

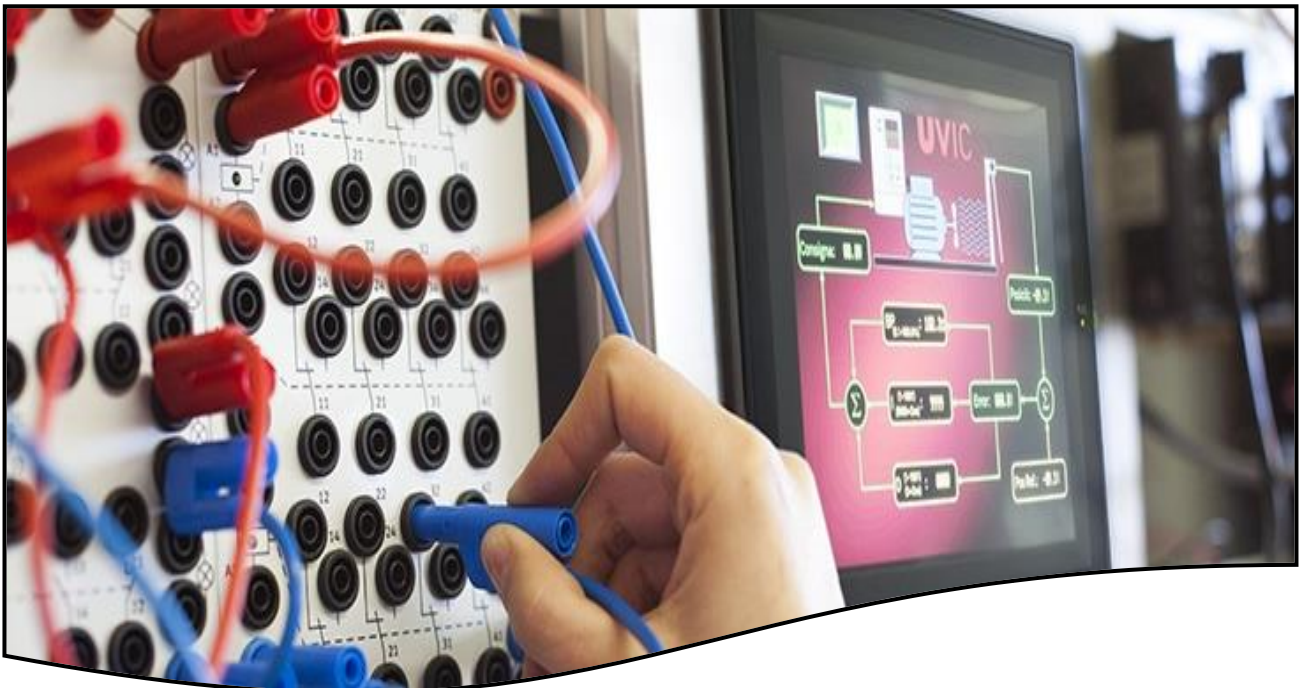


GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT & ENTREPRENEURSHIP
DIRECTORATE GENERAL OF TRAINING

COMPETENCY BASED CURRICULUM

Advance Diploma

INDUSTRIAL ELECTRONICS & AUTOMATION



Sector- Electronics & Hardware

Advance Diploma

INDUSTRIAL ELECTRONICS & AUTOMATION



NSQF LEVEL – 6

Skill India

Qualification Code: **DGT/5003**

कौशल भारत - कुशल भारत

Developed By

Ministry of Skill Development and Entrepreneurship
Directorate General of Training
CENTRAL STAFF TRAINING AND RESEARCH INSTITUTE
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1. COURSE INFORMATION

Introduction:

The Directorate General of Training (DGT) is an apex organization under Ministry of Skill Development and Entrepreneurship, Govt. of India for the development and coordination of the vocational training in our country. The DGT conducts the vocational training programmes through the Craftsmen Training Scheme (CTS), Apprenticeship Training Scheme (ATS), Modular Employable Scheme (MES) under the Skill Development Initiative (SDI) Scheme and Craftsmen Instructor Training Scheme (CITS) to cater the needs of different segments of the Labour market. The National Council for Vocational Training (NCVT) acts as a central agency to advise Government of India in framing the training policy and coordinating vocational training throughout India. The day-to-day administration of the ITIs rests with the State Governments/ Union Territories.

Issues Related to Vocational Training:

Key workforce related issues observed from demand perspective have typically been the following:

- Low employability due to low level of technical competency.
- Lack of employee attitude/inclination for career in engineering.
- Skill gap arises when the education and training system is not responsive to the changing needs of the industry requirements.

To address these issues, Ministry has set up Mentor Councils to focus on courses under NCVT in various sectors with representation from different stakeholders viz., industries, innovative entrepreneurs, academic/professional institutions, and champion ITIs for each of the sectors. The Mentor Council for each sector reviews curriculum, course duration, and assessment/evaluation systems for the sector on a continuous basis and make recommendations.

Skill Diploma Initiative:

In addition to that, the Ministry has planned to start Skill Diploma courses to cater the need of demand raised on a comprehensive workforce requirement, under NCVT gamut. The proposed skill diploma holders will be trained more on practical competencies (70% Practical & 30% Theory) rather than more of theoretical knowledge offered in regular Polytechnic/Diploma colleges.

The necessity of Diploma in Industrial Electronics and Automation:

Automation is a key word for any industry and machines/ processes are automated right from raw material management to handling the finished product. Various types of control technologies, state of art equipment both in software and hardware form are used in automating a plant. Several types of equipment of domestic to international standards are part of today's industry.

Industrial electronics and automation are the two key areas in any industry that include oil and natural gas, steel and cement, power, food and beverage, pharmaceutical, Automotive, chemical and fertilizer industries. Electrical machines, Drives, UPS, Solar power, component manufacturing, testing and assembly, embedded controllers, programmable controllers, SCADA/HMI, DCS, Field instrumentation and control, pneumatic and hydraulics, are some of the technical areas dealt in any automated industry.

When we consider the old technology in process industries, it has many disadvantages and it is due to the lack in consistency and repeatability of quality output. Diploma holders (regular) employed in the industrial field have been educated in a variety of disciplines, but rarely in practical and application oriented advanced automation technologies.

Hence the requirement of workforce is always exists in the arena. Service Technicians, programmers, component assembly and testing personnel, installation and commissioning engineers, techno commercial sales cum service technicians, Shop floor Supervisors, Quality Inspectors, are the category of workforces required in Industries.

Benefits:

Industry Advantage:

The Ministry of Skill Development & Entrepreneurship will provide a pool of service technicians to work at shop floor level, supervisors for electronic product manufacturing, trained to international bench mark for industry. This will also enable industry to take challenges in the automated industries.

Career for Professionals:

Automation is a key technology for the manufacturing industries of Electronics & Hardware sector and requires qualified persons with the competencies at various levels of skill and knowledge. The Diploma offers opportunity for upward career progression for the NTC (NCVT) certificate holders. There is enormous scope to obtain domestic and overseas

appointment for diploma holders having practical competencies from the ground level as automation technician, to Shop floor supervisor and Maintenance engineer.

Course Particulars:

In this Diploma in **Industrial Electronics & Automation** the trainee is trained on **Five Core modules** each of 320 hours duration in first year. Each Core module contains professional skill & professional knowledge. In addition to this, the trainee is entrusted with the project work and extracurricular activities to build up confidence. In second year amongst the available electives trainee has to select any of two elective modules, each module containing 320 hours duration with total duration of 640 hours. The trainee will be trained in Industry for 800 hours (as a part of on-the-job training). There will be a common subject for all Diploma courses on **Employability Skills** which will be for 160 hours in second year. The module wise course coverage is categorized as below:-

Core Module 1 (Applied Electronics & Applications): In this module the trainee will learn testing of electronic components, Digital and analog ICs used in various electronic systems. Construct application circuits, test them and analyze for proper performance. Operate, disassemble and assemble various electronic measuring instruments and repair/test the performance. Construct and test simple projects using electronic components and ICs. Draw, analyze and troubleshoot electronic circuits using Electronic simulation software. Troubleshoot Maintain and repair of electronic billing machines and LED lighting systems. Disassemble and assemble of computer hardware modules and interfacing. Install and configure of operating systems and Ethernet communications. Connect various peripherals such as scanner, intelligent UPS, mobile phone etc to transfer data and troubleshoot various defects.

Core Module 2 (Power Electronics & Drives): In this module the trainee will learn testing of power electronics semiconductor devices, construct and troubleshoot DC-DC Converter, PWM Inverter, Multilevel inverters, controlled rectifier, AC Voltage regulators, static switches. Install, Test and Repair the industrial SMPS Power supplies, Inverter and UPS systems. Install and test different functional modules of solar power systems. AC/DC motors identification, test, connect and run in different modes. Wire, Construct and test conventional industrial motor control circuits. Commission and configure of AC and Servo drive for various applications. Fault recognizing through parameter and rectify it.

Core Module 3 (Embedded Controllers And Applications): In this module the trainee will learn to Integrate and Interface various peripherals to a microcontroller system (ATMEGA, ARM Microcontroller based) and to program and troubleshoot the system. Set up an embedded system for the given application, enter the available code and test it for its

functioning. Explore the resources of an embedded controller and enter the given code for different applications. Interfacing I/O ports, serial port, ADC, DAC modules, switches, keyboard, LCD and various sensors and communication modules. Practice entering of simple Programs using C, Embedded C instructions that are useful for project development. Interface and communicate using different bus standards such as UART, I2C, SPI and develop applications for PWM, GSM, GPS, Zigbee etc. Implement Bluetooth technology to communicate with Bluetooth enabled devices.

Core Module 4 (Field Instruments And Controls): In this module the trainee will be able to test, wire and maintain appropriate input primary elements such as sensors, transducers and signal conditioning of related instruments. Calibration, measuring, and maintenance of various types of indicating, recording and transmitting instruments related to process parameters like flow, level, pressure and temperature etc., Operation, and maintenance of various types of field controllers, transmitters, converters and final control devices related to electric, pneumatic and hydraulic media used in process control loops. Practicing on configuration of different control modes: P, PI, PD, & PID etc, based on industrial requirement. Practice and usage of programmable and non-programmable electronic, pneumatic controllers. Troubleshooting of Field instruments.

Core Module 5 (Programmable Logic Controllers And Applications): In this module the trainee will interpret indications on various modules of PLC system. Follow Safety practices of handling. PLC systems. Programming practice for various I/O terminals. Mount different modules of a PLC system onto various types of racks, Wire various field input and output devices to respective I/O modules and test. Install and configure different PLCs of different makes. Monitor and modify the logic to make minor changes in the logic for the purpose of expanding the process and troubleshooting. Read and interpret healthiness/fault indicators provided on various modules. Interface different application models (lift, bottling plant) to PLC and control the different types of processes. Visit various troubleshooting resources provided in the software to diagnose the faults with the PLC system.

Elective Module 1 (Automation Using PLC, SCADA & DCS): In this module the trainee will learn to interconnect PLC systems with different industry standard communication protocols for data transfer. Configure HMI to communicate with PLC to monitor and modify field data. Configure PLC with SCADA to monitor and modify field data and perform data logging, alarm logging, etc., Interface VFD with HMI and PLC on a network to monitor and control various motor parameters. Configure the given DCS system to communicate with a

model process plant in order to perform closed loop control of temperature, pressure, flow and level parameters. Integrate various electro-pneumatic, Electro-hydraulic sensors and actuator elements with PLC and SCADA systems. Set up automation system, modify PLC program and troubleshoot a simple automated production system at module and software levels.

Elective Module 2 (Mechatronics): In this module the trainee will learn at the end of the course the student shall be able to Install, maintain and service pneumatic and electro pneumatic control systems. Test and wire the control devices and proximity sensors used in Pneumatic and electro-pneumatic control system. Construct and test of pneumatic and electro-pneumatic control circuits for manufacturing applications. Troubleshoot and repair of compressor unit, Filter, Regulator, lubricator (FRL) and pipelines. Test and operations of hydraulic power unit. Construct and test hydraulic and electro-hydraulic control circuits for construction and material handling applications. Disassemble and assemble of Mechatronics system as per the drawings.

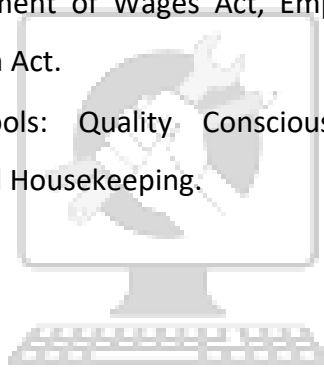
Elective Module 3 (Robotic Control Systems): In this module the trainee will be able to Set up and Test run industrial Robot with the available test program. Identify the different parts of industrial multi-axis robotic system. Program and test of multi-axis robotic control system. Set up precision motion control system. Disassemble and assemble electrical/electronic parts of industrial robotic system. Maintenance of servo motor control circuits. Robotic industrial applications - material handling, processing and dispensing.

On the Job Training: In this module the trainees will be working/training in the Industry for 800 hours. They work as apprentices/Personnel.

Employability Skills: This module is common for all Diploma courses and the total period is 160 hours. In this module the trainees will improve

- English literacy such as Pronunciation, functional grammar, reading, writing, speaking and spoken English
- Learn communication skills, listening skills, motivational training, Facing interviews and behavioural skills.

- Understand concepts of Entrepreneurship, Project preparation and marketing analysis, Institutions support and Investment Procurement.
- Understand on productivity, its benefits, affecting factors, comparison with developed countries, personal finance management.
- Understand Safety, Health and Environment Education - Safety & Health, Occupational Hazards, Accident & safety, First Aid, Basic Provisions, Ecosystem, Pollution, Energy Conservation, Global warming, Ground Water, Environment.
- Understand benefits guaranteed under various acts- Factories Act, Apprenticeship Act, Employees State In
- Insurance Act (ESI), Payment of Wages Act, Employees Provident Fund Act, The Workmen's compensation Act.
- Understand Quality Tools: Quality Consciousness, Quality Circles, Quality Management System, and Housekeeping.



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2. TRAINING SYSTEM

2.1 GENERAL

Directorate General of Training (DGT) under Ministry of Skill Development & Entrepreneurship offers a range of Vocational Training courses catering to the need of different sectors of economy/ Labour market. The Vocational Training Programmes are delivered under aegis of National Council of Vocational Training (NCVT). Craftsman Training Scheme (CTS) and Apprenticeship Training Scheme (ATS) are two pioneer programmes of NCVT for propagating vocational training. Recently DGT has started Technical Diplomas for different streams and primarily implemented at DGT field institutes such as NSTIs, FTIs and AHI and planned to expand to State Directorates in future.

Industrial Electronics & Automation course is very much essential in the current scenario due to a lot of demand in software industries where every industry is using cloud as base. The course is for two years duration. In the first year there are five core modules each module is credit based and employable. Each module is of 320 hours and is independent. In second year the trainee will be taking two elective modules out of three electives each of 320 hours and will be doing on the job training in Industry for 800 hours. In addition the trainees will pick up employability skills for 160 hours. After passing out the training programme, the trainee will be awarded Technical Diploma by NCVT which has worldwide recognition.

Candidates need broadly to demonstrate that they are able to:

- Read and interpret technical parameters/ documents, plan and organize work processes, identify necessary materials and tools;
- Perform task with due consideration to safety rules, accident prevention regulations and environmental protection stipulations;
- Apply professional skill, knowledge & employability skills while performing jobs.
- Document the technical parameters related to the task undertaken.

2.2 CAREER PROGRESSION PATHWAYS

- Can pursue higher technical education like BE/B. Tech.
- Can start their own enterprise on the concerned trade.

2.3 COURSE STRUCTURE

Table below depicts the distribution of training hours across various course elements during a period of two years: -

S No.	Module	Course Element	Notional Training Hours
1.	For five Core Modules	Professional Skill (Trade Practical)	1120
		Professional Knowledge (Trade Theory)	480
2.	For two Elective Module	Professional Skill (Trade Practical)	448
		Professional Knowledge (Trade Theory)	192
3.	Employability Skills		160
4.	On the job training		800
5.	Total		3200*
6.	Project Work for each Module (40 Hours x 5 Modules) <i>Note : For Elective modules in second year work included in the Instructional hours.</i>		280
7.	Revision (80Hours x 7 Modules)		560
8.	Theory & Practical Examination of 7 Modules + Employability Skills + On the Job Training		120
	Grand Total		4160

*** Core Components (3200hrs):-**

Name		Teaching Hours		Total Hours
Core Subjects (All Compulsory)		Practical	Theory	
1.	Applied Electronics & Applications	224	96	1600
2.	Power Electronics and Drives	224	96	
3.	Embedded Controllers and Applications	224	96	
4.	Field Instruments and Controls	224	96	
5.	Programmable Logic Controllers and Applications	224	96	
Elective Subjects (any two)				
6.	Automation Using PLC, SCADA & DCS	224	96	640
7.	Mechatronics	224	96	
8.	Robotic Control Systems	224	96	
Industrial Training				
9.	On the Job Training	800		800
Common Subjects				
10.	Employability Skills	160		160
Total Hours of Training				3200

- Note :*
1. The trainee must complete all the 5 core modules
 2. The trainee must select any of two elective courses from the given three elective options

2.4 ASSESSMENT & CERTIFICATION

The trainee will be tested for his skill, knowledge and attitude during the period of course at each module and at the end of the training programme as notified by Govt of India from time to time.

