ICs by connecting switches and LEDs.<br>• Construct and verify the truth table of all the gates using NAND and NOR gates<br>• Use digital IC tester to test the various digital ICs (TTL and CMOS) | Introduction to Digital Electronics.<br><br>Difference between analog and digital signals, Logic families and their comparison, Logic levels of TTL and CMOS. Number systems (Decimal, binary, octal, Hexadecimal) BCD code, ASCII code and code conversions.<br><br>Logic Gates and their truth tables, propagation delay, power dissipation and noise immunity |
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| 12 | **Combinational Circuits:**<br>• Construct Half Adder circuit and verify the truth table.<br>• Construct Full adder and verify the truth table.<br>• Construct the Adder cum Subtractor and verify the result<br>• Construct and Test a 2 to 4 Decoder<br>• Construct and Test a 4 to 2 Encoder<br>• Construct and Test a 4 to 1 Multiplexer<br>• Construct and Test a 1 to 4 De Multiplexer | Combinational logic circuits such as Half Adder, Full adder, Parallel Binary adders, 2-bit and four bit full adders. Magnitude comparators. Half adder, full adder ICs and their applications for implementing arithmetic operations<br><br>Basic Binary Decoder and four bit binary decoders.. Concept of encoder and decoder, Need for multiplexing of data. 1:4 line Multiplexer /De-multiplexer. |
| 13 | **Flip Flops:**<br>• Identify different Flip-Flop (ICs) by the number printed on them<br>• Construct and test four bit latch using 7475 .<br>• Verify the truth tables of Flip-Flop ICs (RS, D, T, JK, MSJK) by connecting switches and LEDs | Introduction to Flip-Flop. S-R Latch, Gated S-R Latch, D- Latch. Flip-Flop: Basic RS Flip Flop, edge triggered D Flip Flop, JK Flip Flop, T Flip Flop, Master-Slave flip flops and Timing diagrams, Basic flip flop applications like data storage , data transfer and frequency division. |
| 14-15 | **Electronic circuit simulation software**<br><br>• Prepare simple digital and electronic circuits using the software<br>• Simulate and test the prepared digital and analog circuits<br>• Convert the prepared circuit into a layout diagram.<br>• Explore various troubleshooting and fault finding resources provided in the simulation software. | Study the library components available in the circuit simulation software. Various resources of the software. |
| 16-17 | **Counter & shift Registers:**<br>• Construct and test a four bit asynchronous binary counter using 7493. | Basics of Counters, types of counters, two bit |

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| | • Construct and test 7493 as a modulus-12 counter.<br>• Construct and test a four bit Synchronous binary counter using 74163.<br>• Construct and test synchronous Decade counter.<br>• Construct and test an up/down synchronous decade counter using 74190 and monitor the output on LEDs.<br>• Identify and test common anode and common cathode seven segment LED display using multi meter<br>• Display the two digit count value on seven segment display using decoder/driver ICs.<br>• Construct a shift register using RS/D/JK flip flop and verify the result<br>• Construct and test four bit SIPO register<br>• Construct and test four bit PIPO register<br>• Construct and test bidirectional shift registers | and three bit Asynchronous binary counters and decade counters with the timing diagrams.<br><br>3-bit Synchronous counters and synchronous decade counters.<br><br>Types of seven segment display,<br><br>BCD display, BCD to decimal decoder. BCD to 7 segment display circuits,<br><br>Basics of Register, types and application of Registers. |
| 18-21 | **Op – Amp & Timer 555 Applications:**<br>• Use analog IC tester to test the various analog ICs<br>• Construction and testing of various Op-Amp circuits Inverting, Non-inverting and Summing Amplifiers<br>• Construct and test Differentiator and Integrator<br>• Construct and test a zero crossing detector<br>• Construct and test Instrumentation amplifier<br>• Construct and test a Binary weighted and R-2R Ladder type Digital-to-Analog Converters.<br>• Construct and test Astable timer circuit using IC 555<br>• Construct and test mono stable timer circuit using IC 555<br>• Construct and test VCO (V to F Converter) using IC 555<br>• Construct and test 555 timers as pulse width modulator | Block diagram and Working of Op-Amp, importance, Ideal characteristics, advantages and applications.<br><br>Schematic diagram of 741, symbol, Non inverting voltage amplifier, inverting voltage amplifier, summing amplifier, Comparator, zero cross detector, differentiator, integrator and instrumentation amplifier, other popular Op-Amps.<br><br><br>Block diagram of 555, functional description w.r.t. different configurations of 555 such as mono stable, Astable and VCO operations for various application |
| 22-23 | Implant training / Project work (work in a team) | |
| 24-25 | Revision | |
| 26 | Examination | |

