MAHARASHTRA STATE BOARD OF VOCATIONAL EDUCATION EXAMINATION, MUMBAI - 51

<table>
<tr><td>1</td><td>Name of Course</td><td>C.C. in Automation & PLC
(301126)</td></tr>
<tr><td>2</td><td>Max.Nos. of Student</td><td>25 Students</td></tr>
<tr><td>3</td><td>Duration</td><td>6 Months</td></tr>
<tr><td>4</td><td>Type</td><td>Full Time</td></tr>
<tr><td>5</td><td>Nos Of Days / Week</td><td>6 Days</td></tr>
<tr><td>6</td><td>Nos Of Hours /Days</td><td>7 Hrs</td></tr>
<tr><td>7</td><td>Space Required</td><td>Laboratory = 1000 Sq feet
Class Room = 200 Sq feet
TOTAL = 1200 Sq feet</td></tr>
<tr><td>8</td><td>Entry Qualification</td><td>S.S.C. + Any Course in Electronics Group of MSBVE</td></tr>
<tr><td>9</td><td>Objective Of Syllabus/ introduction</td><td>Awareness of Safety precautions
Knowledge of Engineering skill, use of tools in assembly
Awareness of PLC.
Awareness of PLC Programming.
Awareness of AC/DC motor Control.
Awareness of Instrumentation.
Awareness of Pneumatics & Hydraulics.</td></tr>
<tr><td>10</td><td>Employment Opportunity</td><td>The trainee will either to be able to take up jobs with agencies which Develop, Maintain, Repair Automation & PLC. Work as or with working experience will be in a position to start his own independent Business.</td></tr>
<tr><td>11</td><td>Teacher’s Qualification</td><td>Diploma in Electronics, Mechanical & Instrumentation Engg. With 3 year Teaching experience in Automation & PLC.</td></tr>
<tr><td>12</td><td>Training System</td><td>Training System Per Week
<table><tr><th>Theory</th><th>Practical</th><th>Total</th></tr><tr><td>12 Hours</td><td>30 Hours</td><td>42 Hours</td></tr></table></td></tr>
<tr><td>13</td><td>Exam. System</td><td><table><tr><th>Sr. No.</th><th>Paper Code</th><th>Name of Subject</th><th>TH/PR</th><th>Hours</th><th>Max. Marks</th><th>Min. Marks</th></tr><tr><td>1</td><td>30312611</td><td>Automation & PLC</td><td>TH-I</td><td>3 hrs</td><td>100</td><td>35</td></tr><tr><td>2</td><td>30312621</td><td>Electronics & Process Instrumentation in Automation.</td><td>PR-I</td><td>3 hrs</td><td>100</td><td>50</td></tr><tr><td>3</td><td>30312622</td><td>Automation & PLC</td><td>PR-II</td><td>6 hrs</td><td>200</td><td>100</td></tr><tr><td></td><td></td><td>TOTAL</td><td></td><td></td><td>400</td><td>185</td></tr></table></td></tr>
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SYLLABUS

Automation & PLC

Practical – II	Theory - I
Demonstration of care and safe working habits, first aid, treatment of electrical sock Lab demo of . tools and measuring & test instruments related to the trade	Safety precaution to be observed in the trade during training hours. Electrical safety. Elementary first aid. Earthing- types and importance. ISI rule on earthing. Fuses and its type. Use of personal protective equipment from electrical safety point of view. Identification, specification, uses and maintenance of hand tools and measuring & test instruments Revision of electrical fundamentals, Ohm's law, semiconductor theory, diode and transistor characteristics
• Verification of network theorem • Study of RLC circuits • Determination of Q factor of a coil	Circuit theory: Kirchhop's law, superposition theorem, Thevenin & Norton's theory, Star Delta transformation, maximum power transfer theorem (detailed mathematical treatment not required) Series & parallel AC circuits, AC through R,L,C, RC,RL,RLC network, resonance, Q factor of a coil.
Demonstration of conventional methods of DC motor speed control	DC motors- principle, types and characteristics Speed control methods of DC motors - Armature voltage control and Field voltage control. Motor starter circuits. AC Motors -Principle of operation. of 1 phase & 3 phase AC induction motors, types and their characteristics. Starting & Running of AC motors using starters. Reversing of motors. Synchronous Motors- characteristics and their applications. Electrical Breaking and its types mechanical brakings, Plugging, Rheostatic breaking, Regenerative braking etc.
Demonstration of conventional methods of AC motor speed control	Synchronous Motor and their applications. Electrical Braking and its types - Mechanical braking, Plugging, Rheostatic braking, Regenerative braking etc.