- a) The **Internal assessment** during the period of training will be done by **Formative assessment method** by testing for assessment criteria listed against learning outcomes. The training institute have to maintain individual *trainee portfolio* as detailed in assessment guideline. The marks of internal assessment will be as per the template (Annexure – I).
- b) The final assessment will be in the form of **summative assessment** method. The All India Trade Test for awarding Technical Diploma will be conducted by NCVT at the end of each Module/year as per guideline of Govt of India. The pattern and marking structure is being notified by govt of India from time to time. **The learning outcome and assessment criteria will be basis for setting question papers for final assessment. The examiner during final examination will also check** individual trainee's profile as detailed in assessment guideline before giving marks for practical examination.

2.4.1 PASS REGULATION

The minimum pass percent for Practical is 60% & minimum pass percent for Theory subjects is 40%.

2.4.2 ASSESSMENT GUIDELINE

Appropriate arrangements should be made to ensure that there will be no artificial barriers to assessment. The nature of special needs should be taken into account while undertaking assessment. Due consideration should be given while assessing for team work, avoidance/reduction of scrap/wastage and disposal of scarp/wastage as per procedure, behavioral attitude, sensitivity to environment and regularity in training. The sensitivity towards OSHE and self-learning attitude are to be considered while assessing competency.

Assessment will be evidence based comprising the following:

- Job carried out in labs/workshop
- Record book/ daily diary
- Answer sheet of assessment
- Viva-voce
- Progress chart
- Attendance and punctuality
- Assignment
- Project work

Evidences of internal assessments are to be preserved until forthcoming semester examination for audit and verification by examination body. The following marking pattern to be adopted while assessing:

Performance Level	Evidence
(a) Weightage in the range of 60 -75% to be allotted during assessment	
For performance in this grade, the candidate with occasional guidance and showing due regard for safety procedures and practices, has produced work which demonstrates attainment of an acceptable standard of craftsmanship.	<ul style="list-style-type: none"> • Demonstration of good skill in the use of hand tools, machine tools and workshop equipment • 60-70% accuracy achieved while undertaking different work with those demanded by the component/job. • A fairly good level of neatness and consistency in the finish • Occasional support in completing the project/job.
(b)Weightage in the range of above 75% - 90% to be allotted during assessment	
For this grade, the candidate, with little guidance and showing due regard for safety procedures and practices, has produced work which demonstrates attainment of a reasonable standard of craftsmanship.	<ul style="list-style-type: none"> • Good skill levels in the use of hand tools, machine tools and workshop equipment • 70-80% accuracy achieved while undertaking different work with those demanded by the component/job. • A good level of neatness and consistency in the finish • Little support in completing the project/job
(c) Weightage in the range of above 90% to be allotted during assessment	

For performance in this grade, the candidate, with minimal or no support in organization and execution and with due regard for safety procedures and practices, has produced work which demonstrates attainment of a high standard of craftsmanship.

- High skill levels in the use of hand tools, machine tools and workshop equipment
- Above 80% accuracy achieved while undertaking different work with those demanded by the component/job.
- A high level of neatness and consistency in the finish.
- Minimal or no support in completing the project.



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3. JOB ROLE

Brief description of Job roles:

Industrial Electronics and Automation technician repairs electronic equipment, such as power supplies, Multimeters, UPS, Solar power systems, electronic billing machines. Perform Installation and commissioning of PLC Systems, AC drives, SCADA and HMI Systems. Perform field wiring of process instruments and troubleshoot for proper functioning. Work with systems and devices designed with microcontrollers on various industry communication protocols.

Wire various industrial controls, transmitters, and control systems following blueprints and manufacturer's specifications and using hand tools and test instruments. Tests faulty equipment and applies knowledge of functional operation of electronic units and systems to diagnose cause of malfunction. Tests electronic components and circuits to locate defects, using instruments, such as oscilloscopes, signal generators, ammeters and voltmeters. Replaces defective components and wiring and adjusts mechanical parts, using hand tools and soldering iron. Aligns, adjusts and calibrates testing instruments. Maintains records of repairs, calibrations and test. May install equipment in industrial or military establishments.

Follow the Safety precautions to be taken while working on the automated machines and process plant equipments. Perform testing by observing Quality checks to be followed. Ensures routine maintenance of process control equipment and follow maintenance schedules of the concerned equipment.

Operate and control of Pneumatic and Hydraulic equipment (air compressor, power pack). Maintain Pneumatic and hydraulic pressure for various applications as per requirement of CNC and other machines.

As an automation specialist, Individuals at this job are responsible for providing support to production operations through maintenance of process control systems installed at shop floor for various manufacturing processes.

Perform electrical and electronic maintenance of ROBOTS used in various industrial applications by checking the wiring, replacing defective sensors, actuators and other control elements.

Reference NCO-2015:

- 7421.0300 – Electronic Mechanic
- 7412.0101 – Automation Specialist

4. GENERAL INFORMATION

Name of the Course	Diploma in Industrial Electronics & Automation
NCO – 2015	<ul style="list-style-type: none"> • 7421.0300 – Electronic Mechanic • 7412.0101 – Automation Specialist
NSQF Level	Level 6
Duration of course	2 Years (5 Core Modules of 320 hours each, Two Elective Modules of 320 hours each, On-the-job training of 800 hours and Employability Skills of 160 hours)
Entry Qualification	NTC/NAC (Electronics Mechanic/ Electrician/instrument mechanic and other similar trades)
Unit Strength (No. Of Student)	20
Space Norms	Workshop: 120 Sq. m
Power Norms	8 KW
Instructors Qualification for	
Industrial Electronics & Automation	<p>Degree in Electronics/ Electronics and Telecommunication /Electronics and communication Engineering from recognized Engineering College/ university with one year experience in the relevant field.</p> <p style="text-align: center;">OR</p> <p>Diploma in Electronics / Electronics and telecommunication/ Electronics and communication from recognized board of technical education with two years experience in the relevant field.</p>
Employability Skill	<p>MBA OR BBA with two years experience OR Graduate in Sociology/ Social Welfare/ Economics with Two years experience OR Graduate/ Diploma with Two years experience and trained in Employability Skills from DGET institutes.</p> <p style="text-align: center;">AND</p> <p>Must have studied English/ Communication Skills and Basic Computer at 12th / Diploma level and above.</p> <p style="text-align: center;">OR</p> <p>Existing Social Studies Instructors duly trained in Employability Skills from DGET institutes</p>

5. NSQF LEVEL COMPLIANCE

NSQF level for Diploma in Industrial Electronics & Automation: Level 6

As per notification issued by Govt. of India dated- 27.12.2013 on National Skill Qualification Framework total 10 (Ten) Levels are defined.

Each level of the NSQF is associated with a set of descriptors made up of five outcome statements, which describe in general terms, the minimum knowledge, skills and attributes that a learner needs to acquire in order to be certified for that level.

Each level of the NSQF is described by a statement of learning outcomes in five domains, known as level descriptors. These five domains are:

- a. Process
- b. Professional Knowledge
- c. Professional Skill
- d. Core Skill
- e. Responsibility

The Broad Learning outcome of **Diploma in Industrial Electronics & Automation** under BBT mostly matches with the Level descriptor at Level- 6.

The NSQF level-6 descriptor is given below:

Level	Process Required	Professional Knowledge	Professional Skill	Core Skill	Responsibility
Level 6	Demands wide range of specialized technical skill, clarity of knowledge and practice in broad range of activity involving standard non standard practices.	Factual and theoretical knowledge in broad contexts within a field of work or study.	A range of cognitive and practical skills required to generate solutions to specific problems in a field of work or study.	Reasonably good in mathematical calculation, understanding of social, political and reasonably good in data collecting organizing information and logical communication.	Responsibility for own work and learning and full responsibility for other`s works and learning.

6. LEARNING OUTCOME

Learning outcomes are a reflection of total competencies of a trainee and assessment will be carried out as per the assessment criteria.

6.1 GENERIC LEARNING OUTCOME

1. Recognize & comply with safe working practices, environment regulation and housekeeping.
2. Explain the concept in productivity, quality tools and labour welfare legislation and apply such in day-to-day work to improve productivity & quality.
3. Explain energy conservation, global warming, pollution and contribute in day-to-day work by optimally using available resources.
4. Explain personnel finance, entrepreneurship and manage/ organize related task in day-to-day work for personal & societal growth.
5. Plan and organize the work related to the occupation.
6. Apply Problem solving skills and supervise team.

6.2 SPECIFIC LEARNING OUTCOME

1. Interpretation of data sheets of various electronic components.
2. Operation & use of various measuring instruments in the lab. And disassemble and assemble various electronic measuring instruments and repair/ test the performance.
3. Construct application circuits, test them and analyze for proper performance.
4. Construct and test simple projects using electronic components and ICs. Draw, analyze and troubleshoot electronic circuits using Electronic simulation software.
5. Install and configure of operating systems and Basic networking skills with connection of various peripherals such as scanner/ printer, intelligent UPS, mobile phone etc. to transfer data and troubleshoot various defects.
6. Troubleshoot Maintain and repair of electronic billing machines and LED lighting systems.
7. Troubleshoot DC-DC Converter, PWM Inverter, Multilevel inverters, controlled rectifiers, AC Voltage regulators, static switches.
8. Install, Test and Repair the industrial SMPS Power supplies, Inverter and UPS systems. Install and test different functional modules of solar power systems.
9. Commission and configure of AC/ Servo drive for various applications. Fault recognizing through parameter and rectify it.
10. Configure the drive for different communication parameters and operate through PC.
11. Plan Execute commissioning and evaluate performance of AC/ DC machine.

12. Plan & prepare entering of simple Programs using Embedded C instructions that are useful for project development.
13. Set up an embedded system for a given application, enter the available code and test it for its functioning.
14. Integrate and Interface various peripherals of a microcontroller system (8051 and AVR/ARDUINO Microcontroller based), program and troubleshoot the system.
15. Explore the resources of a embedded controller and enter the given code for different applications. Interfacing I/O ports, serial port, ADC, DAC modules, Switches, keyboard, LCD and various sensors and communication modules.
16. Interface and communicate using the bus standards such as UART and develop applications for PWM, GSM, GPS, Zigbee etc. implement Bluetooth technology to communicate with blue tooth enabled devices.
17. Execute the CAD and PCB design for the embedded application.
18. Test, wire and maintain appropriate input primary elements such as sensors, transducers and signal conditioning of related instruments.
19. Calibrate, measure, and maintain indicating, recording and transmitting instruments related to process parameters like flow, level, pressure and temperature etc.
20. Operate and maintain various types of field controllers, transmitters, converters and final control devices related to electric, pneumatic and hydraulic media used in process control loops.
21. Select and tune PID Controllers.
22. Select AB-SLC500 PLC and its modules for the given application.
23. Install and configure different AB PLCs with safety practices of handling PLC systems.
24. Develop application programs using various programming techniques such as Ladder, STL and FBD.
25. Wire, program and automate a working model applications.
26. Monitor and modify the logic to make minor changes in the logic for the purpose of expanding the process and troubleshooting.
27. Interface different Industrial application models (lift, bottling plant, batch process reactor, pick and place etc) to PLC and control the different types of processes.
28. Access various troubleshooting resources provided in the software to diagnose the faults with the PLC system.
29. Setup and run a PLC system to automate the given project and Troubleshoot the system for its defects.
30. Interconnect PLC systems with different industry standard communication protocols for data transfer.
31. Configure HMI/ SCADA to communicate with PLC to monitor and modify field data and perform data logging, alarm logging, etc.
32. Interface VFD with HMI and PLC on a network to monitor and control various motor parameters.

33. Configure the given DCS system to communicate with a model process plant in order to perform closed loop control of temperature, pressure, flow and level parameters.
34. Create SCADA Graphical animation screen for objects like trends, alarms, monitor display multiple screens and menus.
35. Configure and program DCS to acquire and control data in SCADA and troubleshoot a simple automated process system at working model and software levels.
36. Perform, operate and control the pneumatic equipment for industrial applications.
37. Troubleshoot maintain and repair Pneumatics and electro pneumatic components.
38. Construct –pneumatic and electro-pneumatic Circuits for various industrial applications.
39. Construct, test pneumatic and electro pneumatic applications for various industries.
40. Perform, operate troubleshoot and control the Hydraulic and elctro- Hydraulic equipment for industrial applications.
41. Construct–Hydraulic and elctro - Hydraulic Circuits for various industrial applications.
42. Construct, test Hydraulic and elctro- Hydraulic applications for various industries.
43. Set up and Test run industrial Robot with the available test program. Identify different parts of industrial multi-axis robotic system.
44. Program and test multi-axis robotic control system. Set up precision motion control system.
45. Interpret the error codes or messages and correlate by cross-referencing in the data fields and how it is used to rank the severity of the fault.
46. Disassemble and assemble electrical/electronic parts of industrial robotic, system and measure preventive maintenance lubrication procedures. End of Arm Tooling (EOAT) devices.
47. Demonstrate Robotic industrial applications - material handling, processing and dispensing.

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7. LEARNING OUTCOME WITH ASSESSMENT CRITERIA

GENERIC LEARNIG OUTCOME		
Sl. No.	Learning Outcome	Assessment criteria
1	Recognize & comply with safe working practices, environment regulation and housekeeping.	1.1 Follow and maintain procedures to achieve a safe working environment in line with occupational health and safety regulations and requirements.
		1.2 Recognize and report all unsafe situations according to site policy.
		1.3 Identify and take necessary precautions on fire and safety hazards and report according to site policy and procedures.
		1.4 Identify, handle and store/ dispose of dangerous/unsalvageable goods and substances according to site policy and procedures following safety regulations and requirements.
		1.5 Identify and observe site policies and procedures in regard to illness or accident.
		1.6 Identify safety alarms accurately.
		1.7 Report competent of authority in the event of accident or sickness of any staff and record accident details correctly according to accident/injury procedures.
		1.8 Identify basic first aid and use them under different circumstances.
		1.9 Identify different fire extinguisher and use the same as per requirement.
		1.10 Identify environmental pollution & contribute to avoidance of same.
		1.11 Take opportunities to use energy and materials in an environmentally friendly manner.
		1.12 Avoid waste and dispose waste as per procedure.
		1.13 Recognize different components of 5S and apply the same in the working environment.
2	Explain the concept in productivity, quality tools and labour welfare legislation and apply such in day-to-day work to improve productivity & quality.	2.1 Explain the concept of productivity and quality tools and apply during execution of job.
		2.2 Understand the basic concept of labour welfare legislation and adhere to responsibilities and remain sensitive towards such laws.
		2.3 Knows benefits guaranteed under various acts.
3	Explain energy conservation, global warming, pollution and	3.1 Explain the concept of energy conservation, global warming, pollution and utilize the available resources optimally & remain sensitive to avoid environment pollution.

	contribute in day-to-day work by optimally using available resources.	3.2 Dispose waste following standard procedure.
4	Explain personnel finance, entrepreneurship and manage/ organize related task in day-to-day work for personal & societal growth.	4.1 Explain personnel finance and entrepreneurship.
		4.2 Explain role of various schemes and institutes for self-employment i.e. DIC, SIDA, SISI, NSIC, SIDO, Idea for financing/ non-financing support agencies to familiarize with the policies/ programmes, procedure & the available scheme.
		4.3 Prepare Project report to become an entrepreneur for submission to financial institutions.
5	Plan and organize the work related to the occupation.	5.1 Communicate effectively with others and plan project tasks.
		5.2 Assign roles and responsibilities of the co-trainees for execution of the task effectively and monitor the same.
6	Apply Problem solving skills and supervise team.	6.1 Ability to understand a problem by breaking it down into smaller parts.
		6.2 Identify the key issues, implications and identifying solutions.
		6.3 Apply knowledge from many different areas to solving a task.
		6.4 Motivate and supervise team for achieving the required goal.


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SPECIFIC LEARNING OUTCOME		
Core Module 1 : Applied Electronics & Applications		
Sl. No.	Learning Outcome	Assessment Criteria
1	Interpretation of data sheets of various electronic components.	1.1 Test active components.
		1.2 Test Passive components.
		1.3 Read of data sheets of various electronic devices.
2	Operation & use of various measuring instruments in the lab. And disassemble and assemble various electronic measuring instruments and repair/test the performance.	2.1 Plan work in compliance to standard safety norms.
		2.2 Identify the type of electronic instrument.
		2.3 Determine the measurement error while measuring resistance by appropriate method.
		2.4 Dismantle electronic measuring instrument applying range of skills and check for defect as per standard procedure.
3	Construct application circuits, test them and analyze for proper performance.	3.1 Demonstrate construction of rectifier circuits and measurement of load voltage.
		3.2 Apply work, analyze the effect of line voltage and load current on the rectifier circuit.
		3.3 Fabricate and test RC/LC/Crystal oscillator circuits.
		3.4 Construct the amplifier using FET.
		3.5 Demonstrate different types of special semi-conductor diodes application and their specifications.
		3.6 Verify and test a transistor for switching and amplification.
		3.7 Demonstrate construction of dual power supply voltage regulators.
		3.8 Tracing the circuit and perform fault finding of amplifier circuits.
		3.9 Analyze construction of summing amplifiers/voltage comparators.
		3.10 Formulate integrator/differentiator circuits using Op-amps.
		3.11 Construct and analyze V to I and I to V circuits using Op-amps.
		3.12 Detect place of fault in commercial amplifier circuit.
4	Construct and test simple projects using electronic components and ICs. Draw, analyze and troubleshoot electronic circuits using Electronic simulation software.	4.1 Plan, analyze and estimate the cost of the particular project.
		4.2 Simulate and test the prepared circuit.
		4.3 Assemble and test the circuit.
		4.4 Simulate and work on electronic circuits and PCB design software tools.
		4.5 Convert the prepared circuit into a layout diagram.
		4.6 Explore various troubleshooting and fault finding the resource provided in the simulation software.
		4.7 Practice and work with two stage amplifier circuit using altium designer simulation and PCB software.