## Third Semester
### (Semester Code no. ELM - 03)
### Duration: Six Month

## LEARNING OBJECTIVES OF 3<sup>rd</sup> SEMESTER

1. Operate DSO to perform various functions
2. Practice SMD Soldering and De-soldering of various types of IC Packages
3. Identify defects and do rework of PCB Repairs.
4. Construct and test simple electrical control circuits and various electrical protective devices
5. Identify, prepare, terminate and test various types of electronic cables used in various systems
6. Identify various functional blocks of a microcontroller system and Identify various I/O Ports, Interface a model application with the Microcontroller kit and run the application
7. Construct and test various modulation/demodulation circuits
8. Identify and test various types of sensors used in electronic industries
9. Construct and test analog and digital IC based application circuits

| Week No. | Professional Skills | Professional Knowledge |
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| | Trade Practical | Trade Theory |
| 1 | **Digital Storage Oscilloscope:**<br>• Identify the different front panel control of a DSO.<br>• Measure the Amplitude, Frequency and time period of typical electronic signals using DSO<br>• Store a portion of signal waveform using DSO.<br>• Take a print of a signal from DSO by connecting it to a printer<br>• Construct and test function generator using IC 8038 | Block diagram of DSO/CRO and applications of DSO/CRO application of digital CRO, block diagram of function generator. Differentiate a CRO with DSO. Advantages of DSO. Major features of DSO. |
| 2-3 | **SMD Soldering and De-soldering:**<br>• Identify various connections and the setup required for SMD Soldering station<br>• Identification of crimping tools for various IC packages.<br>• Make the necessary settings on SMD soldering station to de-solder various ICs of different packages (at least four) by choosing proper crimping tools.<br>• Make the necessary settings on SMD soldering station to solder various ICs of different packages (at least four) by | Soldering / de-soldering of above components<br><br>Identification of Programmable Gate Array (PGA) packages<br><br>Soldering / De-soldering of above PGA components<br><br>Cold/Continuity check of PCBs<br><br>Identification of lose /dry solders, broken tracks |

| | | choosing proper crimping tools. | on printed wiring assemblies |
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| 4 | | **PCB Rework:**<br>• Prevention of Static charges, Handling of static sensitive devices<br>• Familiarizations of various crimping tools, wire wrapping, Conductive adhesives, Chip on Board, Tape Automated bonding.<br>• Construction of Printed Circuit Boards (single, Double, multi-layer), Important tests for PCBs<br>• Identify different types of soldering guns and practice soldering of different electronic active and passive components and IC bases on lug boards and PCBs<br>• Join the broken PCB track and test<br>• Practice the de-soldering using pump and wick<br>• Prepare component for soldering<br>• Demonstrate soldering and de soldering using soldering and de-soldering stations<br>• Familiarizations of soldering technology, use of materials like solder, flux and cleaning solvents, Usage of correct tools, Component mounting, Solderability testing,<br>• Practical's on soldering Inspection of solder joints, Defects of soldered joints<br>• Familiarizations to rework and repair concepts<br>• Practical on Types of conformal coating and its removal methods<br>• Practical on Rework of through hole and surface mount soldered joints<br>• Practical on Repair of damaged track<br>• Practical on Repair of damaged pad<br>• Practical on Repair of Plated through hole<br>• Practical on Repair of solder mask | **ESD Control in Electronics**<br><br>Introduction to Static charges, Prevention of Static charges, Handling of static sensitive devices, Various standards for ESD<br><br>**Introduction to non soldering interconnections**<br><br>Introduction to crimping, wire wrapping, Conductive adhesives, Chip on Board, Tape Automated bonding.<br><br>Introduction to components, Printed Circuit Boards<br><br>Introduction to components, Construction of Printed Circuit Boards(single, Double, multi-layer), Important tests for PCBs<br><br>**Soldering guns**<br><br>Different types of soldering guns, related to Temperature and wattages, types of tips.<br><br>Solder materials and their grading. Selection of a soldering gun for specific requirement.<br><br>Soldering and De-soldering stations and their specifications.<br><br>Reliable Soldering Practices (Manual)<br><br>Fundamentals of soldering technology, Materials selection like solder, flux and cleaning solvents, Usage of correct tools, Component mounting, Solderability testing, Process for soldering Inspection of solder joints, Defects of soldered joints<br><br>**Introduction to Surface Mount Technology (SMT)**<br><br>Introduction to surface mount technology – advantages Surface Mount components and packages, Introduction to solder paste (flux), Soldering of SM assemblies - Reflow soldering |