Demonstration of physical systems - mechanical, fluid and thermal.	Introduction to control system, basic concept of control, Open loop and close loop control system with examples, concept of linear and non-linear system. Definition of a physical system- mechanical , electrical , fluid and thermal system with examples (i.e. dash-pot, electrical motor, tank level and flow control, water heating system etc.) Elementary idea of transfer function, transfer function of above systems. Block diagram representation of above systems.
Demonstration of control system components like servo motors, encoders, tacho-genertaors, stepper motors and synchros, flapper nozzle system	Control system components - Feedback control system and controllers. Principle of working , transfer function and application of following components : D.C. servo motor , A.C. servo motor , D.C. and A.C. Tacho-generators, synchros, stepper motor, rotary encoders, servo mechanism, flapper nozzle system. (Detail mathematical treatment not required.)
Use of signal and function generators Observation of output waveform of response of simple electrical system after applying test signals. Study of flapper nozzle system.	Time domain analysis of a system :Standard test signals used , concept of impulse response , response of first and second order system to step input (steady state and transient response) , steady state error and error , concepts of stability. Concepts of process characteristics- lag, time delay, dead zone etc.
• Demonstration of modulations and demodulation on training kits. • Demonstration of pulse modulation	Introduction to communication system_and its importance. Analog communicati on ^fundamentals, modulation and demodulation techniques, basic concepts of AM,.FM, and PM and its applications. Electromagnetic waves, frequency ranges, speed of transmission, band-width, antena. Digital communicationj_principles of digital communication, different types of pulse modulations : PCM, FSK,PSK,ASK etc, multiplexing. ıple concepts of communication (block diagram only): Telephone (fixed and mobile), radio, microwave and LASER, DA and PA system.

• Demo of fibre optic system. • Demonstration of serial & parallel Communication techniques.	Fibre optical communication - principles, methods and application. Satellite communication- methods and applications. Data communication: Simplex and duplex modes, serial & parallel communication, modems Serial communication standards : RS-232, RS-422, RS-485 standards. Networking principles and topology, Local area network standards
• Observation of different types of power electronic components • Thyristor characteristics. • Firing of thyristor : resistance, RC, UJT & logic gates • Commutation of thyristor : natural, line and forced. • Checking of power MOSFET, thyristors, IGBT, GTO, IGCT	Power electronics introduction to power electronic devices: Thyristor, its construction, characteristics and family (DIAC, TRIAC, SBS, SUS) Turn "ON" & turn "OFF" behavior of thyristor. Firing & commutation circuits, role of snubber circuit. Rating & protection of thyristor. Power diodes and power BJT, power MOSFET, IGBT, GTO, IGCT and their application
Study of converter : half wave, full wave, half wave controlled, Chopper, Inverter.	Thyristor circuits : a) Converter b) Regulator (AC) c) Chopper d) Inverter e) IGBT circuit, its use in converter, inverter and UPS
• Understanding parameters of DC drives • Checking of firing pulses in a digital drive	Electric Drive : Classification of load and motor according to their speed/torque characteristics and drive performance characteristics. Behavior of drive system during change of state. Modern drive system : concept of open & closed loop system DC drive : single & four quadrant control.
• Understanding parameters of AC drives • Checking of firing pulses in a digital drive • Understanding of UPS working	AC drive : stator V/f, rotor resistance & voltage. Basic concepts of digital drives. Understanding of float charger, off-line UPS and On-line redundant UPS, circuit and maintenance of UPS.