		4.8 Construct and test digital clock circuit using Altium designer simulation and PCB software.
		4.9 Develop different multivibrator circuit using 555 timer.
		4.10 Demonstrate and construct VCO/PWM using 555 timer.
		4.11 Develop a simple project using the digital and analog circuit.
		4.12 Demonstrate different logic circuits using IC tester and verification of truth tables.
		4.13 Construct and test encoder/decoder and MUX/De MUX circuits.
		4.14 Develop and simulate a project with ICs using electronic circuit simulation software.
		4.15 Fabricate shift registers and perform various circuit operations.
		4.16 Construct decade counter/binary counter.
		4.17 Fabricate two seven segment displays to numbers from 0 to 99 using clock pulse.
		4.18 Construct and test simulator of an ADC/ DAC circuit and simple memory circuit using RAM.
5	Install and configure of operating systems and Basic networking skills with connection of various peripherals such as scanner / printer, intelligent UPS, mobile phone etc. to transfer data and troubleshoot various defects.	5.1 Dismantle; identify the different connector parts, indicators used in computers.
		5.2 Assemble/disassemble of PC and install, configure operating System to a PC/Scanner.
		5.3 Interface the cell phone /smart phone to the PC and transfer the data.
		5.4 Demonstrate troubleshooting of faults in connection of UPS/Scanner to PC
		5.5 Plan to repair the defective parts of peripherals and rectify.
6	Troubleshoot and repair of electronic billing machines and LED lighting systems. Maintain and repair of electronic billing machines and LED lighting systems.	6.1 Analyze estimate the maintenance of electronic billing machine cost.
		6.2 Demonstrate LED display and types of LED panels used in lighting.
		6.3 Demonstrate measurement of current flowing through a resistor and display it on LED panels used in lighting.
		6.4 Display a panel lighting word on a two line LED.
		6.5 Demonstrate different parts of different types of application motors.
		6.6 Connect and run DC shunt motor using 3 point starter.
		6.7 Measure the coil resistance of DC motors.
		6.8 Control the speed of DC motor by armature control method and field control method.
		6.9 Plan, analyze and estimate the repair of electronic billing machines.

Core Module 2 : Power Electronics And Drives		
Sl. No	Learning Outcome	Assessment Criteria
1	Troubleshoot DC-DC Converter, PWM Inverter, Multilevel inverters, controlled rectifiers, AC Voltage regulators, static switches.	1.1 Construct and test various power semiconductor diodes.
		1.2 Demonstrate various application circuits using diodes, thyristors.
		1.3 Construct and test various circuits using power transistors such as, BJTs & IGBTs.
		1.4 Construct and test IC based DC-DC converter for different Voltages.
		1.5 Detect the faults and replace the faulty components of DC-DC converter of different voltages.
		1.6 Demonstrate PWM an inverter and its function.
		1.7 Construct and test different control rectifiers circuits using modules.
		1.8 Construct and test various gate control circuit using operational amplifier and switch mode regulator.
		1.9 Construct and test lamp dimmer/ motor speed using AC Voltage regulator circuit.
		1.10 Apply work with the onboard converters using industrial control modules.
		1.11 Determine the load performance DC-AC converter, develop an inverter and test it.
2	Install, Test and Repair the industrial SMPS Power supplies, Inverter and UPS systems. Install and test different functional modules of solar power systems.	2.1 Demonstrate tools and instruments for testing of UPS batteries.
		2.2 Measure and test the voltage of the given cell/battery using analog/digital multimeters.
		2.3 Observe safety procedure during testing, repairing of batteries and work as per standard norms & company guidelines.
		2.4 Charging & discharging the batteries.
		2.5 Identify various input & output sockets/connectors of the given SMPS.
		2.6 Identify major sections/ICs/components of SMPS.
		2.7 Dismantle the inverter/SMPS and find major sections/ICs components.
		2.8 Demonstrate front panel control and indicators of UPS.
		2.9 Dismantle the UPS & test various blocks/ circuit boards/ test point and measure voltage at various points.
		2.10 Install a solar panel to a roof.
		2.11 Wire a solar controller to a battery storage station.
		2.12 Connect storage batteries to a power inverter.
		2.13 Wire a power inverter to an electrical service panel.
		2.14 Connect and test solar panel to the Inverter and run the load.
		2.15 Measure insulation resistance and wet leakage current of PV modules.

		2.16 Prepare a first inspection report on the solar plant installation.
		2.17 Demonstrate standard operating procedure of PV system.
		2.18 Demonstrate and diagnose the simulated faults and explore the remedial measure of solar power systems.
3	Commission and configure AC/DC drive for various applications. Fault recognizing through parameter and rectify it.	<p>3.1 Understand the commission parameters number and values.</p> <p>3.2 Plan work in wiring and test of VFD with motor control panel.</p> <p>3.3 Control the speed of DC motor by using DC drive.</p> <p>3.4 Draw and wire up the control panel for a given circuit diagram and connect the motor.</p> <p>3.5 Trace the control panel for all the required logics.</p> <p>3.6 Control speed and reverse the direction of rotation of different types of 3 phase induction motor using VFD control/AC drive.</p> <p>3.7 Analyze, configure and run the motor with factory settings.</p> <p>3.8 Plan work and monitor in various motor parameters using the given drive software.</p> <p>3.9 Demonstrate and diagnose the simulated faults and explore the remedial measure of AC drives.</p>
4	Configure the drive for different communication parameters and operate through PC.	<p>4.1 Study the servo drive set up & its connections.</p> <p>4.2 Demonstrate different cables and connectors used in the Servo drive set up.</p> <p>4.3 Demonstrate various input and output terminals of the servo drive unit, operate panel and display unit.</p> <p>4.4 Demonstrate access parameters number and values.</p> <p>4.5 Reset to default values/factory setting values.</p> <p>4.6 Connect Servo motor with dry and control parameters.</p> <p>4.7 Connect the Servo motor to PC for monitoring and controlling of various parameters.</p> <p>4.8 Demonstrate operation of the servo motor through PC monitoring and controlling of drive various parameter/programming.</p> <p>4.9 Familiarization with commissioning and quick commissioning.</p> <p>4.10 Demonstrate, analyze, configure the different drive for different communication parameters & operate the PC.</p>
5	Plan Execute commissioning and evaluate performance of AC/DC machine.	<p>5.1 Identify different types of voltmeter, current meter, megger, high voltage tester & energy meter used in single phase and three phase system for testing various parameters.</p> <p>5.2 Identify parts for different types of Single phase & three phase motor.</p> <p>5.3 Measure the coil resistance (armature and field) of AC & DC motor.</p> <p>5.4 Control the speed of DC motor by armature control method and field control method.</p> <p>5.5 Construct a self-hold contractor circuit and run a 3-Phase</p>

	Induction Motor.
	5.6 Connect and operate an induction motor using DOL starter.
	5.7 Connect and run a 3-phase motor using manual and automatic star-delta starters.
	5.8 Identify different cables and connectors used in AC DRIVE setup.
	5.9 Identify various input and output terminals of the DRIVE unit, operator panel and display unit.
	5.10 Install AC Drive and check their specification.
	5.11 Perform ON/OFF, Forward/Reverse, Jog(R)/Jog(L), braking and speed control Familiarization with different parts and terminals of DC Drive.
	5.12 Perform Parameterization for variation of motor speed through POT with Armature voltage feedback (with internal setting), through POT with encoder feedback and external speed raise/lower buttons.



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Core Module 3 : Embedded Controllers And Applications		
Sl. No.	Learning Outcome	Assessment Criteria
1	Plan & prepare entering of simple Programs using Embedded C instructions that are useful for project development.	1.1 Demonstrate various section of a microcontroller system (8051 & AURDINO) and execute the C programme as per the manual of microcontroller Keil uVision Software.
		1.2 Demonstrate various interfacing devices like keyboard and LCD display and execute the Calculation programme.
		1.3 Demonstrate the interfacing devices like seven segment display and execute the one dimensional & two dimensional arrays.
		1.4 Compile the embedded C programme using Keil uVision software and execute the output by interfacing LCD devices and ISIS proteus simulator.
		1.5 Demonstrate the EEPROM interfacing with the 8051 microcontroller and execute and test the file read and write operation in EEPROM.
2	Set up an embedded system for the given application, enter the available code and test it for its functioning.	2.1 Demonstrate Atmega 328P/Different pressure sensor/seven segment display/LCD unit.
		2.2 Demonstrate different wiring of pressure sensor and 4digit seven segment display used in the Atmega 328P.
		2.3 Detect various input and output terminals of the system operator panel and display unit.
		2.4 Plan setup, interface a keyboard and receive a byte of data for displaying on serial LCD using serial port.
3	Integrate and Interface various peripherals of a microcontroller system (8051 and AURDINO Microcontroller based), program and troubleshoot the system.	3.1 Demonstrate the inter connections of humidity sensor with 89S52 microcontroller and to control the fan speed.
		3.2 Demonstrate the inter connections of RTD and heater with the 89S52 and to maintain the temperature in food industry.
		3.3 Interface the water detector with 89S52 microcontroller to know the presence of water and operate the motor accordingly.
		3.4 Interface the PIR sensor and buzzer to the 89S52 ports and execute the programme.
		3.5 Demonstrate to detect the distance of a moving object using ultrasonic sensor and sound a buzzer.
		3.6 Demonstrate the inter connection of servomotor with the 89S52 microcontrollers for precise position control.
		3.7 Demonstrate the inter connection of stepper motor with the 89S52 microcontroller for a step moment of motor.
		3.8 Interface the wireless communication module with the 89S52 and access the WiFi network.
4	Explore the resources of a embedded controller and	4.1 Demonstrate interface Atmega 16 to control the LED as per the status of switches.

	<p>enter the given code for different applications. Interfacing I/O ports, serial port, ADC, DAC modules, Switches, keyboard, LCD and various sensors and communication modules.</p>	<p>4.2 Detect the various input output port, serial port, ADC, DAC modules, switches keyboard, LCD and various sensors and communication modules.</p> <p>4.3 Plan, work interface a seven segment display unit to display the two digit numbers.</p> <p>4.4 Demonstrate basic pattern of digital lights and their outputs.</p> <p>4.5 Demonstrate digital input using momentary switches/sensors along with Atmega microcontroller and sound the Buzzer.</p> <p>4.6 Plan, work interface of alphanumeric LCD and display your name on the display.</p> <p>4.7 Demonstrate different analog sensors and convert them into digital using the inbuilt analog to digital converter of Atmega microcontroller.</p> <p>4.8 Wire a LDR interface and control the street light by making /changing ON, OFF the intensity.</p> <p>4.9 Monitor and evaluate interface a thermistor to Atmega 16 and temperature control the Speed of the fan.</p> <p>4.10 Measure the battery voltage with the help of ADC and display it on LCD, construct Low voltage alarm system, Prevent deep discharge in a good UPS system.</p> <p>4.11 Check interface a stepper motor using ULN2003.</p> <p>4.12 Select test method of relay interfacing using ULN2003/2803</p>
<p>5</p>	<p>Interface and Communicate using different bus standards such as UART, I2C, SPI and develop applications for PWM, GSM, GPS, Zigbee etc. implement Bluetooth technology to communicate with blue tooth enabled devices.</p>	<p>5.1 Demonstrate and test to interface EEPROM to save data into Atmega microcontroller permanently.</p> <p>5.2 Plan and setup the AVR microcontroller to connect serial LCD and send data serially.</p> <p>5.3 Plan the work interfacing GSM module to make call and send SMS.</p> <p>5.4 Built a computerized Library management system by interfacing RFID modules and RFID tags to the system.</p> <p>5.5 Construct a remote patient monitoring system and medicine reminder system with SMS alert using ATMEGA 16.</p> <p>5.6 Construct a home security with remote monitoring/alert system like heater, Geysers using GSM module by sending SMS.</p>
<p>6</p>	<p>Execute the CAD and PCB design for the embedded application.</p>	<p>6.1 Demonstrate the installation of a electrical CAD software tool and PCB design tool in a computer.</p> <p>6.2 Demonstrate various tools available in CAD tool and its usage.</p> <p>6.3 Demonstrate and execute simple wiring diagram with correct specification.</p> <p>6.4 Demonstrate various symbols available in the cad and simulator tool and its inter connections.</p> <p>6.5 Demonstrate the wiring tools with wire number and execute a simple wiring diagram.</p>

		6.6 Demonstrate a ladder diagram for PLC application and execute it.
		6.7 Demonstrate the tools which are useful to prepare PLC layout.
		6.8 Demonstrate the CAD tool to prepare the panel layout in a simple way.



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Core Module 4 : Field instruments and Control		
Sl. No.	Learning Outcome	Assessment Criteria
1	Test, wire and maintain appropriate input primary elements such as sensors, transducers and signal conditioning of related instruments.	1.1 Check various types of instrument constructions, various parts and section.
		1.2 Ensure units for Fundamental and Derived physical variable, in different system of measurements, multiplying factor.
		1.3 Measure the voltage and current using analog/ digital standard voltmeter and ammeter.
		1.4 Check the repeatability, reproducibility, drift, dead band, back clash, hysteresis speed of response and lag etc. Of analog and digital instruments.
		1.5 Apply various types of sensors and transducers used in process industries for stress, strain, load, displacement and Thickness based on resistive, capacitive, inductive and photoelectric etc. such as strain gauge, load cells, LVDT and proximity transducers.
		1.6 Verify the characteristics of different types of resistive, capacitive, inductive, strain gauge, load cells, LVDT, RVDT, photoelectric, proximity Transducers.
		1.7 Detect different objectives using capacitive, inductive and photoelectric proximity sensors
		1.8 Demonstrate circuit operation of analog/ digital instruments for stress, strain, load, displacement and Thickness referring to instrument manual.
		1.9 Carry out maintenance, Servicing and calibration Of instruments for stress, strain, load, displacement and Thickness measurements.
2	Calibrate, measure, and maintain indicating, recording and transmitting instruments related to process parameters like, pressure and temperature etc.	2.1 Identify and check different temperature devices
		2.2 Verify the characteristic of different temperature sensors RTD's, Thermistors and Thermocouples .
		2.3 Study circuit operation of analog/ digital indicators and transmitters
		2.4 Install, WIRE and test various types RTDS, Thermistor & Thermocouples with Indicators/ Transmitters as per guide lines. Ex-tension wires. and protecting wells for temperature measurement.
		2.5 Measure the temperature using RTD'S, Thermistors & Thermocouples base instruments and verify the performance as per field requirements.
		2.6 Maintain, service, trouble shoot and calibrate various types of electronic indicators and transmitters(analog and digital version)
		2.7 Identify parts/ section and its function, circuit operation of analog/ digital type Optical and Radiation pyrometer.

		2.8	Install, WIRE and test Optical and Radiation pyrometer as per guide lines.
		2.9	Identify and check different types of humidity sensors.
		2.10	Measure the relative humidity using humidity sensors.
		2.11	Install, wire, test, service, trouble shoots and calibrates various types' humidity sensors with Indicators/ Transmitters as per guide lines.
		2.12	Check visually and identify the defects of instruments.
		2.13	Rectify the defective instrument using proper tools and equipments as per required.
		2.14	Inspect the all assemble part in visually.
		2.15	Assemble all dismantling parts as reverse direction which is done at the procedure of assembled.
		2.16	Check the condition of dismantling instruments and make it at suitable condition and usable.
		2.17	Set the pressure as requirement.
		2.18	Maintain all the safety precaution and cleanliness.
		2.19	Calibrate the instruments in proper way and execute plan and utilize suitable calibrator.
		2.20	Care & maintain different types of pressure measuring instruments as per schedule.
3	Operate & maintain various types of field controllers, transmitters like flow, level measuring instruments, converters and final control devices related to electric, pneumatic and hydraulic media used in process control loops.	3.1	Construction and operation of various type sight glasses.
		3.2	Install, test and measure the performance of sight glasses for liquid level.
		3.3	Identify different parts, its function and operation of various types of floats and displacers liquid level indicators, transmitters and different types of level switches for liquid vessel.
		3.4	Construction and operation of various types of liquid level traps, air purge, liquid purge, flash diaphragm, liquid level gauges and differential pressure indicating and transmitters.
		3.5	Install, wire, test and measure the liquid level by different types of floats displacers and hydrostatics level indicators and transmitters
		3.6	Study the constructional feature, identify different parts, its function, and circuit operation of various types of electrical level indicators and transmitters i.e. capacitance probes, ultrasonic, microwave and nuclear types for liquid and solid level measurements.
		3.7	Install, wire, test and measure the liquid level/ solid level by different types of electrical level indicators and transmitters
		3.8	Service and calibrate electrical type's level indicators and

		transmitters.
		3.9 Identify and carry out maintenance of level indicators and transmitters and switches for liquid and solid level.
		3.10 Basic Process control system and identify various functional elements.
		3.11 Study construction and operation of thermostatic, pressure and humidity switches.
		3.12 Install, wire up and test the control operation using auto /smart switches.
		3.13 Study construction and operation of ON-OFF electronic and pneumatic controllers.
		3.14 Install, connect pneumatic signal, align and test the control operation using PID pneumatic controller.
		3.15 Select feed forward, and feedback process control system, check loop and identify various functional elements.
		3.16 Demonstrate cascade and ratio process control system.
		3.17 Check loop and identify various functional elements.
		3.18 Perform the control operation in manual and automatic mode.
		3.19 Set optimum setting for unit process in PID controller. (Electronic and pneumatic).
4	Select and tune PID Controllers.	4.1 Study construction and operation of PID electronic/ digital controller.
		4.2 Install, wire up, configure, test the control operation using ON-OFF &PID electronic/digital controller
		4.3 Verify the study state and transient responses of PID electronic/digital controllers in P, PI, PD, PID.
		4.4 Study construction& operation of PID pneumatic Controllers.