| | | | Tips for selection of hardware, Inspection of SM. |
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| | | | **Rework and Repair of Printed Circuit board assemblies** |
| | | | Introduction to rework and repair concepts |
| | | | Types of conformal coating and its removal methods |
| | | | Rework of through hole and surface mount soldered joints |
| | | | Repair of damaged track |
| | | | Repair of damaged pad |
| | | | Repair of Plated through hole |
| | | | Repair of solder mask |
| 5 | | **Protection devices:**<br>• Identify different types of fuses along with fuse holders.<br>• Wire an MCB to a motor and run it<br>• Test and rectify defects associated with MCBs.<br>• Connect an ELCB and test the leakage of an electrical motor control circuit. | Fuse ratings, types of Fuses, Fuse bases, single/three phase MCBs, single phase ELCBs.<br><br>Types of Contactors, contactor coils and working voltages, contactor contact currents, protection to contactors and high current applications. |
| 6 | | **Electrical control circuits:**<br>• Measure the coil winding resistance of the given motor<br>• Prepare the setup and Control an induction motor using a DOL Starter<br>• Construct a direction control circuit to change direction of an induction motor<br>• Connect an overload relay and test for its proper functioning. | Fundamentals of single phase Induction motors, synchronous speed, slip, rotor frequency, torque – speed characteristics, Starters used for Induction motors. |
| 7-8 | | **Electronic Cables & Connectors**<br><br>• Identify various types of cables used for various applications viz. insulation, gauge, current capacity, flexibility etc. used in variouselectronics products.<br>• Identify suitable connectors, solder/crimp /terminate & test the cable sets. | Cable signal diagram conventions<br><br>Classification of electronic cables as per the application w.r.t. insulation, gauge, current capacity, flexibility etc. different types of connector & their terminations to the cables. |

| | | • Read & follow markings on the connectors for testing the continuity of the prepared cable sets<br>*The set of cables prepared should cover applications like computer, audio, video products, RF, DATA Transmission, IDE etc* | Male / Female type DB connectors, Ethernet 10 Base cross over cables and pin out assignments, UTP and STP, SCTP Cables<br><br>Cable trays.<br><br>Different types of connectors Servo 0.1" connectors, FTP, RCA,BNC,HDMI<br><br>Audio/video connectors like XLR,RCA(phono),6.3mm PHONO,3.5/2.5mm PHONO, BANTAM,SPEAKON, DIN, mini DIN, RF connectors, USB, Firewire, SATA Connectors, VGA,DVI connectors, MIDI etc |
| 9-10 | **Communication electronics:**<br><br>• Modulate and Demodulate various signals using AM and FM on the trainer kit and observe waveforms<br>• Construct and test IC based AM Receiver<br>• Construct and test IC based FM transmitter<br>• Construct and test IC based FM Receiver<br>• Dismantle the given FM receiver set and identify different stages ( AM section, audio amplifier section etc)<br><br>• Modulate and Demodulate a signal using PAM,PPM,PWM Techniques | Radio Wave Propagation – Principle, Fading,<br><br>Need for Modulation, types of modulation. Demodulation techniques.<br><br>Fundamentals of Antenna, various parameters, types of Antennas & application.<br><br>Introduction to AM, FM & PM, SSB-SC<br><br>& DSB-SC,block diagram of AM and FM transmitter.<br><br>FM Generation & Detection<br><br>Radio Receivers: Types, Super heterodyne receiver Blocks, Principle, characteristics, advantages and disadvantages, Block diagram of FM Receives, RF, IF & AF Amplifier Sections, AM/FM RF Alignment.<br><br>Digital modulation and demodulation techniques, sampling, quantization & encoding.<br><br>Concept of multiplexing and de multiplexing<br><br>of AM/FM/PAM/ PPM /PWM signals.<br><br>*A simple block diagram approach to be adopted for explaining the above mod/demo. techniques.* |
| 11-12 | **Microcontroller (8051)**<br><br>• Identify various ICs & their functions on | Introduction to 8051 Microcontroller, architecture, pin details & the bus system. Function of different ICs used in the |

| | | the given Microcontroller Kit<br>• Identify the address range of RAM & ROM.<br>• Write data into RAM & observe its volatility<br>• Measure the crystal frequency, connect it to the controller.<br>• Identify the port pins of the controller & configure the ports for Input & Output operation<br>• Connect an input switch & control a lamp using necessary program<br>• Demonstrate the initialization, load & turn on a LED with delay using Timer.<br>• Demonstrate the use of a Timer as an Event counter to count external events.<br>• Demonstrate entering of simple programs, execute & monitor the results | Microcontroller Kit. Differentiate microcontroller with microprocessor. Interfacing of memory to the microcontroller. Internal hardware resources of microcontroller. I/O port pin configuration. Different variants of 8051 & their resources. Register banks & their functioning. SFRs & their configuration for different applications. Utilization of on chip resources such as ADC. Availability of assembly software & complier for 8051. Application of microcontroller in domestic, consumer & industries.<br><br>Comparative study of 8051 with 8052. Introduction to PIC Architecture. |
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| 13-14 | | **<u>Sensors ,Transducers and Applications</u>**<br><br>• Identify sensors used in process industries such as RTDs, Temperature ICs, Thermocouples, proximity switches (inductive, capacitive and photo electric), load cells, strain gauge. LVDT by their appearance<br>• Measure temperature of a lit fire using a Thermocouple and record the readings referring to data chart.<br>• Measure temperature of a lit fire using RTD and record the readings referring to data chart.<br>• Measure the strain of a given material using strain gauge<br>• Measure the DC voltage of a LVDT<br>• Detect different objectives using capacitive, inductive and photoelectric proximity sensors | Basics of passive and active transducers.<br><br>Role, selection and characteristics.<br><br>Working principles of RTD, PT-100 Thermocouple, Sensor voltage and current formats.<br><br>Thermistors – salient features –operating range, composition, advantages and disadvantages.<br><br>Thermocouples – basic principle – commonly used combinations, operating range, advantages and disadvantages.<br><br>Strain gauges – principle, gauge factor, types of strain gauges.<br><br>Load cell –definition, uses, working of strain gauge load cell<br><br>Principle of operation of capacitive transducers,- advantages and disadvantages<br><br>Principle of operation of inductive transducers,- advantages and disadvantages<br><br>Principle of operation of LVDT-its advantages and disadvantages<br><br>Proximity sensors – applications, working principles of eddy current , capacitive and |