• Identify simple components such as reservoir, filter pumps, valves, actuators etc. • Operation of proportional and servo valves, functions of control and feedback components	Fluid power : Basic principles of hydraulic and pneumatics, characteristic of fluid media Operational details of fluid power control element. (Constructional details not required) Energy converter, Fluid conditioner, Control valves Symbols of basic hydraulic and pneumatic components. Basics of proportional and servo valves, its electrical and electronic circuitry, control and feedback systems
• Simulation of simple hydraulic circuits. • Simulation of simple pneumatic circuits	Concepts of interfacing of hydraulic & pneumatic components with controllers Hydraulic and pneumatic circuits, reading and interpretation. Specifications of components and safety Aspects
Process control • Operation of a controller, setting of its PID values, controller tuning. • Fault finding and trouble shooting exercises on simulators.	Process control automation Introduction to process control, process variables, manual & automatic control system close loop & open loop process control systems, process disturbances, process dynamics. P, D & I control modes. Tuning of a controller.
Overhauling and calibration of control valves, valve positioners and I/P converters.	Final control elements: I/P converters: types, working principle, construction, calibration and maintenance. Control valves & actuators : types, working principle, construction, characteristic, calibration and maintenance. Selection and sizing of a control valve. Valve positioner: : types, working principle, construction, calibration and maintenance
• Familiarization with different I/O modules of PLC. • Development of simple programmes involving bit level instructions, timers and counters, simple • Data manipulation instructions.	Introduction to PLC, its hard ware details. Function and working of different cards. Program techniques of PLC, inputs, outputs, timer and counter instructions, data manipulation. Development of simple programs Documentation, different functional blocks & mathematical
• Feeding and running the programmes in PLC, I/O forcing • Documentation and editing of programmes. • Simple fault finding and trouble shooting	DCS: basic concepts, advantages. Architecture of typical DCS, function of different nodes and modules, Programming concepts, applications. Industrial weighing system-components and applications. Static and dynamic weighing systems.

• Demonstration of SCADA system, communication system used in networking of PLC. • Reading & interpretation of P& I diagrams. • Exercise on instrument fault finding and trouble shooting.	DAS and SCADA, Introduction to MMI packages, applications. Reading and interpretation of PI diagrams, instrument manuals and part list, panel wiring diagram etc. Instrument cabling, relays, terminals, fuse terminals, junction boxes, MCBs, cable gland, pipe and its colour code, air filter regulators. Basic concepts of FIELDBUS, its types and applications area.. Earthing and grounding of instruments and its importance.
Plant visits	Industrial control application: Cement plant- Process overview, major units, automation strategies, mill automation, kiln automation, dispatch automation, levels of automation, case studies of automation used in major cement plants. Thermal power plants-process overview, major units and process variable, automation strategies, boiler control and automation, turbine control and automation, fuel and its control, levels of automation, case studies.
Plant visits	Steel plants- Different zones - iron, steel and mills, process overview of different zones and its control, case studies. Process and automation system used in industries located near the institute may also be covered.
	Project, Revision & Examination

Electronics & Process Instrumentation in Automation

Practical – I
Measurement of voltage, current, power and energy in the given simple circuit. • Identify and measure voltage of dry battery and cells using Multimeter. • Measure DC quantity & sinewave parameters using oscilloscope.
Identify and read values using colour code wherever applicable, draw symbols and test the various passive components using appropriate meters / instruments. • Identify, draw symbols and test the various passive components using analog and digital multimeters. Verifythe condition of the passive components using Component tester of C.R.O
Characteristics of PN junction diode • Construction & testing of half wave / full wave rectifiers • Characteristics of zener diode • Zener diode as voltage regulator • Clamping and clipping circuits using diode