Core Module 5 : Programmable Logic Controllers And Applications		
Sl. No.	Learning Outcome	Assessment Criteria
1	Select AB-SLC500 PLC and its modules for the given application.	1.1 Identify each module in a rack and mount in the specified slot.
		1.2 Wire and connect the digital I/OS field devices to the I/O modules of PLC.
		1.3 Install PLC Programming software and establish communication with PC and PLC.
		1.4 Hardware configuration and prepare the input output addresses for each slot.
		1.5 Prepare and download ladder programmes for various switching gates.
		1.6 Write and execute programme logic control operation, sequence control using timers and counters.
		1.7 Interface analog I/P module of PLC with sensor, O/P module of PLC with actuator, relay.
		1.8 Prepare programmes based on ON-delay and OFF-delay timers making ON and OFF of a single LED taking one input and one output.
		1.9 Sequencer task using three LEDs as output and two input push buttons one as input (No) for start and other for stop (No).
		1.10 Development of the ladder logic for the running a traffic control with the different display indicator.
		1.11 Write and execute real application programs.
2	Install and configure different AB PLCs with safety practices of handling PLC systems.	2.1 Identify the modules on the chasis on the backplane architecture of the control logix / Compact logix platform.
		2.2 Install the RSlogix 5000 software and establish the communication link between PC and PLC.
		2.3 Configuration of diagnostic modules.
		2.4 Implementing ladder logic and special instructions of RS LOGIX-5000 Software.
		2.5 Implementing the ADD-ON instructions for the motor logic.
		2.6 Configure timers and counters in the RSlogix 5000 software.
		2.7 Getting and setting system values and extracting valuable data bits used for troubleshooting.
3	Develop application programs using various programming techniques such as Ladder, STL and FBD.	3.1 Demonstrate the Simatic manager software and its components.
		3.2 Construct ladder for various switching operations.
		3.3 Construct STL programming language
		3.4 Plan and programme creation on VAT.
		3.5 Construct ladder logic for various task related to timers and

		counter based industrial applications.
		3.6 Configure the analog inputs and outputs.
		3.7 Demonstrate wire and programme the pneumatic components in the electro pneumatic station.
4	Wire, program and automate a model application.	<p>4.1 Demonstrate the sensor process in the bottle filling plant.</p> <p>4.2 Plan and implement a ON OFF closed loop control for the given process.</p> <p>4.3 Wire and programme to run the system using RS logix500 software.</p> <p>4.4 Programme and run the pick and place trainer plant.</p> <p>4.5 Demonstrate ladder logic for the running a lift model along with different display indicator as in the commercial lift.</p>
5	Monitor and modify the logic to make minor changes in the logic for the purpose of expanding the process and troubleshooting.	<p>5.1 Plan and modify to make minor change on LOGO soft comfort, basic functions of LOGO, advance function of LOGO.</p> <p>5.2 Demonstrate design using FBD and execution of programmes, message display, text display.</p> <p>5.3 Plan and implement of industrial garage door control using FBD.</p> <p>5.4 Construct ventilation system for building using FBD and school bell system</p> <p>5.5 Plan, monitor and troubleshoot utilization power project using FBD.</p> <p>5.6 Demonstrate shop window lighting using FBD.</p>
6	Interface different Industrial application models (lift, bottling plant, batch process reactor, pick and place etc) to PLC and control the different types of processes.	<p>6.1 Plan and configure the project using analog input and output instructions and implement a ON OFF closed loop control for the given process.</p> <p>6.2 Demonstrate sensors in the bottle filling plant, wire and programme to run the bottle filling unit using RSlogix 500 software.</p> <p>6.3 Plan, wire & identify the sensors and valves in the batch process reactor plant and programming it for mixing of the two ingredients.</p> <p>6.4 Demonstrate of closed loop on off controller and PID controllers.</p> <p>6.5 Demonstrate programming the unit to sort three different types of jobs with SLC 500.</p> <p>6.6 Demonstrate wiring and the ladder logic for the running lift</p>

		and different display indication as in the commercial lift.
7	Access various troubleshooting resources provided in the software to diagnose the faults with the PLC system.	<p>7.1 Demonstrate explore the resources of codesys software and practice various options to implement application task.</p> <p>7.2 Plan monitor and troubleshoot various resources provided in the software.</p> <p>7.3 Plan and diagnose the faults with the PLC system.</p> <p>7.4 Demonstrate automate the light, fan and AC system in the Lab using PLC.</p> <p>7.5 Construct a project using the PLC to automate a simple process/machines.</p>
8	Setup and run a PLC system to automate the given project and Troubleshoot the system for its defects.	<p>8.1 Demonstrate program and run the different units in the press machine plant.</p> <p>8.2 Plan and induce the magazine unit in the system and programme the conveyor unit in the press machine.</p> <p>8.3 Demonstrate set up and run a PLC system to automate the given project.</p> <p>8.4 Demonstrate troubleshoot the system for its defect.</p> <p>8.5 Plan and configure the FB, FC, DB, SFC.</p> <p>8.6 Demonstrate PID control system and troubleshoot of PLC.</p> <p>8.7 Demonstrate programme and run the bottle filling unit using somatic Manager Software.</p>

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Elective Subject 1 : Automation Using PLC, SCADA & DCS		
Sl. No.	Learning Outcome	Assessment Criteria
1	Interconnect PLC systems with different industry standard communication protocols for data transfer using SCADA..	1.1 Install and make settings of Network / communication driver software for PLC and SCADA.
		1.2 Configure the network node settings for PLC and SCADA.
		1.3 Configure the network channel settings for PLC and SCADA.
		1.4 Install and configure the proprietary communication modules for different PLCs
		1.5 Prepare the instrumentation network cables - serial (RS232/485 standards or equivalent) and Ethernet
		1.6 Modbus configuration for PLC and SCADA.
2	Configure HMI/ SCADA to communicate with PLC to monitor and modify field data and perform data logging, alarm logging, etc.	2.1 Set up and configure HMI with PLC and Perform supervisory control to turn on/off output field devices
		2.2 Animate objects on a HMI screen to monitor` motor status.
		2.3 Trend the data of a process parameter using trend tool
		2.4 Create user groups and monitor screens with proper authentication.
		2.5 Use security features to do tag logging and command execution.
3	Interface VFD with HMI and PLC on a network to monitor and control various motor parameters.	3.1 Configure a VFD from the given PLC.
		3.2 Interface digital and analog I/O channels with VFD to control the motor.
		3.3 Monitor various motor from PLC software.
		3.4 Control servo motor from PLC on a network for various operations such as acceleration/ deceleration.
		3.5 Configure a servo Drive from the given PLC and Control the motor speed for fixed steps for indexing operations.
		3.6 Examine the given PLC, SCADA/HMI and VFD systems to automate the given process.
		3.7 Install and configure HMI/VFD with PLC.
4	Configure the given DCS system to communicate with a model process plant in order to perform closed loop control of temperature, pressure, flow and level parameters.	4.1 Install and make settings Network / communication driver software for DCS and SCADA.
		4.2 Configure the network node settings for DCS and SCADA.
		4.3 Configure the network channel settings for DCS and SCADA.
		4.4 Preparation of instrumentation network cables - Ethernet.
		4.5 Configure Modbus for DCS and SCADA.
		4.6 Measure and control the flow using flow transmitters with control valves.
		4.7 Measure and control the Level using Differential Transmitter with valves.

		4.8 Measure and control the temperature using Temperature transmitter and heating element.
		4.9 Operate the bypass manual control valves.
		4.10 Identify the different modules of DCS and different process instruments in process plant.
		4.11 Wire the Process plant cabling with wiring details.
		4.12 Write FBD program operate DCS to measure and control the flow loop with PID.
		4.13 Write FBD program operate DCS to measure and control the Level loop with PID.
		4.14 Write FBD program operate DCS to measure and control the temperature loop with PID.
5	Create SCADA Graphical animation screen for objects like trends, alarms, monitor display multiple screens and menus.	5.1 Analyze SCADA project with the given PLC.
		5.2 Develop analog and digital device tags.
		5.3 Assess set points from SCADA screens.
		5.4 Monitor graphically the process parameters.
		5.5 Plan and prepare display event alarm message and log the alarm data.
		5.6 Develop user administration to provide security at different levels.
6	Configure and program DCS to acquire and control data in SCADA and troubleshoot a simple automated process system at working model and software levels.	6.1 Develop DCS programming for sequence, control digital signal and graphical signal for the same with safety operation.
		6.2 Formulate a graphical screen for supervisory control.
		6.3 Create a graphical screen for flow measurement and control.
		6.4 Design a screen for level measurement, control measurement and control.
		6.5 Create screens for trends and alarming/events.
		6.6 Outline severity and multiple screens and graphical screens for multiple trends on multiple screens and configure security levels.
		6.7 Examine DCS process plant with SCADA.
		6.8 Demonstrate troubleshooting of simple automated production system at module and different software levels.

Elective Subject 2 : Mechatronics		
Sl. No.	Learning Outcome	Assessment Criteria
1	Perform, operate and control the pneumatic equipment for industrial applications.	1.1 Demonstrate air compressors and compressed air generation.
		1.2 Identify different pneumatics components.
		1.3 Plan & setup a system to provide pneumatic air supply output from the available compressor.
		1.4 Demonstrate operation and control of pneumatic equipment in the industry.
		1.5 Demonstrate pressure gauge, FRL unit, manifold, T connectors, Plastic tubing.
		1.6 Identify different types of valves and actuators.
		1.7 Demonstrate pressure regulators & Air receiver.
		1.8 Demonstrate air generation, preparation and distribution.
		1.9 Identify air production system component parts and their main function.
		1.10 Plan, workoperate and control of air compressors.
		1.11 Demonstrate regulate air pressure for pneumatic applications.
		1.12 Identify pressure switch, cheek valve, tank, pressure gauge, safety valve, regulated air pressure, line filter.
		1.13 Identify pneumatic cylinder rotary actuators and air motors their forces.
		1.14 Demonstrate pneumatic control systems and process materials.
2	Troubleshoot maintain and repair Pneumatics and electro pneumatic components.	2.1 Operate, Dismantle, repair and assemble of FRL unit.
		2.2 Plan &work different functional parts, dismantle and assemble of pneumatic cylinders and directional control valves.
		2.3 Identify dismantle and assemble of quick exhaust, flow control, time delay valves.
		2.4 Identify parts of shuttle OR valve, dual pressure AND valve, pressure sequence valve, dismantle & assemble of above velve.
		2.5 Construct application circuits, test direct control of single acting, speed control of single acting cylinder, indirect control.
		2.6 Perform a pneumatic circuit for direct& indirect control of double acting cylinder.
		2.7 Construct and test a pneumatic circuit for speed control of double acting cylinder.
		2.8 Perform a pneumatic circuit for the memory control of a double acting cylinder andthe control of double acting cylinder with OR logic
		2.9 Connect various peripherals of a pneumatic circuit for the control of double acting cylinder with AND logic& for automatic return motion of double acting cylinder.
		2.10 Build a pneumatic circuit for the rapid Return motion &

		continuous back-and-forth motion of double acting cylinder.
		2.11 Demonstrate maintenance, repair and troubleshoot of pneumatic sensors and control system.
		2.12 Demonstrate different devices in air distribution system and construction.
		2.13 Analyze operation and use of air filters, regulator and lubricator.
		2.14 Assess and use of pneumatic air distribution system associated components piping and fitting.
		2.15 Demonstrate drawing symbolic representation of different pneumatic component, various supply elements such as compressor, regulator, filter, lubricator, service unit etc.
		2.16 Monitor, recording of operation of various service system.
		2.17 Detect, troubleshoot and service Filter, Regulator, Lubricator(FRL) and pipelines.
3	Construct –pneumatic and electro-pneumatic Circuits for various industrial applications.	3.1 Assess construction operation and use of air compressor.
		3.2 Configure and test various electro pneumatic control circuits.
		3.3 Construct and test different types of sensors.
		3.4 Perform electro pneumatic circuit for direct & indirect control of double acting cylinder with single and double solenoid valve.
		3.5 Demonstrate electro pneumatic circuit of a double acting cylinder advances then actuated by a solenoid valve but its retract movement is delayed by time lag through a timer.
		3.6 Construct and test manufacturing applications for electro pneumatic circuit to control unidirectional pneumatic motors.
		3.7 Demonstrate electro pneumatic circuit of a double acting cylinder.
		3.8 Analyze electro pneumatic transport system and test its operation using time delay for forward retract operations, semi-automotive drilling operations.
		3.9 Construct and control different solenoid valve without pilot control &with pilot control.
		3.10 Demonstrate direct and indirect control of a single acting &double acting cylinder.
		3.11 Develop electro pneumatic memory circuit with double solenoid valve, simple sequential control of two cylinders and semi sequential control of three cylinders.
		3.12 Construct application electro pneumatic circuits, test direct control of single acting, speed control of single acting cylinder, indirect control.
		3.13 Demonstrate construction of electro pneumatic circuits of sorting device/ opening & closing device/ lid fitting device/ assembly station/ flap control/ conveyor belt control/ diverting device/ clamping device.

		3.14 Perform Electro pneumatic circuit for direct & indirect control of double acting cylinder.
		3.15 Construct and test a Electro pneumatic circuit for speed control of double acting cylinder.
		3.16 Perform a electro pneumatic circuit for the memory control of a double acting cylinder and the control of double acting cylinder with OR logic
		3.17 Connect various peripherals of a electro pneumatic circuit for the control of double acting cylinder with AND logic & for automatic return motion of double acting cylinder.
		3.18 Build a electro pneumatic circuit for the rapid Return motion & continuous back-and-forth motion of double acting cylinder.
4	Construct, test pneumatic and electro pneumatic applications for various industries.	4.1 Demonstrate maintenance, repair and troubleshoot of electro pneumatic sensors and control system.
		4.2 Analyze operation and use of electro pneumatics.
		4.3 Assess and use of electro pneumatic system associated components piping and fitting.
		4.4 Demonstrate drawing symbolic representation of different electro pneumatic component, various supply elements such as compressor, regulator, filter, lubricator, service unit etc.
		4.5 Monitor, recording of operation of various service system.
		4.6 Detect, troubleshoot and service Filter, Regulator, Lubricator (FRL) and pipelines.
5	Perform operate, troubleshoot and control the Hydraulic and elctro-Hydraulic equipment for industrial applications.	5.1 Identify Hydraulic components.
		5.2 Demonstrate operation & control of Hydraulic equipment.
		5.3 Inspect hydraulic oil level, oil reservoirs, clean and replace oil filters.
		5.4 Plan and work of disassembling of hydraulic cylinder, identify parts and assemble.
		5.5 Demonstrate operation and control of hydraulic equipment in the industry.
		5.6 Identify different types of valves and actuators.
		5.7 Detect the parts of different types of directional control valve.
		5.8 Demonstrate disassembling & assembling of different types of directional control valve.
		5.9 Construct a circuit for the control of a hydraulic cylinder using a 4/2 & 4/3 way valve.
		5.10 Perform a hydraulics circuit for the control of a conveyor tensioning device using a 4/3 way valves, pilot operated non return valves.
		5.11 Construct a hydraulic circuit for operation and control of Cold store door/ Rotary Machining station/ Embossing machine/ Table of a surface grinding machine/ Clamping of workpieces in a vice/ Bulk head door/ Assembly device for pressing work

		pieces together
		5.12 Demonstrate operation and control of distribution station.
		5.13 Analyse operation and control of testing station.
		5.14 Demonstrate operation and control of processing station.
		5.15 Demonstrate operation and control of handling station.
		5.16 Demonstrate operation and control of separating station.
		5.17 Demonstration operation and control of sorting station.
		5.18 Troubleshoot, maintain and repair of hydraulics system.
		5.19 Follow safety precaution during maintenance of hydraulic system.
		5.20 Perform Preventive maintenance of hydraulic system.
6	Construct–Hydraulic and electro - Hydraulic Circuits for various industrial applications.	<p>6.1 Identify different valve used in hydraulic and electro hydraulic circuits and their applications</p> <p>6.2 Demonstrate operation ,control of hydraulic and electro hydraulic circuits for various industries</p> <p>6.3 Demonstrate construction of hydraulic and electro hydraulic circuits in various industrial and their application.</p> <p>6.4 Demonstrate hydraulic and electro hydraulic circuits for the control of a conveyor tensioning device using 4/3 way valve, pilot operated non return valve.</p> <p>6.5 Analyse hydraulic circuits used assembly device for pressing work pieces, clamping work pieces and embossing machine.</p>
7	Construct ,test Hydraulic and elctro- Hydraulic applications for various industries	<p>7.1 Plan and prepare different industries application in hydraulic and electro hydraulic circuits.</p> <p>7.2 Plan and work of distribution station.</p> <p>7.3 Monitoring processing and separating station.</p> <p>7.4 Assess and used in pick and place station.</p> <p>7.5 Perform the plc setup to assemble the press fitting.</p> <p>7.6 Monitor ,recording hydraulic and electro hydraulic of various industrial applications.</p> <p>7.7 Perform Wire various electro-hydraulic devices with PLC.</p> <p>7.8 Plan and program using ladder programming various applications.</p>

Elective Subject 3 : Robotic Control System		
Sl. No.	Learning Outcome	Assessment Criteria
1	Set up and Test run industrial Robot with the available test program. Identify different parts of industrial multi-axis robotic system.	1.1 Demonstrate and test to run industrial robot with the available test program.
		1.2 Demonstrate different parts of industrial multiaxis robotic system.
		1.3 Assess wiring and routing of electrical circuit in a robot.
		1.4 Demonstrate and assess various connectors and test the continuity between the electrical components.
		1.5 Demonstrate Robot arms sensory components and controller components.
2	Program and test multi-axis robotic control system. Set up precision motion control system.	2.1 Perform, test and program multi-axis robotic control system.
		2.2 Monitor precision motion control system of robotics.
		2.3 Plan and execute robot programs.
		2.4 Plan and perform pick and place operation.
		2.5 Demonstrate coding of programs and use in loop/delay.
3	Interpret the error codes or messages and correlate by cross-referencing in the data fields and how it is used to rank the severity of the fault.	3.1 Demonstrate Coding of programs using Loops.
		3.2 Demonstrate Coding of programs using Delay.
		3.3 Plan and work Wiring Interface practice of PLC and Robot trainer kit.
		3.4 Monitor the interlocks and logic control in the PLC program of the given Robot.
		3.5 Plan and execute Programming with different languages.
3	Disassemble and assemble electrical/ electronic parts of industrial robotic, system and measure preventive maintenance lubrication procedures. End Of Arm Tooling (EOAT) devices.	4.1 Demonstrate disassemble and assemble electrical / electronic /PCB parts.
		4.2 Demonstrate sub assemble of industrial robotics system.
		4.3 Demonstrate disassembling the given miniaturized robot model, test the individual component and sub assemble, reassemble the same and test.
		4.4 Demonstrate sensors in robotics, robotics programming, capability & limitation and application of robots.
		4.5 Demonstrate EOAT kit testing and operation.
		4.6 Execute testing of All electric end effector kit and operation.
		4.7 Demonstrate possible solutions and task within the team.
		4.8 Demonstrate sensors used in industrial robots.
		4.9 Plan work automated assembly kit operation and testing.
		4.10 Plan and prepare different material handling by using industrial robots.
		4.11 Demonstrate robot arm testing and operation.
		4.12 Demonstrate press trending robot testing and operation.