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| | | inductive proximity sensors |
| 15-17 | **<u>Analog IC Applications</u>**<br><br>Make simple projects/Applications using ICs 741, 723, 555, 7106, 7107<br><br>Sample projects:<br><br>• Laptop protector<br>• Mobile cell phone charger<br>• Battery monitor<br>• Metal detector<br>• Mains detector<br>• Lead acid battery charger<br>• Smoke detector<br>• Solar charger<br>• Emergency light<br>• Water level controller<br>• Door watcher<br>(Instructor will pick up any five of the projects for implementation) | Discussion on the identified projects with respect to data of the concerned ICs, components used in the project |
| 20-21 | **<u>Digital IC Applications</u>**<br><br>Make simple projects/Applications using various digital ICs ( digital display, event counter, stepper motor driver etc)<br><br>• Duty cycle selector<br>• Frequency Multiplier<br>• Digital Mains Resumption Alarm<br>• Digital Lucky Random number generator<br>• Dancing LEDs<br>• Count down timer<br>• Clap switch<br>• Stepper motor control<br>• Digital clock<br>• Event counter<br>• Remote jammer<br>(Instructor will pick up any five of the projects for implementation) | Discussion on the identified projects with respect to data of the concerned ICs, components used in the project |
| 22-23 | Implant training/Project work/work in a team | |
| 24-25 | Revision | |
| 26 | Examination | |

## Fourth Semester
### (Semester Code no. ELM - 04)
### Duration: Six Month

## LEARNING OBJECTIVES OF 4<sup>th</sup> SEMESTER

1. Work with DPM Modules to measure various electrical parameter
2. Practice various modulation techniques to acquaint with fiber optic trainer
3. Identify various functional blocks/major components/ICs in the given stabilizer. Rectify the faults
4. Identify various Input and output sockets/connectors of the given SMPS and UPS
5. Identify various functional blocks/major components/ICs in the given SMPS and UPS
6. Install and troubleshoot the given solar panel system
7. Dismantle and assemble various types of cell / smart phones and trouble shoot the cell/smart phone
8. Dismantle and assemble the given LED light stack
9. Dismantle, assemble, trouble shoot and rectify LED and LCD TV sets

| Week No. | Professional Skills | Professional Knowledge |
|---|---|---|
| | **Trade Practical** | **Trade Theory** |
| 1 | **Fiber optic communication:** <br><br> • Identify the resources and their need on the given fiber optic trainer kit <br> • Make optical fiber setup to transmit and receive analog and digital data <br> • Demonstrate FM modulation and demodulation using OFC trainer kit using audio signal and voice link <br> • Demonstrate PWM modulation and demodulation using OFC trainer kit using audio signal and voice link <br> • Demonstrate PPM modulation and demodulation using OFC trainer kit using audio signal and voice link | Introduction to optical fiber as a transmission media, its advantages over other media, properties of optic fiber, testing, losses , types of fiber optic cables and specifications. <br><br> Encoding of light. <br><br> Fiber optic joints, splicing, testing and the related equipments/measuring tools, precautions to be taken laying of cables, safety aspects while handling optical cables. |
| 2-3 | **Digital panel Meter:** <br><br> • Identify LED Display module and its decoder/driver ICs <br> • Display a word on a two line LED <br> • Measure/current flowing through a resistor and display it on LED Module <br> • Measure/current flowing through a sensor and display it on a LED module(DPM) <br> • Identify LCD Display module and its decoder/driver ICs <br> • Display a word on a two line LCD | Different types of seven segment displays, decoders and driver IC s for them. Concept of multiplexing and its advantages. <br><br> Block diagrams of 7106 and 7107 and their configuration for different measurements. <br><br> Use of DPM (Digital Panel Meter) with seven segment displays to display different voltage &current signals. |