Assemble, Test and calculate voltage gain, power gain, input/ output impedance and phase relationship of a common emitter and common base amplifier. • Construct and test a RC coupled amplifier and an emitter follower and verify gain. • Testing & Verification of the Characteristics of SCR, DIAC, TRIAC, UJT
Measure offset voltage of OP- AMP 741. • Construct and test the Inverting & Non Inverting Amplifier, Differentiator, Integrator, etc. • Construct and test the voltage comparator using OP-AMP. • Construct and observe & interpret the waveforms on CRO for the phase shift oscillator . • Test the monostable / astable multivibrator circuits of 555 timer IC.
Assemble & test a transistor series and shunt regulator. Assemble and test a + ve / -ve regulator using three pin regulator IC's. • Assemble and test a regulator using op-amp.
Assemble & Verify the truth table of the basic logic (AND, OR, NOT) circuits using TTL 7400series IC's • Flip flops – RS, D, JK flip flops. • Construct & test up/down counters using flip- flops.
Interpreting the microprocessor IC number, package, pin details. • Interpreting the supporting IC's for Microprocessor based system using Trainer kit • Operating procedure and basic commands of 8085 - 8 bit microprocessor trainer kit • Practice on simple Assembly language programming • Demonstration on interfacing of Switches, thermocouple & flow meter, LED's, Relays, Stepper Motor, DC Motor, etc., Calculate span, range for various measurement systems in 0% to 100% • Calculate the accuracy and error in percentage & engineering units of various process measuring instruments
Calculate and list the derived units from fundamental units and its dimension • Calculate conversion of unit from English to SI. • Discuss and List the prefix values and its symbols and equivalent of decimal multiples and submultiples
Construct and testing Wheatstone bridge / Kelvin bridge • Construct & testing of Wein bridge • Calculation of resistance voltage and current using voltage divider and current divider method
Identifying the C-type bourdon tube, link, lever, gear and teeth of pressure gauge and its adjustments screws. • Testing LVDT circuit, record the results and draw a graph for linear region. • Measurement and record the output values of RTD & Thermocouple. • Testing of optical detector circuit (photo diode, photo transistor, photo resistor, photovoltaic cell) and record the results. • Measurement of speed using tachogenerator
Testing cantilever type bonded strain gauge, adjusting offset, record readings and results. • Testing Voltage to Current (V to I) and I to V converter circuits using instrumentation amplifier IC's OP07, OP82 and adjust signal ranges with reference to the industrial standard signals
Testing optical encoder circuit and measurement of pulses through oscilloscope

Demonstrate the operation of components requirement for feedback closed loop control and tuning of a feedback control loop. • Draw / practice freehand sketches of process using appropriate control symbols • Configure and calibrate a single loop digital controller • Testing of input signals and power supply terminals of controller.
Demonstration on PC based measurement using data acquisition hardware module & data acquisition software • Demonstration on interface programmable test & measuring instrument to PC through RS232, USB, or GPIB standard interface and its configuration. • Testing & preparing serial interface cables and D-type connectors of different pin configuration.

Suggested List of Equipments / Instruments / Machines

Item / Specification	Quantity
1. Connecting screwdriver 100 mm	10
2. Neon tester 500 V.	10
3. Screw driver set (set of 5 bits)	10
4. Insulated combination pliers 150 mm	10
5. Long nose pliers 150 mm	10
6. Soldering iron 25 W. 240 V	10
7. Electrician knife D.B.	10
8. Digital multimeter portable	8
9. Function generator	2
10. Signal generator	2
11. Insulated side cutting pliers 150 mm	10
12. First aid kit	01
13. Digital Multimeter	08
14. 30-0-30 V, 2 Amps DC regulated power supply	08
15. 0-300 V, 500 mA, DC regulated power supply	02
16. LCR Bridge (Digital)	01
17. Digital storage Oscilloscope, 100 MHz, with probe	02
18. Analog communication training kits	04
19. Digital communication training kits	04

20. Fibre optics training kits	02
21. Serial communication training kits	04
22. LAN trainers	02
23. Power electronics training kit	08
24. DC Drive with motor and braking arrangement	02
25. AC Drive with motor and braking arrangement	02
26. IGBT trainers	02
27. Proportional Hydraulic trainer	02

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