4	Demonstrate Robotic industrial applications - material handling, processing and dispensing.	5.1	Collect relevant information to programme robot via software.
		5.2	Programme robot via software.
		5.3	Test functionality.



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8. SYLLABUS

Syllabus for Diploma in “Industrial Electronics & Automation”			
Core Module 1 : Applied Electronics & Applications: 320 Hrs			
Hour No.	Learning outcome	Professional Skills (Trade Practical) (224 hrs)	Professional Knowledge (Trade Theory) (96 hrs)
		(with indicative Hours)	
1-9	Interpretation of data sheets of various electronic components.	(6 hrs) <ul style="list-style-type: none"> • Testing of active components. (2 hrs) • Testing of Passive components. (2 hrs) • Reading of data sheets of various electronic devices. (2 hrs) 	(3 hrs) <ul style="list-style-type: none"> • Overview of Basic Electronic components. • Semiconductor theory and application of semiconductor device.
10-52	Operation & use of various measuring instruments in the lab. And disassemble and assemble various electronic measuring instruments and repair/ test the performance.	(30 hrs) <ul style="list-style-type: none"> • Operation and use of measuring instruments used in the lab. (10 hrs) • Measurement of noise and ripple in analog signal. (10 hrs) • Utilisation of oscilloscope various modes. (10 hrs) 	(13 hrs) <ul style="list-style-type: none"> • Principle and working of Basic measuring instruments. • Classification of electronic cables with respect to insulation, gauge and current capacity.
53-69	Construct application circuits, test them and analyze for proper performance.	(12 hrs) <ul style="list-style-type: none"> • Construction of rectifier circuits and measurement of load voltage. (6 hrs) • Analyzing the effect of line voltage and load current on the rectifier circuits. (4 hrs) • Application of special purpose semiconductor diodes. (2 Hrs) 	(5 hrs) <ul style="list-style-type: none"> • Conversion of AC to DC voltage using rectifier circuits. • Principle and working of Special purpose devices like Zener/LED/LDR etc.
70-146	Construct and test simple projects	(54 hrs) <ul style="list-style-type: none"> • Construct and test a transistor 	(23 hrs) <ul style="list-style-type: none"> • Construction and working of

	using electronic components and ICs. Draw, analyze and troubleshoot electronic circuits using Electronic simulation software.	for switching and amplification. (8 hrs) <ul style="list-style-type: none"> • Testing of FET/ construction of amplifier using FET. (6 hrs) • Construction of RC/LC/Crystal oscillator circuits. (6 hrs) • Construction of dual power supply using + ve and - ve voltage regulators. (3 hrs) • Tracing and fault finding of amplifier circuits. (6 hrs) • Construction of amplifier circuits using op. Amps. (3 hrs) • Construction of summing amplifiers/voltage comparator. (3 hrs) • Construction of Integrator/ Differentiator circuits using op-amps. (3 hrs) • Construction of V to I and I to V circuits using Op. amps. (6 hrs) • Tracing and fault finding of commercial amplifier circuits. (10 hrs) 	transistor. <ul style="list-style-type: none"> • Construction and working of JFET and MOS FET. • Feed back in amplifier and effect of +ve and -ve feedback. • Study of Colpitts/ Hartley/ Wien bridge/ and crystal oscillators. • 78XX and 79xx series voltage regulators. • Block diagram and working of operational amplifier. • Ideal characteristics of an op. amp. • Application of Op. amp circuits like Inverting /Non- inverting amplifiers. • Summing amplifiers / voltage comparator. • Application of various op amp circuits.
147-174	-do-	(20 hrs) <ul style="list-style-type: none"> • Construct Astable and Monostable multi vibrator using 555 timer. (5 hrs) • Construct VCO using 555 timer. (2 hrs) • Construct PWM using 555 timer. (3 hrs) • Develop a simple project using the above ICs. (10 hrs) 	(8 hrs) <ul style="list-style-type: none"> • Block diagram of 555 timer. • Functional description of different configurations of 555 timer as astable, monostable multivibrators. • VCO and PWM operation and various applications.
175-232	-do-	(40 hrs) <ul style="list-style-type: none"> • Testing of Logic gates using IC tester and verification of truth tables of basic gates and universal gates. (6 hrs) • Testing of encoder /decoder 	(18 hrs) <ul style="list-style-type: none"> • Introduction to digital electronics. • Logic families and their comparison.

		<p>ICs. (4 hrs)</p> <ul style="list-style-type: none"> • Testing of MUX/De MUX circuits using ICs. (4 hrs) • Develop and simulate a project with the above ICs using Electronic circuit simulation software tool. (5 Hrs) • Construction of shift registers and perform various operations like SIPO, SISO etc. (4 Hrs) • Construction of a decade counter / binary counter. (3 hrs) • Construction of two seven segment displays to numbers from 0 to 99 using clock pulse. (5 hrs) • Construction and simulation of a ADC and DAC circuit using IC. (6 hrs) • Construction of a simple memory circuit using RAM IC. (3 hrs) 	<ul style="list-style-type: none"> • Combinational logic circuits like adders/ encoders /decoders. • Mux and Demux –Need of Mux and Demux and its application. • Introduction to sequential circuits. • Basic flip flops and application of flip flops. • Types of registers and their applications. • Types of counters and their applications. • Types of Semiconductor memories.
233-275	-do-	<p>(30 hrs)</p> <ul style="list-style-type: none"> • Practice and work with Electronics circuit Simulation and PCB design software tool. (4 hrs) • Power supply schematics and component layout. (3 hrs) • Drawing schematics and single layer PCB layout design. (3 hrs) • Double Layered PCB, Polygons, vias. (4 hrs) • Double layer circuit layout for RTC circuit. (4 hrs) • Create gerber files for various schematics / boards and 	<p>(13 hrs)</p> <ul style="list-style-type: none"> • Electronic circuit simulation and PCB design software and its features. • Study the library components available in the circuit simulation and PCB design software. • Gerber files and their formats. • Executable files creation.

		<p>Creation of executable files circuit. (6 hrs)</p> <ul style="list-style-type: none"> Analyze two stage amplifier circuit using altium designer simulation and PCB software. (3 hrs) Construct a digital clock circuit using altium designer simulation and PCB software. (3 hrs) 	
276-296	<p>Install and configure of operating systems and Basic networking skills with connection of various peripherals such as scanner/ printer, intelligent UPS, mobile phone etc. to transfer data and troubleshoot various defects.</p>	<p>(15 hrs)</p> <ul style="list-style-type: none"> Identify different connectors, ports, indicators used in computer hardware. (2 hrs) Assemble/Disassemble a PC. (4 hrs) Install and configure OS to a PC (4 hrs) Connect an UPS/ Scanner to PC. (3 hrs) Connect a mobile phone to PC and transfer the data. (2 hrs) 	<p>(6 hrs)</p> <ul style="list-style-type: none"> Block diagram of a computer. Hardware and Software of a computer. Different types of keyboards/ Mouse/Printers. Different ports of a computer and applications.
297-320	<p>Troubleshoot Maintain and repair of electronic billing machines and LED lighting systems.</p>	<p>(17 hrs)</p> <ul style="list-style-type: none"> Operation and Maintenance of Electronic Billing Machine. (6 hrs) Construction of simple LED lighting system. (5 hrs) Construct and test conventional DC motor control circuit. (5 hrs) Isolation techniques used in analog and digital circuits. (5 hrs) 	<p>(7 hrs)</p> <ul style="list-style-type: none"> Working of an electronic billing machine. Types of LED panels used in lighting applications. DC motors and their applications. Concepts of isolation.
Project work/ Industrial Visit			
Revision			

Syllabus for Diploma in “Industrial Electronics & Automation”			
Core Module 2: Power Electronics And Drives: 320 Hrs			
Hour No.	Learning outcome Reference	Professional Skills (Trade Practical) (224 hrs)	Professional Knowledge (Trade Theory) (96 hrs)
		(with indicative Hours)	
1-64	Troubleshoot DC-DC Converter, PWM Inverter, Multilevel inverters, controlled rectifiers, AC Voltage regulators, static switches.	(45 hrs) <ul style="list-style-type: none"> Identify and test various power semiconductor diodes. (5 hrs) Construct various application circuits using diodes, Thyristors and test it. (6 hrs) Construct and test lamp dimmer, flashing, time delay circuits. (5 hrs) Identify and test different Power Transistors such as BJT's, MOSFET's and IGBT'S. (6 hrs) Construct, test application circuits using Power transistors. (6 hrs) Construct and test the operation of various DC-DC converters. (6 hrs) Work with the onboard DC-DC converters used in industrial control modules. (5 hrs) Construct, test and analyse DC-AC converters, develop an inverter and test it. (6 hrs) 	(19 hrs) <ul style="list-style-type: none"> Power semiconductor diodes, Thyristors and circuits. Power electronic switches such as BJT's, MOSFET's and IGBT'S. Various gate control circuits of Power transistors for applications. Learn switching techniques for DC-DC conversion and types of DC-DC conversion. Learn switching techniques for DC-AC conversion and types of DC-AC conversion.
65-175	Install, Test and Repair the industrial SMPS Power supplies, Inverter and UPS systems. Install and test different	(78 hrs) <ul style="list-style-type: none"> Construct and test various gate control circuits using operational amplifiers, switch mode regulator ic's. (4 hrs) Measure and test the healthiness of UPS Batteries. 	(33 hrs) <ul style="list-style-type: none"> Types of inverters and working principles. Different types of Rechargeable batteries used in UPS and its charging circuits. Different types of UPS and its

	<p>functional modules of solar power systems.</p>	<p>(8 hrs)</p> <ul style="list-style-type: none"> • Testing the battery charger circuit with reference to backup time of UPS. (6 hrs) • Connect, install and Perform load test of the given UPS. (5 hrs) • Dismantle the UPS and test various blocks for the healthiness. (5 hrs) • Troubleshoot the given UPS for different defects and rectify. (9 hrs) • Connect and Commission the given solar power system. (5 hrs) • Measure and monitor critical parameters of blocks of solar power system. (5 hrs) • Test Solar PV module and its wiring. (5 hrs) • Test the solar PV array towards its sun tracking position. (5 hrs) • Test the solar charge controller hardware module. (5 hrs) • Measure and test the solar power inverter input/ outputs. (5 hrs) • Wiring practice on solar power inverter with PV modules and batteries. (5 hrs) • Diagnose the simulated faults and explore the remedial measures of given solar power system. (7 hrs) 	<p>working.</p> <ul style="list-style-type: none"> • Explanation of its various stages and its trouble shooting. • AC drives, principle of operation and its application. • Block diagram of solar power system, type of panels and their specifications, applications of solar power inverters, types of failures and their remedial measures, safety aspects.
<p>176-244</p>	<p>Commission and configure of AC/ Servo drive for</p>	<p>(48 hrs)</p> <ul style="list-style-type: none"> • Wiring and test of VFD with motor control panel. (6 hrs) 	<p>(21 hrs)</p> <ul style="list-style-type: none"> • VFD with motor control panel, modules of VFD.

	various applications. Fault recognizing through parameter and rectify it.	<ul style="list-style-type: none"> • Test the communication port, cable and module of VFD. (5 hrs) • Connect and Commission the given VFD. (5 hrs) • Configure and run the motor with factory settings. (5 hrs) • Diagnose the simulated faults and explore the remedial measures of AC drives. (5 hrs) • Wiring and test of Servo drive. (6 hrs) • Connect and Commission the given servo Drive. (5 hrs) • Configure and run the motor with factory settings. (5 hrs) • Diagnose the simulated faults and explore the remedial measures of servo drives. (6 hrs) 	<ul style="list-style-type: none"> • Servo motors, specifications and servo drives, AC Drives, principle of operation and its applications in motion control, precision measurements etc.
245-271	Configure the drive for different communication parameters and operate through PC.	(19 hrs) <ul style="list-style-type: none"> • Connect the Drive with computer, configure and establish communication. (6 hrs) • Configure the drive for various application using the software. (7 hrs) • Monitor various motor parameters using the given drive software. (6 hrs) 	(8 hrs) <ul style="list-style-type: none"> • Various communication standards and protocols used in Drives. • Communication cables and adapters. • Various Fault diagnosis in the communication modules.
272-320	Plan Execute commissioning and evaluate performance of AC/ DC machine.	(34 hrs) <ul style="list-style-type: none"> • Connect and test various parameters of single phase and three phase system using voltmeter, current meter, megger, high voltage tester and energy meter. (6 hrs) • Wire and test a single phase and three phase AC motor. 	(15 hrs) <ul style="list-style-type: none"> • Electrical safety and precautions. • Electrical protection devices. • Single phase and three phase systems. • Various meters used in electrical sub systems. • Working principles of AC

		<p>Transformer and its testing. (6 hrs)</p> <ul style="list-style-type: none"> • Wire and test different types of DC motors. (4 hrs) • Wire and test single phase & three phase motor control circuit. (4 hrs) • Wire and run the motor using DOL Starter. (4 hrs) • Wire and run the motor using Star Delta Starter. (5 hrs) • Wire and run a motor using time delay relay. (5 hrs) 	<p>Motors.</p> <ul style="list-style-type: none"> • Working principles of DC Motors. • Single phase and three phase transformer and its installation maintenance and testing. • Understand the construction, various control and application of DC/AC motors. • Single phase & three phase motors and their speed control techniques. • Introduction to Power Electronic system and power electronic switches.
	Project work / Industrial visit		
	Revision		



Skill India

 कौशल भारत - कुशल भारत

Syllabus for Diploma in “Industrial Electronics & Automation”			
Core Module 3 : Embedded Controllers And Applications: 320 Hrs			
HOUR No.	Learning outcome Reference	Professional Skills (Trade Practical) (224 hrs)	Professional Knowledge (Trade Theory) (96 hrs)
		(with indicative Hours)	
1-63	Plan & Prepare entering of simple Programs using Embedded C instructions that are useful for project development.	Embedded C Programming: (44 hrs) <ul style="list-style-type: none"> Practice C Programs to familiarise with different operators and data types. (5 Hrs) Practice C Programs to familiarise with different loops (ex: if.. else, for loop, while(), do.. while()). (5 Hrs) Write a C Program to Make a Simple Calculator Using switch...case. (8 Hrs) Practice C Programs to familiarise with one dimensional, two dimensional arrays and user defined functions. (9 Hrs) Practice simple C Programs to familiarise with structure and union. (7 Hrs) Practice C Program to familiarise with file read & write operations. (10 Hrs) 	Embedded C Programming: (19 Hrs) <ul style="list-style-type: none"> Introduction, Basic features, operators Date types declaration, Decision control in C, Bit wise operations. Flow Control using if.. else loop, for loop. Familiarization of- while loop and do...while loop. Familiarization of Switch...case.... Statement. Declaration of Function prototypes and Arrays Basics of Structures and unions. Basics of file handing (Read a files write in a file and file error).
64-106	Set up an embedded system for a given application, enter the available code and test it for its functioning.	8051 Microcontroller Practical: (30 Hrs) <ul style="list-style-type: none"> Read the pressure sensors (Pi600D) the 2 – wire, 4-20 mA, (0-10 V) and display the pressure on 4 digit 7 segment display in your preferred engineering units Using 89S52 Microcontroller. (10 Hrs) 	8051 Microcontroller Theory : (13 Hrs) <ul style="list-style-type: none"> 8051 Microcontroller Overview: Introduction to the 8051 Microcontrollers, Introduction Keil software and Proteus Simulator. I/O Port Programming