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| | • Measure/current flowing through a resistor and display it. Measure/current flowing through a sensor and display it on a LCD module(DPM) | Principles of working of LCD. Different sizes of LCDs. Decoder/Driver ICs used with LCDs and their pin-out diagrams.<br><br>Scrolling displays and its design.<br><br>Use of DPM ( Digital Panel Meter) with LCD to display different voltage & current signals |
| 4-7 | **<u>SMPS:</u>**<br><br>• Dismantle the given stabilizer and find major sections/ ICs components.<br>• Measure voltages at vital test points.<br>• Identify various input and output sockets / connectors of the given SMPS.<br>• Apply input and measure outputs using a multi meter.<br>• Test capacity of the given SMPS.<br>• Identify major sections/ ICs/components of SMPS.<br>• Measure / Monitor major test points of computer SMPS.<br>• Identify and replace the faulty components.<br>*Use SMPS used in TVs and PCs for Practice*<br>• Construct and test IC Based DC-DC converter for different voltages<br>• Construct and test a switching step down regulator using LM2576<br>• Construct and test a switching step up regulator using MC 34063 | Concept and block diagram of manual, automatic and servo voltage stabilizer, o/p voltage adjustment, voltage cutoff systems, study of different types of relays used in stabilizer. Block Diagram of Switch mode power supplies and their working principles<br><br>Various types of chopper circuits step-up, step down, inverting types.<br><br>Introduction to DC-DC Converters<br><br>ICs used for converting DC- DC, block diagrams and their pin outs. Applications of DC-DC converters |
| 8-10 | **<u>UPS</u>**<br><br>• Make individual connections between batteries of battery stack and test for healthiness of batteries on stack.<br>• Connect battery stack to the UPS.<br>• Identify front panel control & indicators of UPS<br>• Identify & practice on the use of back panel sockets & connections.<br>• Connect Battery & load to UPS & test on battery mode<br>• Measure battery current UPS is working on Battery Mode & measure load current<br>• Open Top cover of UPS & identify isolator transformer & UPS | Concept of UPS,<br><br>Difference between Inverters and UPS. Basic block diagram of UPS & operating principle,-explanation of rectifier, battery, inverter, static transfer switch.<br><br>Types of UPS : Off line UPS, On line UPS, Line interactive UPS & their comparison<br><br>UPS specifications. Load power factor & types of indications & protections<br><br>UPS circuit description and working - controlling circuits, Micro controller circuits, power circuits, charging circuits, alarm circuits, Indicator circuits. |

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| | transformer & additional circuit other than inverter<br>• Identify various circuit boards in UPS and monitor voltages at various test points<br>• Perform load test to measure backup time.<br>• Test UPS under Fault condition & rectify fault<br>• Perform all above experiment for three phase UPS | Three phase UPS Circuits.<br><br>Installation of single phase & three phase UPS<br><br>Electrical wiring for Single phase and Three phase systems, Earthing and earth resistance measurement, calculation of load power and power factor of a power source.<br><br>Protection circuits used in inverters– battery level, over load, over charging etc. Various faults and its rectification |
| 11-12 | **Solar Power (Renewable Energy System)**<br>• Install a solar panel to a roof.<br>• Wire a solar panel to a solar controller.<br>• Wire a solar controller to a battery storage station.<br>• Connect storage batteries to a power inverter<br>• Wire a power inverter to an electrical service panel.<br>• Connect and test solar panel to the Inverter and run the load.<br>• Test circuits for voltages.<br>• Installation of Solar Inverter.<br>• Take the trainees to the nearest solar power installation and demonstrate various aspects to cover skills as specified above. | Need for renewable energy sources, Solar energy as a renewable resource. Materials used for solar cells. Principles of conversion of solar light into electricity. Basics of photovoltaic's cell. Types of solar cells. Mono crystalline and poly crystalline PV cells.<br><br>Define Components like Solar cell,<br><br>Module, panel and Arrays. Factors that influence the output of a PV module. SPV systems and the key benefits. Difference between SPV and conventional power. Define solar charge controller or regulator and its role.<br><br>Safety precautions while working with solar systems. |
| 13-14 | **Cell phones**<br><br>• Dismantle, identify the parts and assemble different types of smart phones<br>• Dismantle the cell phone/smart phone replace the display<br>• Dismantle the cell phone/smart phone remove the key pad and clean it, test for the continuity of the matrix/tracks<br>• Interface the cell phone/smart phone to the PC and transfer the data<br>• Enhance the memory capacity of the cell phone/smart phone<br>• Connect internet on cell phone and | Introduction to mobile communication, concept cell site, hand off, frequency reuse, block diagram and working of cell phones, cell phone features, GSM and CDMA technology. Use IEMI number to trace lost/misplaced mobile phone. |