		<ul style="list-style-type: none"> • Read the pressure sensors (Pi600D) the 2 – wire, (4-20) mA (0-10 V) and display the pressure on 16 x 2 LCD with 89S52 Microcontroller in your preferred engineering units. (10 Hrs) • Interface a Keyboard to enter the data display it. (5 Hrs) • Interface a Keyboard and receive a byte of data using Serial port. (5 Hrs) 	<ul style="list-style-type: none"> • 8051 Programming in Embedded C. • 8051 Hardware Connection and Hex File. <p>8051 Timer/Counter:</p> <ul style="list-style-type: none"> • Different modes of Timers and programming the TMOD registers. • 8051 Serial Port communication, Structure of SCON register and its significance. • Interrupts and its related registers. • 8051 Real World Interfacing: LCD & ADC and Keyboard Interfacing.
107-179	Integrate and Interface various peripherals of a microcontroller system (8051 and AURDINO Microcontroller based), program and troubleshoot the system.	<p>8051 and Sensors: (51 hrs)</p> <ul style="list-style-type: none"> • Interface a Humidity Sensor with 89S52 Microcontroller. (5 Hrs) • Control the temperature in foodservice equipment Industry by sensing the temperature using Resistance Temperature Detector with 89S52 Microcontroller. (5 Hrs) • Interface a Water Detector / Sensor with 89S52 Microcontroller. (5 Hrs) • Detect the moment of human around 3-5 mts range by interfacing a PIR Sensor 89S52 Microcontroller. (5 Hrs) • Interface a Ultrasonic Sensor with 89S52 Microcontroller. (5 Hrs) <p>Motor Control:</p> <ul style="list-style-type: none"> • Interface a Servo Motor with 89S52 Microcontroller. (8 Hrs) 	<p>(22 hrs)</p> <ul style="list-style-type: none"> • Introduction to humidity sensor and signal conditioning circuit with micro controller. • Introduction to temperature sensor and to read the data sheet of different temperature sensors. • Moisture sensor, IR sensor interfacing with microcontrollers and its pin diagram and its pin voltages. • Pin diagram, specification and working principal of ultrasonic sensor. • Principle of servo motor, stepper motor and its interfacing with microcontroller, isolation circuits for microcontrollers, opto couplers. • Introduction and principles of wifi modules and Bluetooth

		<ul style="list-style-type: none"> Interface a Stepper Motor with 89S52 Microcontroller. (8 Hrs) <p>89S52 Microcontroller And Sound:</p> <ul style="list-style-type: none"> Interface a Wireless Communication module with 89S52 Microcontroller. (10 Hrs) 	modules.
180-219	<p>Explore the resources of a embedded controller and enter the given code for different applications. Interfacing I/O ports, serial port, ADC, DAC modules, Switches, keyboard, LCD and various sensors and communication modules.</p>	<p>ATMEGA16 MICROCONTROLLER Practical (28 Hrs)</p> <ul style="list-style-type: none"> Interface an LED and a switch to ATMEGA 16 to control the LED as per the response of the switch. (2 Hrs) Interface a 7 Segment display unit to display the numbers from 00-99. (2 Hrs) Interface a 16x2 alphanumeric LCD with an ATMEGA 16 and display your name on the display. (2 Hrs) Detect the moment of unauthorised persons near the wall/ Gate by interfacing an Infrared Sensor along with Atmega microcontroller and sound the buzzer. (2 Hrs) Interface an analog Sensor and convert the analog into digital using the inbuilt Analog to Digital Converter of Atmega 16 Microcontroller. (2 Hrs) Interface a potentiometer to one of the analog port of Atmega 16 and display the analog voltage on the LCD. (2 Hrs) Interface a LDR to Atmega 16 and control the street light by making it ON, OFF or changing 	<p>ATMEGA 16 MICROCONTROLLER Theory (12 Hrs)</p> <ul style="list-style-type: none"> Microcontrollers (Atmega8515, ATmega 8535, ATmega8, Atmega16 etc.) Pin Detail of Atmega8515, ATmega8535, ATmega8, Atmega16 etc. Architecture of AVR Microcontroller Family. Introduction to Proteus ISIS Software for Schematic preparation and Simulation. LED interfacing- Basic Patterns of LED Lights as an example of Digital Output. <p>Switches interfacing:-</p> <ul style="list-style-type: none"> To learn about Digital Input using Momentary Switches <p>7 Segment interfacing:-</p> <ul style="list-style-type: none"> Learn Digital Numeric Display through 7 Segment Interfacing. <p>LCD Interfacing-</p> <ul style="list-style-type: none"> Interfacing of an alphanumeric, 16x2 LCD and the command set. Infrared Sensor basics and LM358 and LM324 Comparator ICs <p>Analog to Digital Converter Interfacing:-</p>

		<p>the intensity. (2 Hrs)</p> <ul style="list-style-type: none"> • Interface a Thermistor to Atmega 16 and according to the outside temperature control the speed of the fan. (2 Hrs) • Measure the Battery Voltage (12V) with help of ADC and display it on LCD, and construct a low voltage alarm system and disconnect battery in case of low voltage to prevent deep discharge in a good UPS system. (5 Hrs) • Interface a Stepper Motor using ULN2003 with Atmega 16 for forward and reverse moment in a Robot. (2 Hrs) • Interface a Relay using ULN2003/2803 with Atmega 16 to connect 230 volt supply line to control a motor for an overhead tank. (5 Hrs) 	<ul style="list-style-type: none"> • Theory to interface analog Sensors and convert them into digital using the inbuilt Analog to Digital Converter of Atmega Microcontrollers. <p><u>Voltage measurement using variable resistor:-</u></p> <ul style="list-style-type: none"> • Interface a potentiometer to read analog voltage <p><u>Interfacing IR Sensor & LDR:</u></p> <ul style="list-style-type: none"> • Interfacing different Sensors and thermistor using the inbuilt ADC. • Measurement of a Battery Voltage (12V) with help of ADC and display it on LCD, also design a low voltage alarm system and disconnect battery in case of low voltage to prevent deep discharge. This circuit is very commonly found in good UPS system. • Stepper Motor Interfacing using ULN2003 • Relay Interfacing using ULN2003/2803
220-250	Interface and Communicate using the bus standards such as UART and develop applications for PWM, GSM, GPS, Zigbee etc. implement Bluetooth technology to communicate with blue tooth enabled devices.	<p>(22 hrs)</p> <ul style="list-style-type: none"> • Interface an EEPROM to save data into Atmega microcontroller permanently. (3 Hrs) • Interface a Serial LCD to Atmega 16 to send message. (3 Hrs) • Interface a GSM Module to make calls and send SMS to a GSM Mobile. (3 Hrs) • Build a Computerized Library management System by interfacing RFID Module and 	<p>(9 hrs)</p> <ul style="list-style-type: none"> • Interfacing internal EEPROM of AVR. • Interfacing EEPROM to save data into Atmega microcontroller permanently. • Serial Communication/ Serial Interfacing using USB. • Interfacing GSM Module to make calls and send SMS. • Interfacing RFID Module and RFID Tags and projects related to it. • Radio Frequency Controlled

		<p>RFID Tags to Atmega 16. (3 Hrs)</p> <ul style="list-style-type: none"> • Construct a remote patient monitoring and medicine reminder system with SMS alert and in emergency to inform Dr for advice. (5 Hrs) • Construct a Home security with remote monitoring and controlling of devices like heater and Geysers and SMS Alert System using Atmega 16. (5 Hrs) 	<p>Home appliances Devices (Wireless).</p> <ul style="list-style-type: none"> • Interfacing GSM to control devices using SMS.
251-320	Execute the CAD and PCB design for the embedded application.	<p>Electrical CAD software tool: (49 Hrs)</p> <ul style="list-style-type: none"> • Work with Electrical CAD software Tool. (5 hrs) • Work with Project Management resources. (5 hrs) • Schematic components, wiring, editing and reports. (8 hrs) • Prepare symbols using Symbol Builder. (5 hrs) • Use Circuit Builder and prepare electrical control circuits Component tools. (5 hrs) • Work with Wire/Wire number tools. (5 hrs) • Work with PCB design software for the embedded application. (8 hrs) • Prepare a PCB for single layer and double layer using PCB design software. (8 hrs) 	<p>Electrical CAD software tool: (21 Hrs)</p> <ul style="list-style-type: none"> • Introduction • Project management • Schematic components • Symbol Builder • Circuit Builder • Component tools • Wire/Wire number tools • PCB Design specifications.
Project work/Industrial visit (optional)			
Revision			

Syllabus for Diploma in “Industrial Electronics & Automation”			
Core Module 4 : Field Instruments And Controls: 320 Hrs			
HOUR No.	Learning outcome Reference	Professional Skills (Trade Practical) (224 hrs)	Professional Knowledge (Trade Theory) (96 hrs)
		(with indicative Hours)	
1-80	Test, wire and maintain appropriate input primary elements such as sensors, transducers and signal conditioning of related instruments.	(56 hrs) <ul style="list-style-type: none"> • Test and Check performance of Resistive and Capacitive Transducer with its Signal Conditioner for the Rectilinear and Angular displacement Measurement. (6 hrs) • Test and Check performance of Inductive Transducers and LVDT with its Signal Conditioner for rectilinear and Angular displacement. (6 hrs) • Select and Verify characteristics of strain gauges. (6 hrs) • Test & Check Performance Of load cells and Practice mass measurement. (6 hrs) • Test and Check Performance of Piezo-Electric Transducer and Measure the vibration of rotary body. (6 hrs) • Select and Verify characteristics of LDR, Photo Diode, Photo Transistor. (6 hrs) • Check Performance of photo transducer for specification application. (5 hrs) • Construction, operation of tachometers (2 hrs) • Verify the speed of a shaft by using electro- magnetic and photo- electric encoder sensor. (3 hrs) • Test and Check Performance of Proximity sensor and switches. (5 hrs) • Construction, operation and 	(24 hrs) <ul style="list-style-type: none"> • Importance of process sensors. • Classifications and Characteristics of process sensor / transducer. • Working principle of Resistive and Capacitive, Inductive and LVDT Transducer, types and its industrial Application. • Strain gauges and load cells: Working principle of different types of strain gauges and load cells, construction, and its Industrial Application. • Working principle of Piezo electric transducer and its application. • Photo Transducers: Working principle - types and its Ind. Application • Speed Measurement: Working principle - different types of Tachometers. • electro- magnetic and photo- electric encoder its Ind. Application • Working principle of different types of Proximity sensor and Switches. • Humidity Instruments: Working principle of different types of humidity transducers, field instruments and its Ind. Application.

		verify the response of humidity sensors and instruments. (5 hrs)	
81-160	Calibrate, measure, and maintain indicating, recording and transmitting instruments related to process parameters like flow, level, pressure and temperature etc.	<p>(56 hrs)</p> <ul style="list-style-type: none"> • Dismantle the different types of Thermometers and thermo switches. (4 hrs) • Identify the parts and its function, adjustments for correct functioning of filled system Thermometers and Switches. (4 hrs) • Practice temperature measurement using different Thermometers, Check the accuracy and calibrate it. (5 hrs) • Select and verify the characteristics of different types of RTD's, Thermocouples and Thermistors. (5 hrs) • Select suitable compensating cable and hook up different types temperature instruments (analog and digital). (3 hrs) • Test, check Performance, AND Calibrate electronic types temperature indicating Instruments. (3 hrs) • Construction, Operation and Measure high temperature using Optical and Radiation pyrometer. (5 hrs) • Practice Measurement of Atmosphere, Gauge, Vacuum and Differential pressure using different Barometers and Manometers. (5 hrs) • Dismantle the different types of Pressure gauge and 	<p>(24 hrs)</p> <ul style="list-style-type: none"> • Introduction to Temperature measurement. Temperature terms and scales. • Working principle of different types of field system Thermometers and Thermostats. • Working principle of RTD's, Thermistors & Thermocouples, Types, compensating cable, signal conditioning and Instruments. • Working principle Temperature Calibrators and its application for calibration and testing Temperature Instruments, • Working principle, types of Optical and Radiation Pyrometer and its application. • Introduction to Pressure measurement. Pressure terms and units, • Working principle of barometers, and manometers. • Working principle of various types of pressure gauges. (bourdon tubes, bellows, diaphragms and capsule), and selection. • Electric type Pressure Transducer: Working principle and its application in Transmitters. • Working principle, and operation of pressure calibrators, Dead weight Tester, etc.

		<p>switches. (4 hrs)</p> <ul style="list-style-type: none"> • Identify the parts and its function, adjustments for correct functioning and practice the pressures measurement. (4 hrs) • Check and adjust the performance of Pressure Transmitters.- (2 hrs) • Practice the operation of Calibrator/Dead weight Tester. (2 hrs) • Testing and calibration of Pressure gauges, indicators and transmitters with Standard Calibrator/Dead weight Tester. (5 hrs) • Operation and Calibration of Vacuum Instruments. (5 hrs) 	<ul style="list-style-type: none"> • Vacuum measurement: different types of Vacuum Instruments, Working principle and there selection. • Calibration and its standards Pirani and pening guage.
161-276	Operate and maintain various types of field controllers, transmitters, converters and final control devices related to electric, pneumatic and hydraulic media used in process control loops.	<p>(81 hrs)</p> <ul style="list-style-type: none"> • Demonstrate different parts, operation and adjustments for correct functioning of different types of quantity flow meters and practice the flow measurement. (6 hrs) • Select and Measurement of flow using orifice plate, nozzle, pitot tube, venturi and Rota meter. (6 hrs) • Construction and operation of Turbine, ultrasonic, electromagnetic and Mass flow meters. Configure, adjust and verify the performance. (6 hrs) • Construction and operation of different level indicating transmitters and level switches. (6 hrs) 	<p>(35 hrs)</p> <ul style="list-style-type: none"> • Positive displacement Flow meters: Working principles, types, Selection for flow application. • Head flow meters/Differential pressure flow meters –Principle of DP elements- DP transmitter and selection. • Rotameter- Working principle- Selection for application. • Turbine, Ultrasonic and Electromagnetic and mass type flow meters. - working principle and its application. • Level measurement: working principle of sight glass, Float and displacer types Level gauge – Hydrostatic level indicator and transmitters and electronic types level instruments and its

		<ul style="list-style-type: none"> • Verify the performance and calibrate level indicating transmitters. (5 hrs) • Construction, operation, Configure, and adjust OF SMART flow and level DP Transmitters, verify the performance and calibrate using HART configurator. (6 hrs) • Monitor, adjust and compare the thermostat response for temperature control with reference to specifications. (3 hrs) • Monitor, adjust, compare and control the pressure switch response for vessel pressure control with reference to specifications. (3 hrs) • Construction and operation of regulatory control devices. (5 hrs) • Operation of process system. Identity Control components, open loop and closed loop control. (5 hrs) • Construction, operation, Configure, and adjust convertor devices for control Loop. (5 hrs) • Construction, operation of Air compressor and air Distribution. Operation and use of air control device, tubing and fitting. (5 hrs) • Construction, operation, Identify parts and adjust of different types electrical final control elements- solenoid, stepper motor, servomotor 	<ul style="list-style-type: none"> selection and application. • Introduction to Analytical Instruments, pH, conductivity, ORP, TDS, etc., • Introduction to Automatic Control. - process dynamic- Open loop and closed loop system- block diagram. • SMART flow and level DP Transmitters. • Working principles of different types of regulatory control devices and its selection. • Feed Back control system, feed forward control system, controlling of batch and continuous processes. • Working principles of different types of electrical, pneumatic and hydraulic convertor devices for control Loop and its Selection. • Introduction to pneumatic power source and its appl. AIR COMPRESSOR, various supply elements such as reservoir, pressure regulating valve. • Different Final Control elements – electrical, pneumatic and hydraulic operated Actuator, different types of control valves, specifications and industrial applications. Flow characteristics, & accessories and its application.- - Safety Valve, • Controller modes: Discontinuous and continuous controllers, Discontinuous: Two positions, multi position, single
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		<p>used in various applications. (5 hrs)</p> <ul style="list-style-type: none"> • Construction, operation, Identify parts and adjustment of different types pneumatic and hydraulic actuators, manipulators, positioners. (5 hrs) • Service and maintain of Final control elements in the process control. (5 hrs) • Construction, operation, Wire and set ON/OFF electronic controller and Check the response of an ON/OFF controller for temperature and humidity. (5 hrs) 	<p>speed and multi speed floating control modes.</p> <ul style="list-style-type: none"> • ON/OFF electronic controller
277-320	Select and tune PID Controllers.	<p>(31 hrs)</p> <ul style="list-style-type: none"> • Construction, Operation, and test programmable PID electronic controllers. (6 hrs) • Wire and Configuration of PID electronic controllers to control loop. (6 hrs) • Verify the steady state and transient response of Electronic P, PI, PD and PID controllers using real system / simulator. (6 hrs) • Construction and Operation, the PID pneumatic controller. (6 hrs) • Instrument control panel building, Cable glanding and termination. (7 hrs) 	<p>(13 hrs)</p> <ul style="list-style-type: none"> • Continuous: P, I, D, PI, PD & PID control actions. • P, I and D Electronic programmable controllers; description, features & applications. • Pneumatic controllers: description, features & applications. • Optimum control setting • Instrument control panel • P & I DIAGRAM as per ISA 5.1(2007)
Project work / Industrial visit			
Revision			

Syllabus for Diploma in “Industrial Electronics & Automation”

Core Module 5 : Programmable Logic Controllers And Applications: 320 Hrs

HOUR No.	Learning outcome Reference	Professional Skills (Trade Practical) (224 hrs)	Professional Knowledge (Trade Theory) (96 hrs)
		With Indicative Hours	
1-43	Select AB-SLC500 PLC and its modules for the given application.	(30 hrs) <ul style="list-style-type: none"> Identify each module in a rack and mount in the specified slot and Prepare the input and output addresses for each slot. (5 hrs) Install RS Logix 500 software and establish communication with PC and PLC. (5hrs) Prepare and download ladder programs for various switching Gates. (5hrs) Evaluate ladder logic for multiplexer and De multiplexers. (4hrs) Prepare programs based on on-delay and off delay timers making on and off of a single LED taking one input and one output. (5hrs) Write a ladder program for alternate flashing of Two LEDs on and off using pushbutton as an input. (3hrs) Sequencer task using three LEDs as output and two input pushbuttons one as input (NO) for start and other for stop (NO). (3hrs) 	(13 hrs) <p>Allen Bradley of PLCs and Ladder Programming (using SLC-500 & Micrologix series PLCs)</p> <ul style="list-style-type: none"> Evolution of control technology, Basic PLC architecture, Introduction to field input and output devices, Installation and wiring aspects, I/O modules, special function modules, Addressing aspects, CPU and I/O configuration, ladder programming software, uploading and downloading ladder programs, RS-Linx Communication drivers, Data files, Memory concepts. Implementation of Relays, Timers, counters, Arithmetic, Data transfer and compare instructions. Development of application programs, Forcing, Diagnostics. Ethernet IP Protocol.
44-100	Install and configure different AB PLCs with safety practices of	(40 hrs) <ul style="list-style-type: none"> Identify the modules on the chasis on the backplane architecture of the control logix / Compact logix 	(17 hrs) <ul style="list-style-type: none"> Introduction to Logix-5000 platform, Flex-Logix, compact logix and control logix processors series.