| | browse popular web sites<br>• Flash the various brands of cell phone/smart phone ( at least 3)<br>• Upgrade the OS<br>• Format the cell phone/smart phone for virus( approach the mobile repair shop/service centre)<br>• Unlock the handsets through codes and software<br>• Identify the defective parts and rectify<br>• Clean the water damage sets using CTC with vibrator tubs<br>• Replace various faulty parts like mic, speaker, data/charging/audio jack etc. | |
|---|---|---|
| 15-16 | **<u>LED Lights</u>**<br><br>Dismantle the LED light, identify the connections of LEDs stacks, protection circuits, regulator<br><br>• Measure the voltage across LED stacks<br>• Identify the rectifier, controller part of LED lights<br>• Test various subassemblies of the given LED light system | Types of LED panels used in various lighting applications.<br><br>Stacking of LEDs. Driving of LED stacks. |
| 17-21 | **<u>LCD and LED TV</u>**<br><br>• Identification and operate different Controls on LCD, LED TV<br>• Identify various connectors provided on a LCD TV and test the healthiness.<br>• Identification of components and different sector of LCD and LED TV.<br>• Dismantle, Identify the parts of the remote control<br>• Trace and rectify the faults of a various remote controls<br>• Identify various connectors and connect the cable operator's external decoder (set top box) to the TV. | Difference between a conventional CTV with LCD & LED TVs,<br><br>Principle of LCD and LED TV and function of its different section. Basic principle and working of 3D TV.<br><br>IPS panels and their features<br><br>Different types of interfaces like HDMI, USB, RGB etc with latest TVs.<br><br>TV Remote Control –Types, parts and functions, IR Code transmitter and IR Code Receiver, Working principle, operation of remote control. Different adjustments, general faults in Remote Control. |
| 22-23 | Implant training / Project work (work in a team) ||
| 24-25 | Revision ||
| 26 | Examination ||

# 1.2 SYLLABUS CONTENT OF CORE SKILLS

**FirstSemester**
**(Semester Code no. ELM - 01)**
**Duration: Six Month**

## LEARNING OBJECTIVES OF 1<sup>ST</sup> SEMESTER

1. Apply basic arithmetic to derive value of unknown quantity / variable.
2. Understand & apply engineering material, their classification, properties and applications in the day to day technical application.
3. Explain & apply speed, velocity, work, power & energy for application in field of work.
4. Understand & explain importance of engineering drawing, drawing instruments, their standard & uses.
5. Draw lines, geometrical figures, free hand sketches.
6. Understand and apply sizes & layout of drawing sheet, method of presentation of engineering drawing & symbolic representation as per BIS standards

| Sl. No. | Professional Knowledge | Professional Knowledge & Skills |
|---|---|---|
| | **Workshop Calculation and Science** | **Engineering Drawing** |
| 1. | **Unit**: Systems of unit- FPS, CGS, MKS/SI unit, unit of length, Mass and time, Conversion of units | Engineering Drawing: Introduction and its importance<br><br>- Relationship to other technical drawing types<br>- Conventions<br>- Viewing of engineering drawing sheets.<br>- Method of Folding of printed Drawing Sheet as per BIS SP:46-2003 |
| 2. | **Fractions** : Fractions, Decimal fraction, L.C.M., H.C.F., Multiplication and Division of Fractions and Decimals, conversion of Fraction to Decimal and vice versa. Simple problems using Scientific Calculator. | Drawing Instruments : their Standard and uses<br>- Drawing board, T-Square, Drafter (Drafting M/c), Set Squares, Protractor, Drawing Instrument Box (Compass, Dividers, Scale, Diagonal Scales etc.), Pencils of different Grades, Drawing pins / Clips. |
| 3. | **Square Root** : Square and Square Root, method of finding out square roots, Simple problem using calculator. | Lines :<br>- Definition, types and applications in Drawing as per BIS SP:46-2003<br>- Classification of lines (Hidden, centre, construction, Extension, Dimension, Section)<br>- Drawing lines of given length (Straight, curved)<br>- Drawing of parallel lines, perpendicular line<br>- Methods of Division of line segment |
| 4. | **Ratio &Proportion** : Simple calculation on related problems. | Drawing of Geometrical Figures: Definition, nomenclature and practice of<br>- Angle: Measurement and its types, method of bisecting.<br>- Triangle -different types<br>- Rectangle, Square, Rhombus, Parallelogram. |

| | | - Circle and its elements. |
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| 5. | **Percentage**: Introduction, Simple calculation. Changing percentage to decimal and fraction and vice-versa. | Lettering and Numbering as per BIS SP46-2003:<br><br>- Single Stroke, Double Stroke, inclined, Upper case and Lower case. |
| 6. | **Material Science** : properties -Physical & Mechanical, Types –Ferrous & Non-Ferrous, difference between Ferrous and Non-Ferrous metals, introduction of Iron, Cast Iron, Wrought Iron, Steel, difference between Iron and Steel, Alloy steel, carbon steel, stainless steel, Non-Ferrous metals, Non-Ferrous Alloys. | Dimensioning:<br><br>- Definition, types and methods of dimensioning (functional, non-functional and auxiliary)<br>- Types of arrowhead<br>- Leader Line with text |
| 7. | **Mass, Weight and Density** : Mass, Unit of Mass, Weight, difference between mass and weight, Density, unit of density, specific gravity of metals. | Free hand drawing of<br><br>- Lines, polygons, ellipse, etc.<br>- geometrical figures and blocks with dimension<br>- Transferring measurement from the given object to the free hand sketches. |
| 8. | **Speed and Velocity**: Rest and motion, speed, velocity, difference between speed and velocity, acceleration, retardation, equations of motions, simple related problems. | Sizes and Layout of Drawing Sheets<br><br>- Basic principle of Sheet Size<br>- Designation of sizes<br>- Selection of sizes<br>- Title Block, its position and content<br>- Borders and Frames (Orientation marks and graduations)<br>- Grid Reference<br>- Item Reference on Drawing Sheet (Item List) |
| 9. | **Work, Power and Energy**: work, unit of work, power, unit of power, Horse power of engines, mechanical efficiency, energy, use of energy, potential and kinetic energy, examples of potential energy and kinetic energy. | Method of presentation of Engineering Drawing<br><br>- Pictorial View<br>- Orthogonal View<br>- Isometric view |
| 10. | ----- | Symbolic Representation (as per BIS SP:46-2003) of :<br>- Fastener (Rivets, Bolts and Nuts)<br>- Bars and profile sections<br>- Weld, brazed and soldered joints.<br>- Electrical and electronics element<br>- Piping joints and fittings |