	<p>handling PLC systems.</p>	<p>platform. (5 hrs)</p> <ul style="list-style-type: none"> • Install the RSLogix 5000 software and establish the communication link between PC and PLC. (6 hrs) • Configuration of diagnostic modules. (6 hrs) • Implementing ladder logic and special instructions of RS LOGIX-5000 Software. (6 hrs) • Implementing the ADD-ON instructions for the motor logic. (6 hrs) • Configure timers and counters in the RSLogix 5000 software. (6 hrs) • Getting and setting system values and extracting valuable data bits used for troubleshooting. (5hrs) 	<ul style="list-style-type: none"> • Introduction to RS LOGIX-5000 Software, establishing communication using RS LINX, configuration of diagnostic modules. • Exploring project resources, tag based representation of control tags and program tags, sharing of resources on a common chassis, continuous, periodic and event type task configuration, Sequencer instructions, BTM, GSV and SSV Instructions. • Working with Servo Drive.
<p>101-143</p>	<p>Develop application programs using various programming techniques such as Ladder, STL and FBD.</p>	<p>(30 hrs) S7-300 /400 (SIEMENS) PLC Programming and applications</p> <ul style="list-style-type: none"> • Install the Simatic manager software and its components. (5hrs) • Development of ladder for various switching operations. (5 hrs) • Develop logic for different applications using STL Programming Language. (5hrs) • Program development, creation of VAT. (5 hrs) • Development of ladder logic for various tasks related to timers and counter based industrial applications. (4hrs) • Configuring the analog inputs 	<p>(13 hrs) S7-300 /400 (SIEMENS) PLC Programming and applications</p> <ul style="list-style-type: none"> • Architecture of S7-300/400 Family of CPUs, Installation of modules, Different addressing modes, Hardware configuration using SIMATIC Manager, Development of ladder. • Introduction to STL Programming Language, Program development, creation of VAT, Data blocks, Forcing, enabling peripherals, rewiring, • Function blocks and SFBs, Functions and System Functions, Data blocks, Intake process plant control using PLCs.

		<p>and outputs. (3hrs)</p> <ul style="list-style-type: none"> Identify, wire and program the pneumatic components in the Electro-pneumatic station. (3 hrs) 	
144-160	Wire, program and automate a working model applications.	<p>(12 hrs)</p> <ul style="list-style-type: none"> Wiring and identifying the sensors and valves in the batch process reactor plant and programming it for mixing of the two ingredients (4 hrs) Program and run the pick and place trainer kit. (4 hrs) Development of the ladder logic for the running a lift model along with the different display indication as in the commercial lift. (4 hrs) 	<p>(5 hrs)</p> <ul style="list-style-type: none"> Introduction to basic pneumatic components, Mechatronic system for an industrial model, PLC control of pneumatic elements, programming of various machines of plant like magazine unit, conveyor unit, pick and place unit, press unit, Automatic sorting and retrieval station.
161-203	Monitor and modify the logic to make minor changes in the logic for the purpose of expanding the process and troubleshooting.	<p>(30 Hrs)</p> <ul style="list-style-type: none"> Introduction to Siemens LOGO! SOFT COMFORT, Basic Functions of LOGO PLC, Advanced functions of LOGO PLC. (6 hrs) Design using FBD and execution of programs, Message displays, Text displays. (5 hrs) Implementation of industrial Garage door control using FBD. (4 hrs) Development of Ventilation system of building using FBD program. (5 hrs) Implementation of School bell system using FBD program. (5 hrs) Monitoring the utilization power project using FBD Shop window lighting using FBD 	<p>(13 hrs)</p> <p><u>Automation using Micro PLCs (SIEMENS LOGO!)</u></p> <ul style="list-style-type: none"> Concept of miniaturized PLCs, functionality of small PLCs, wiring aspects, Different functional resources of LOGO PLC, implementation of Relays, Timers and counters, FBD programming, expansion of I/O capacity, online monitoring. Industrial Automation based project applications like Garage door control, ventilation system of building, school bell, monitoring utilization power etc. Redundancy concepts.

204-260	Interface different Industrial application models (lift, bottling plant, batch process reactor, pick and place etc) to PLC and control the different types of processes.	<p>program. (5 hrs)</p> <p>(40 hrs)</p> <ul style="list-style-type: none"> Configuring the project using analog input and output instructions and implement a on-off closed loop control for the given process. (8 hrs) Identify the sensors in the bottle filling plant, wire and Program to run the bottle filling unit using RSlogix 500 software. (6 hrs) Wiring and identifying the sensors and valves in the batch process reactor plant and programming it for mixing of the two ingredients. (6 hrs) Program and run the pick and place trainer plant. (6 hrs) Wiring and identifying the sensor and conveyor unit in the sorting station and programming the unit to sort three different types of jobs with SLC 500. (7 hrs) Wiring and Development of the ladder logic for the running a lift model along with the different display indication as in the commercial lift. (7 hrs) 	<p>(17 hrs)</p> <p>Industrial Applications using Allen Bradley PLC (SLC-500 family)</p> <ul style="list-style-type: none"> Specifications and Configuration of analog Input Modules, Specifications and Configuration of analog Output modules, Scaling with parameters, Online editing, System clock for flashing, special purpose instructions, configuration of closed loop on/off controller, closed loop PID controllers.
261-289	Access various troubleshooting resources provided in the software to diagnose the faults with the PLC system.	<p>(20 hrs)</p> <ul style="list-style-type: none"> Explore the resources of codesys software and practice various options to implement application tasks. (5 hrs) Automate the light, Fan and AC System in the lab using the PLC. (5 hrs) Develop a project using the 	<p>(9 hrs)</p> <p>Low Cost Automation using MITSUBISHI /DELTA PLCs</p> <ul style="list-style-type: none"> Introduction to Low cost automation using MITSUBISHI /DELTA PLCs, Troubleshooting in installation and wiring aspects, I/O modules, special function

		PLC to automate a simple process/machine. (10hrs)	modules, Addressing aspects, CPU and I/O configuration. <ul style="list-style-type: none"> • Troubleshooting Drive and HMI configuration using MITSUBISHI / DELTA Systems.
290-320	Setup and run a PLC system to automate the given project and Troubleshoot the system for its defects.	(22 hrs) <ul style="list-style-type: none"> • Program and run the different units in the Press machine plant. (6 hrs) • Induce the magazine unit in the press machine and Program the conveyor unit in the press machine. (5hrs) • Configure the FB, FC, DB, SFC. (6 hrs) • Troubleshooting of PID Control using PLC. (5hrs) 	(9 hrs) <ul style="list-style-type: none"> • Configuration of profibus for distributed I/Os. • Configuration of Ethernet for distributed I/Os. • Data communication on Ethernet and profibus.
Project work / Industrial Visit			
Revision			



 Skill India

 कौशल भारत - कुशल भारत

Syllabus for Diploma in “Industrial Electronics & Automation”			
Elective Subject 1 : Automation Using PLC, SCADA & DCS: 320 Hrs.			
Hours No.	Learning outcome	Professional Skills (Trade Practical) (224 hrs)	Professional Knowledge (Trade Theory) (96 hrs)
		(with indicative Hours)	
1-43	Interconnect PLC systems with different industry standard communication protocols for data transfer.	Industrial networking: (30 hrs) <ul style="list-style-type: none"> • Network / communication driver software install and settings for PLC and SCADA. (4 hrs) • Configure the network node settings for PLC and SCADA. (4 hrs) • Configure the network channel settings for PLC and SCADA. (5 hrs) • Install and configure the proprietary communication modules for different PLCs. (4 hrs) • Preparation of instrumentation network cables - serial (RS232/485 standards or equivalent) and Ethernet. (4 hrs) • Modbus configuration for PLC and SCADA. (5 hrs) • Device level networking installation and configuration. (4 hrs) 	Industrial Networking: (13 hrs) <ul style="list-style-type: none"> • Need of Industrial networking : brief history, Different types of networking architecture, Topology • OSI model of networking, Networking hardware, Network standards, Modbus, CAN bus, ControlNet, Ethernet, Profibus, FIP I/O, etc • Proprietary Network standards and protocols: • Master Slave Configurations. • Communication Driver software and Communication hardware modules • Remote Terminal Units. Network Comparisons. Scheme of Remote I/O
44-77	Configure HMI/ SCADA to communicate with PLC to monitor and modify field data and perform data logging , alarm logging , etc.,	PLC with colour Touch screen Human Machine Interface (HMI): (24 hrs) <ul style="list-style-type: none"> • Set up and configure HMI with PLC and Perform supervisory control to turn on/off output field devices (4 hrs) • Animate objects on a HMI 	PLC with colour Touch screen Human Machine Interface (HMI): (10 hrs) <ul style="list-style-type: none"> • Colour Touch Screen HMI panels and specifications, various industry interfaces on HMI panels, features of HMI panels.

		<p>screen to monitor` motor status. (5 hrs)</p> <ul style="list-style-type: none"> • Trend the data of a process parameter using trend tool (5 hrs) • Create user groups and monitor screens with proper authentication. (5 hrs) • Use security features to do tag logging and command execution. (5 hrs) 	<ul style="list-style-type: none"> • Working with HMI software Tool • Configure PLC with HMI • Animation with graphical objects • Troubleshooting of communication problems with drive/PLC
78-113	Interface VFD with HMI and PLC on a network to monitor and control various motor parameters.	<p>Develop industrial applications using SCADA (25 hrs)</p> <ul style="list-style-type: none"> • Configure a VFD from the given PLC. (4 hrs) • Interface digital and analog I/O channels with VFD to control the motor. (4 hrs) • Monitor various motor parameters from PLC software. (4 hrs) • Control the servo motor from PLC on a network for various operations such as acceleration, deceleration. (5 hrs) • Configure a servo Drive from the given PLC and Control the motor speed for fixed steps for indexing operations and integrate the given PLC, SCADA/HMI and VFD systems to automate the given process. (8 hrs) 	<p>Develop Industrial Applications using SCADA: (11 hrs)</p> <ul style="list-style-type: none"> • Building blocks of VFDs, specifications, types and working principles. • Industrial and domestic applications of VFDs. • Fundamentals of Servo motors and motion control applications.
114-220	Configure the given DCS system to communicate with a model process plant in order to perform closed loop	<p>DCS process plant Interfacing and operation: (75 hrs)</p> <ul style="list-style-type: none"> • Network / communication driver software install and settings for DCS and SCADA. (4 hrs) 	<p>DCS process plant interfacing and operation: (32 hrs)</p> <ul style="list-style-type: none"> • Introduction to DCS & its importance in process industry. Honeywell 900 architecture and feature —Study of DCS

	<p>control of temperature, pressure, flow and level parameters.</p>	<ul style="list-style-type: none"> • Configure the network node settings for DCS and SCADA. (5 hrs) • Configure the network channel settings for DCS and SCADA. (5 hrs) • Preparation of instrumentation network cables - Ethernet. (5 hrs) • Modbus configuration for DCS and SCADA. (5 hrs) • Measure and control the flow using flow transmitters with control valves. (5 hrs) • Measure and control the Level using Differential Transmitter with valves. (5 hrs) • Measure and control the temperature using Temperature transmitter and heating element. (5 hrs) • Electrical Actuation of Control valves. (4 hrs) • Operation of bypass manual control valves. (3 hrs) • Identify the different modules of DCS and different process instruments in process plant. (5 hrs) • Process plant cabling/wiring details. (4 hrs) • DCS Interfacing with field signals. (4 hrs) • FBD DCS programming. (4 hrs) • Programming of DCS to measure and control the flow loop with PID. (4 hrs) • Programming of DCS to measure and control the Level loop with PID. (4 hrs) 	<p>instructions.</p> <ul style="list-style-type: none"> • selection of appropriate i/o, and communications - understanding memory, variables, and data types • Building project, downloading the project – identification of function blocks in library. • Process signals and their standards in Industry • -logic function block and its use for status control flow, level and temperature • PID function block and its use for continuous control of flow, - Batch and Continuous process control, Programming of DCS to control ON/OFF and PID controls for level - Concept of Set Point Tracking, Programming of DCS to control temperature. Tuning of PID parameters.
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221-263	Create SCADA Graphical animation screen for objects like trends, alarms, monitor display multiple screens and menus.	<p>Supervisory Control and Data Acquisition (SCADA) for PLCs: (30 hrs)</p> <ul style="list-style-type: none"> • Configure SCADA project with the given PLC. (5 hrs) • Create analog and digital device tags and monitor. (5 hrs) • Give set points from SCADA Screens. (5 hrs) • Monitor graphically the process parameter using trend tool. (5 hrs) • Display Event alarm messages and log the alarm data. (5 hrs) • Perform user administration to provide security at different levels. (5 hrs) 	<p>SCADA for PLCs: (13 hrs)</p> <ul style="list-style-type: none"> • Architectures of SCADA system, different communication channels, features of SCADA system. • Graphical animation and objects. • Study of typical industrial applications of SCADA systems using the SCADA screens. • Multinode / multichannel troubleshoot techniques and Redundancy
264-320	Configure and program DCS to acquire and control data in SCADA and troubleshoot a simple automated process system at working model and software levels.	<p>SCADA for Distribution Control System(DCS):(40 hrs)</p> <ul style="list-style-type: none"> • Programming of DCS to acquire and control digital signals. Develop graphical screen for the same. (5 hrs) • Develop a graphical screen for supervisory control. (5 hrs) • Develop a graphical screen for flow measurement and control. (5 hrs) • Develop a screen for level measurement and control. (5 hrs) • Develop a screen for temperature measurement and control. (5 hrs) • Develop screens for trends 	<p>SCADA for DCS: (17 hrs)</p> <ul style="list-style-type: none"> • Working with Honeywell Experion SCADA. • Features of SCADA • Export/import of function block Diagram (FBD) programs making the points. • Communication between DCS, Master control and local control systems. • Acquire and control digital signals • Concept of supervisory and data acquisition through SCADA graphical screens. • Developing of graphical screens for various process loops like flow, level and temperature.

		<p>and alarming/events. (5 hrs)</p> <ul style="list-style-type: none"> • Concept of severity and multiple screens. Develop graphical screens for multiple trends on multiple screens and configure security levels. (5 hrs) • Operation and integration of DCS process plant with SCADA. (5 hrs) 	<ul style="list-style-type: none"> • Graphical screens for trends and alarming, antilock sequences. • Project start sequences in FBD and SCADA. • Operation and integration of DCS process plant with SCADA. • Protection of DCS System at different levels of I/Os – Isolators, Opto-couplers.
	Project Work/ Industrial Visit:		
	Revision		



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Syllabus for Diploma in “Industrial Electronics & Automation”			
Elective Subject 2 : Mechatronics: 320 Hrs.			
Hours No.	Learning outcome	Professional Skills (Trade Practical) (224 hrs)	Professional Knowledge (Trade Theory) (96 hrs)
		(with indicative Hours)	
1-21	Perform, operate and control the pneumatic equipment for industrial applications.	Pneumatics: (15 hrs) <ul style="list-style-type: none"> Identify different parts of compressor. (3 hrs) Set up a system to provide Pneumatic (air) supply output from the available compressor. (5 hrs) Identify pneumatic components: pressure gauge, FRL unit. (3 hrs) Identify manifold, T Connectors, plastic tubing and different types of valves and actuators. (4 hrs) 	Pneumatics: (6 hrs) <ul style="list-style-type: none"> Compressed air generation and conditioning, Air compressors, Pressure regulation, Dryers, Air receiver, FRL unit, Applications of pneumatics, Hazards & safety precautions in pneumatic systems. (6 hrs) Pneumatic actuators: Types, Basic operation, Force, Stroke length, Single-acting and double-acting cylinders. (2 hrs)
22-64	Troubleshoot maintain and repair Pneumatics and electro pneumatic components.	(30 hrs) <ul style="list-style-type: none"> Dismantling repair and assembling of FRL unit. (3hrs) Identify dismantling & assembling of Pneumatic cylinders. (4 hrs) Identify dismantling & assembling of Directional control valves. (4 hrs) Identify dismantling & assembling of Flow control valves. (4 hrs) Identify dismantling & assembling of Quick exhaust I valves. (4 hrs) Identify dismantling & assembling of Time delay valves. (4 hrs) Identify parts of shuttle (OR) 	(13 hrs) <ul style="list-style-type: none"> Pneumatic valves: Classification, 3/2-way valves (NO & NC types) (manually-actuated & pneumatically-actuated) & 5/2-way valves, Roller valve, Shuttle valve, Two-pressure valve, Check valves, Flow control valves, One-way flow control valve, Time Delay Valves, Pressure Sequence Valves, etc. ISO symbols of pneumatic components. Reading of pneumatic circuit drawings.