**Duration: Six Month**

# LEARNING OBJECTIVES OF 2<sup>ND</sup> SEMESTER

1. Demonstrate basic algebraic, mensuration, trigonometric facts and formulas to derive value of unknown quantity / variable.
2. Apply the factual knowledge of basic heat & temperature, basic electricity for day to day practical application.
3. Explain & apply principles of simple machine & levers for mechanical advantage, efficiency for practical application.
4. Draw & practice dimensioning, construction of solid figures and projections as per IS specifications.

| Sl. No. | Professional Knowledge | Professional Knowledge & Skills |
|---|---|---|
| | **Workshop Calculation and Science** | **Engineering Drawing** |
| 1. | **Algebra** : Addition, Subtraction, Multiplication, Division, Algebraic formula, Linear equations (with two variables). | Construction of Scales and diagonal scale |
| 2. | **Mensuration :** Area and perimeter of square, rectangle, parallelogram, triangle, circle, semi circle, Volume of solids – cube, cuboid, cylinder and Sphere. Surface area of solids – cube, cuboid, cylinder and Sphere. | Practice of Lettering and Title Block |
| 3. | **Trigonometry:** Trigonometrical ratios, measurement of angles. Trigonometric tables | Dimensioning practice: - Position of dimensioning (unidirectional, aligned, oblique as per BIS SP:46-2003) - Symbols preceding the value of dimension and dimensional tolerance. - Text of dimension of repeated features, equidistance elements, circumferential objects. |
| 4. | **Heat &Temperature**: Heat and temperature, their units, difference between heat and temperature, boiling point, melting point, scale of temperature, relation between different scale of temperature, Thermometer, pyrometer, transmission of heat, conduction, convection, radiation. | Construction of Geometrical Drawing Figures: - Different Polygons and their values of included angles. Inscribed and Circumscribed polygons. - Conic Sections (Ellipse & Parabola) |

| 5. | **Basic Electricity**: Introduction, use of electricity, how electricity is produced, Types of current_ AC, DC, their comparison, voltage, resistance, their units. Conductor, insulator, Types of connections – series, parallel, electric power, Horse power, energy, unit of electrical energy | Drawing of Solid figures (Cube, Cuboids, Cone, Prism, Pyramid, Frustum of Cone and Pyramid.) with dimensions. |
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| 6. | **Levers and Simple Machines:** levers and its types. Simple Machines, Effort and Load, Mechanical Advantage, Velocity Ratio, Efficiency of machine, Relationship between Efficiency, velocity ratio and Mechanical Advantage. | Free Hand sketch of hand tools and measuring tools used in respective trades. |
| 7. | ----- | Projections: - Concept of axes plane and quadrant. - Orthographic projections - Method of first angle and third angle projections (definition and difference) - Symbol of 1st angle and 3rd angle projection as per IS specification |
| 8. | ----- | Drawing of Orthographic projection from isometric/3D view of blocks |
| 9. | ----- | Orthographic Drawing of simple fastener (Rivet, Bolts, Nuts & Screw) |
| 10. | ----- | Drawing details of two simple mating blocks and assembled view. |

**LEARNING OBJECTIVES OF 3<sup>rd</sup> SEMESTER**

1. The trainee will acquire the knowledge, explain and apply the basic terms and law related with elasticity & materials, magnetism, pressure and heat treatment process.

2. The trainee will able to explain and solve the problem related to Laws of indices & Quadratic Equation.

3. The trainee will acquire knowledge of electronic circuits, symbols and block diagram of CRO, Micro controller AM/FM receiver, function generator and front panel controls of electronic equipments

| Sl. No. | **Professional Knowledge** | **Professional Knowledge & Skills** |
|---|---|---|
| | **Workshop Calculation and Science** | **Engineering Drawing** |
| 1. | **Elasticity:** Stress, strain, Modulus of elasticity, elastic limit, Hooks law, young's modulus. | **CRO: -** <br><br> Block diagram of Cathode Ray Oscilloscope (CRO). <br><br> Block diagram of Digital storage Oscilloscope (DSO). <br><br> Front panel view of CRO & DSO. |
| 2. | **Material:** Introduction, types and properties. Uses of Conducting, Semi-conducting and insulating materials. | **Surface Mounting devices (SMD):-** <br> Front panel view of SMD station. <br> IC package of SMD. |
| 3. | **Magnetism:** Magnetic material, magnetic field, flux density, magnetic moment, m.m.f. Reluctance, permeability, susceptibility, electromagnet, solenoid and its practical applications. | **Electrical Protective Devices:-** <br><br> Symbol of MCB (Miniature Circuit Breaker), ELCB (Earth Leakage Circuit Breaker), DOL starter, Relays. |
| 4. | **Pressure:-** Pneumatic pressure, PSI, bar, atmospheric pressure, pressure gauge and absolute pressure, Heat treatment process. | **Microcontroller:-** <br> Block diagram of 8051. <br> Pin configuration of 8051. |
| 5. | **Indices:** Laws of indices related problems. <br><br> **Quadratic Equation:** Introduction, solution of simple Quadratic equation and related problems. | **Modulation: -** Block diagram of super Heterodyne Radio Receiver. <br> Block diagram of AM and FM receiver. |
| 6. | Solution of simple A.C. circuit with R.L.C. Calculation of power factor etc. | **Power supply:** Block diagram of SMPS. <br> Block diagram of UPS-ONLINE, OFFLINE, LINE INTERACTING. |
| 7. | **A.C Waveform Calculation:** Calculation of r.m.s, average, instantaneous value, peak value. Peak to peak value, Frequency | ----- |

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| | and wavelength calculation and their relationship | |
| 8. | **Series And Parallel Connection of Electrical and Electronic components:** 1. Calculation Series and parallel connection of Resistors. 2. Calculation Series and parallel connection of Capacitors. 3. Calculation Series and parallel connection of Inductors. 4. Calculation Series and parallel connection of Batteries. Conversion of power flow to H.P. Calculation of KVA. | ----- |

# Fourth Semester
## (Semester Code no. ELM - 04)
## Duration: Six Month

## LEARNING OBJECTIVES OF 4<sup>th</sup> SEMESTER

1. The trainee will acquire the knowledge friction, forceand centre of gravity and their related terms for application in the practical field.
2. Able to explain and apply different types of Number system & conversions.
3. The trainee will acquire the knowledge of calculation on estimation and costing for requirement of materialsin the field.
4. The trainee will acquire the knowledge of symbols of electronic components , Block diagram of DTH, Cell phone, SMPS and circuit diagram of projects

| Sl. No. | Professional Knowledge | Professional Knowledge & Skills |
|---|---|---|
| | **Workshop Calculation and Science** | **Engineering Drawing** |
| 1. | **Power supply:** Calculation of SMPS, regulation, Calculation of load and wattage for selection of UPS, calculate of back up time of Battery related to UPS and Load, calculate of voltage regulation , firing angle calculation of ripple factor, voltage regulation of DC voltage. Calculate the regulation of solar power. | **Symbol of electronic component:-**<br><br>A. Thermocouple<br>B. Strain Gauge<br>C. LVDT(Linear variable differential transformer)<br>D. Proximity Sensor |
| 2. | **Motor parameters & Calculation:** Speed and frequency calculationof A.Cmotors**,** D.C motors. | **DTH system:-**<br>Block diagram connections of Home system. Direct To Home (DTH). |
| 3. | **Modulation:** AM/FM modulation index calculation, calculation of Bandwidth, Percentage of modulation in FM/AM. | **Cell Phone:-**<br>Block diagram of cell phone receiver system. |
| 4. | **Number Systems:** Introduction, Decimal, Binary, Octal, Hexadecimal, BCD code, ASCII code, Bit, Byte, KB, MB, GB, Conversion, Addition, Subtraction, Multiplication, Division, 1<sup>st</sup> and 2s complement method, 9s and 10s complement method. | **Generator:-**<br>Front panel control for function Generator. |
| 5. | **Boolean Algebra:** Simplification of Boolean Algebra equations. | **Project related Drawings:-**<br><br>A. Dancing LED's<br>B. Smoke detector<br>C. Mobile charger<br>D. Metal detector |
| 6. | **Project costing:** Project selection, cost of project, Simple estimation, simple | |

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| | problems on profit and loss , Balance sheet etc. | |
| 7. | Power transmission by shaft, belts and ropes. | |
| 8. | **Friction:** Law of friction, co-efficient of friction, angle of friction, advantage and disadvantage of friction. | |
| 9. | **Force:** Resolution and Composition of forces. Representation of forces by vectors, simple problems on lifting tackles like Jib wall, crane solution of problems with the aid of vectors, General condition of equilibrium for series of forces on a body. | |
| 10. | **Gravity:** Centre of Gravity, simple experiments stable, unstable and neutral equilibrium. | |