		<p>valve and dual pressure (AND) valve, dismantling & assembling of above valve. (4 hrs)</p> <ul style="list-style-type: none"> Identify parts of pressure sequence valve, dismantling & assembling of above valve. (3 hrs) 	
65-135	Construct – pneumatic and electro-pneumatic Circuits for various industrial applications.	<p>(50 hrs)</p> <ul style="list-style-type: none"> Build a pneumatic circuit for direct control of single acting cylinder. (2hrs) Build a pneumatic circuit for speed control of single acting cylinder. (2hrs) Build a pneumatic circuit for indirect control of single acting cylinder. (2hrs) Build a pneumatic circuit for direct control of double acting cylinder. (2hrs) Build a pneumatic circuit for indirect control of double acting cylinder. (2hrs) Build a pneumatic circuit for speed control of double acting cylinder. (2hrs) Build a pneumatic circuit for the memory control of a double acting cylinder. (2hrs) Build a pneumatic circuit for the control of double acting cylinder with OR logic. (2hrs) Build a pneumatic circuit for the control of double acting cylinder with AND logic. (2hrs) Build a pneumatic circuit for automatic Return motion of double acting cylinder. (2hrs) Build a pneumatic circuit for 	<p>(21 hrs)</p> <ul style="list-style-type: none"> Various pneumatic power components such as single acting, double acting cylinders and rotary actuators such as air motors and rotary motors, timers and counters etc, Various pneumatic circuits to perform different industrial application such as, opening and closing device, Pin feeding device, Ejecting work piece, Hopper control, Metal stamping, Clamping device <p>Electro-Pneumatics</p> <ul style="list-style-type: none"> Introduction, 3/2-way single solenoid valve, 5/2-way single solenoid valve, 5/2-way double solenoid valve, Control components -Pushbuttons (NO & NC type) and relay unit, Logic controls, etc. <p>Introduction to various sensors</p> <ul style="list-style-type: none"> Proximity Sensors- Reed Sensors, Inductive proximity sensor, Capacitive proximity sensor, Magnetic Proximity Switches (Reed Switches) , Electrical Output Devices , Optical sensor , Ultrasonic sensors. Relays, contactors, position sensors, displacement sensors, and

		<p>the rapid return motion of double acting cylinder. (3hrs)</p> <ul style="list-style-type: none"> • Build a pneumatic circuit for continuous back-and-forth motion of a double acting cylinder. (3hrs) <p>Electro pneumatics</p> <ul style="list-style-type: none"> • Identify parts of solenoid valve and dismantling & assembling of above valve. (2hrs) • Construct a circuit for the direct and indirect control of a double acting cylinder with single & double solenoid valve. (4hrs) • Construct and test a pneumatic circuit of a double acting cylinder advances when actuated then it's retract movements is delayed by time lag using a timer. (4hrs) • Construct and test a pneumatic circuit to control unidirectional pneumatic motor. (4 hrs) • Build pneumatic control circuit for semi automatic drilling machine operations. (4 hrs) • Wire various electro pneumatic devices with PLC and develop program using ladder programming various applications. (6 hrs) 	<p>Encoders, signal conditioning circuits for different parameters.</p> <ul style="list-style-type: none"> • Plc interface with electro pneumatic devices.
136-169	Construct, test pneumatic and electro pneumatic applications for various industries.	<p>(24 hrs)</p> <ul style="list-style-type: none"> • Construct electro pneumatic circuits for following applications <ol style="list-style-type: none"> a. Sorting device b. Opening& closing device c. Lid fitting device 	<p>(10 hrs)</p> <ul style="list-style-type: none"> • Various pneumatic power components such as rotary actuators and air motors and rotary motors, , Various pneumatic circuits to perform different industrial application

		<p>d. Assembly station e. Cutting device f. Flap control g. Tipping device h. Diverting device i. Hopper control j. Gravity feed magazine k. Conveyor belt control l. Clamping device m. Stamping device n. Heat sealing device o. Transfer station</p>	<p>such as, opening and closing device, Pin feeding device, Ejecting work piece, Hopper control, Metal stamping, Clamping device, Lid fitting device, tipping device, Heat sealing device, transfer station.</p>
170-205	<p>Perform, operate troubleshoot and control the Hydraulic and elctro- Hydraulic equipment for industrial applications.</p>	<p>Hydraulic Systems. (25 hrs)</p> <ul style="list-style-type: none"> • Identify Hydraulic components – hydraulic power pack, Pumps, Oil Reservoir, different grades of hydraulic oils, Pressure relief valve (PRV), Filters, different types of valves, actuators, accumulator, and hoses. (4 hrs) • Inspect hydraulic oil levels, oil reservoirs, clean and replace oil filters. (2 hrs) • Identify the parts of a hydraulic cylinder. (2 hrs) • Dismantling and assembling of a hydraulic cylinder. (4 hrs) • Identify the parts of different types of Directional Control Valves. (4hrs) • Dismantling and assembling of different types of Directional Control Valves. (4 hrs) • Maintenance, servicing and troubleshooting safety of hydraulic and electro hydraulic systems. (5 hrs) 	<p>Hydraulic Systems (11 hrs)</p> <ul style="list-style-type: none"> • ISO Symbols of hydraulic components, Hydraulic oils – function, properties, Contamination in oils and its control. • Hydraulic Filters – types, constructional features, and their typical installation locations, Hazards & safety precautions in hydraulic systems, Hydraulic reservoir & accessories, Pumps, Classification – Gear/vane/ piston types, Hydraulic motors –Types, Pressure relief valves – Direct acting and pilot-operated, Pipes, tubing, Hoses and fittings – Constructional details, Minimum bend radius for hoses. • Hydraulic cylinders –Types, different parts, Working principles, care and handling. • Hydraulic valves: Classification, Directional Control valves – 2/2- and 3/2-way valves;4/2- and 4/3-way valves; Check valves and Pilot-operated check valves, Flow control valves: Types, Speed

			control methods – meter-in and meter-out.
206-255	Construct– Hydraulic and elctro- Hydraulic Circuits for various industrial applications.	<p>(35 hrs)</p> <ul style="list-style-type: none"> • Construct a circuit for the control of a hydraulic cylinder using a, 4/2 & 4/3 way valves. (4 hrs) • Construct a hydraulic circuit for the control of a conveyor tensioning device using a 4/3 way valves, pilot operated non-return valve. (4 hrs) • Construct a hydraulic circuit for operation and control of: (27hrs) <ul style="list-style-type: none"> (a) Cold store door (b) Rotary Machining station (c) Embossing machine (d) Table of a surface grinding machine (e) Clamping of workpieces in a vice. (f) Bulk head door (g) Assembly device for pressing work pieces together. 	<p>(15 hrs)</p> <ul style="list-style-type: none"> • Applications of hydraulics in industrial equipment. Frequently used hydraulic circuits in the industry. Study, analysis and exploring alternative circuits using minimum components for same solutions. • Preventive maintenance & troubleshooting of pneumatic & hydraulic systems, System malfunctions due to contamination, leakage, friction, improper mountings, cavitation, and proper sampling of hydraulic oils.
256-320	Construct, test Hydraulic and elctro- Hydraulic applications for various industries.	<p>(45 hrs)</p> <ul style="list-style-type: none"> • Operation & control of Distribution station. (4 hrs) • Operation & control of testing station. (4 hrs) • Operation & control of processing station. (4 hrs) • Operation & control of handling station. (4 hrs) • Operation & control of separating station. (4 hrs) • Operation & control of sorting station. (4 hrs) • Operation & control of Pick and 	<p>(20 hrs)</p> <ul style="list-style-type: none"> • Study of different controls used in testing station. • Study of different controls used in processing station. • Study of different controls used in handling station. • Study of different controls used in separating station. • Study of different controls used in sorting station. • Study of different controls used in Pick and place station. • circuits with Programmable

		<p>place station. (4 hrs)</p> <ul style="list-style-type: none"> • Assemble the press fitting pneumatic set-up and control by PLC. (9 hrs) • Wire various electro-hydraulic devices with PLC and develop program using ladder programming various applications. (8 hrs) 	Controller (PLC).
	Project Work/ Industrial Visit:		
	Revision		



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Syllabus for Diploma in “Industrial Electronics & Automation”			
Elective Subject 3 : Robotic Control Systems: 320 Hrs.			
Hours No.	Learning outcome	Professional Skills (Trade Practical) (224 hrs)	Professional Knowledge (Trade Theory) (96 hrs)
		(with indicative Hours)	
1-71	Set up and Test run industrial Robot with the available test program. Identify different parts of industrial multi-axis robotic system.	Introduction to Robotics: (50 Hrs) <ul style="list-style-type: none"> • Locate, excite, and test robot arm sensory components. (10 hrs) • Trace the wiring between sensors and actuating components Robot controller components and test. (10 hrs) • Perform wiring and routing of electrical circuit in a Robot. (10 hrs) • Identify various connectors and test the continuity between the electrical components. (10 hrs) • Trace the servo and DC motor control circuits in the given ROBOT and test. (10 hrs) 	Introduction to Robotics: (21 Hrs) <ul style="list-style-type: none"> • Definition of a Robot, Motivating factors for the introductions of Robots system to industrial application for a robot, Robot configurations, Robotic safety & laws of robotics. Classification of robots. • Elements of Robot system: Base, Manipulator arm, End Effectors, Sensors and transducers, Actuators, dc motors, servomotors and Drives Control system. • Robot specifications: Work envelope, Load carrying capacity, Speed of movement, Accuracy, Repeatability, Special resolution. • Sensors in Robotics: Types of Sensors, Tactile Sensors, Touch sensors, Force sensors. Joint sensing, Proximity and Range Sensors, and Miscellaneous.
72-115	Program and test multi-axis robotic control system. Set up precision motion control system.	Programming / Editing Robots: (30 Hours) <ul style="list-style-type: none"> • Robot Start Up, Coordinate Systems and Motion Systems. (5 hrs) • Power up robotic system. (5 hrs) • Robotic coordinate systems. (5 hrs) • Robotic motion systems. (5 hrs) 	Programming/Editing Robots: (14 Hours) <ul style="list-style-type: none"> • Robotics Programming: Methods of Programming a Robot, Lead through Programming Methods. Programming Instructions. Robot Programming Path in Space, Motion Interpolation, WAIT, SIGNAL and DELAY Commands, Branching, Capabilities and Limitations of

		<ul style="list-style-type: none"> • Write and execute robot programs. (5 hrs) • Perform Pick & Place operation. (5 hrs) 	<p>Lead through Methods. Copying, deleting and editing programs.</p> <ul style="list-style-type: none"> • Robot movement: Vertical, Radial, Rotational, Pitch, Roll movement. • Types mechanical joints used in Robotic system: Linear Joint, Orthogonal joint, Rotational Joint, Twisting Joint, Revolving Joint.
116-149	Interpret the error codes or messages and correlate by cross-referencing in the data fields and how it is used to rank the severity of the fault.	<p>(24 hrs)</p> <ul style="list-style-type: none"> • Coding the programs using Loops. (5 hrs) • Coding the programs using Delay. (5 hrs) • Wiring Interface practice of PLC and Robot trainer kit. (5 hrs) • Monitor the interlocks and logic control in the PLC program of the given Robot. (4 hrs) • Programming with different languages. (5hrs) 	<p>(10 hrs)</p> <ul style="list-style-type: none"> • Programming of robot with different instructions • Integration of PLC and Robots • Programming of plc with interlocks • Wiring of robot with plc • Interface of robot with plc • Introduction to different languages
150-263	Disassemble and assemble electrical/ electronic parts of industrial robotic, system and measure preventive maintenance lubrication procedures. End Of Arm Tooling (EOAT) devices.	<p>(80 hrs)</p> <ul style="list-style-type: none"> • Disassemble the given miniaturised robot model as per mechanical drawings. (10 hrs) • Test the individual components / sub assembly. (8 Hours) • Reassemble the sub-assemblies as per mechanical drawing and test the all subassemblies. (10 hrs) • Reassemble and integrate the all sub-assemblies together and test the entire robot for 	<p>(34 hrs)</p> <ul style="list-style-type: none"> • Frequently occurring mechanical, electrical and controller oriented faults and their remedies. • Error Codes & Troubleshooting: Robot Error Codes-Locating and Interpreting. Using Error Codes –Troubleshoot and Repair Robot. Recover Procedures- Back up and Start up • Mastering the Robot Backup System: Mastering Concepts, Backup Batteries and Components

		<p>its operation. (10 hrs)</p> <ul style="list-style-type: none"> • Maintenance of Robots: (34 hrs) • Lubrication. Maintaining EOAT and Sensors. (8 hrs) 	<ul style="list-style-type: none"> • Maintenance of Robots: (30 Hours) • Performing Preventive Maintenance (PM) on Robot Components: Lubrication. Maintaining EOAT and Sensors.
264-320	Demonstrate Robotic industrial applications - material handling, processing and dispensing.	<p>Applications of Industrial Robot: (40 Hours)</p> <p>Practice on Material Handling Applications</p> <ul style="list-style-type: none"> • End of arm tooling (EOAT) kit testing and operation. (8 hrs) • All electric end effector kit testing and operation. (8 hrs) • Automated assembly Kit operation & testing. (8 hrs) • Material Handling Robot Arm testing and operation. (8 hrs) • Press Tending Robot testing and operation. (8 hrs) 	<p>Applications of Industrial Robot (17 Hours)</p> <ul style="list-style-type: none"> • In Manufacturing applications: • Robot Material Handling. • Pick and place. • Robots as automated assembly and Robots as automated inspections.
Project Work/ Industrial Visit:			
Revision			

9. SYLLABUS – EMPLOYABILITY SKILL

1. Leadership Skills Duration : 20Hrs.	
Interact with people and convince them.	Leadership - Define leadership, types of leadership, leadership Traits, Functions of leadership, styles of leadership. Resolving Individual differences among people.
Assess risk and take the initiative.	Risk Analysis tools; estimate the risks that you could face in your role. In turn, this helps you manage these risks and minimize their impact on your plans. Break-even point analysis. Risk Value = Probability of Event x Cost of Event.
Think differently with the innovative mindset.	Success stories / Best Practices – Inspection, inspect Demo displacement. Innovation has become one of the most popular buzz- words of the Digital Age. Re-evaluate the true meaning of a concept than when it is being touted by individuals and companies around the world. Spark innovation, maximize productivity, and increase profitability as a result of implementing the Big Five behaviors.
Handle the pressure.	Stress management - Define Management, Type of stress Management, How to improve stress in workplace, Team leader in workplace.
Ability to gather the client's requirement.	Manage relationships with client who may be confused with the services requirements. Build healthy client relationships and use customer centric approach.
2. Entrepreneurship Skills Duration : 20Hrs.	
Identifying opportunities not obvious to others.	Self Employment as a Career path - Define Entrepreneurship, Strategy of entrepreneurship, Market Research. Implementation of self Employment in workplace Ps, Mange self employment in workplace. Quality consciousness – its relevance.
Assessing the competitive advantage of ideas.	Study of Competitive Advantage Model. PEST factors for external changes and implement VRIO resources for getting an edge over the competitors.
Identifying customer or client requirements.	Ensure that environmental conditions are suitable for the client and the services to be carried. Deal with clients lacking the technical background to solve the problem on their own.
Determining the commercial viability of ideas.	Immediate or temporary solutions to resolve delays.
Demonstrating sensitivities (political, commercial, environmental, cultural, and so on).	5 Strategies of handling sensitive issues (political, commercial, environmental, cultural, and so on) at workplace – 1. Define the issues, 2. Develop Policies Adhering to

	Company Goals, 3. Communicate Policies, 4. Hold People Accountable and 5. Continue to Evolve.
Identifying opportunities for setting up business.	Define marketing, Tools of marketing, 7 Ps define market strategy, important of market strategy, use of strategy in trade theory (Labour Market Information).
3. Organizational Skills Duration : 20Hrs.	
Project deadlines.	Training & Managerial responsibilities Introduction & discussion on managerial responsibilities.
Work under pressure and tight deadlines.	Basic quality Concept & 5'S Colour Dynamics
Organize the workload to meet with the timelines.	Follow the organisation's policies and procedures for working with colleagues.
Prioritize the tasks.	Time management - Workplace time Management, maintain Time management, Benefits of Time Management in workplace, Time management schedule.
4. Creative Abilities Duration : 30Hrs.	
Visualize a business idea end-to-end	Boosting Morale - Boosting ethics & Development work environment, ethics theory, Development of work environment & training process, knowledge of presentation & self motivation.
Conceptualize an idea	Five Dimensions to conceptualize your idea to make it a successful innovation. When conceptualizing an idea, it is essential to ask questions like what is the problem that the idea solves, who is the consumer for the idea, does the idea solve the consumer's problems and how will the solution be delivered to the consumer. It is very important to direct the thinking to specific dimensions and search answers to certain questions that help in evolving the idea from the initial thought through the various stages of innovation.
Transform notions into business ideas	The single most effective way to come up with a business idea is to solve a problem . Next step, you bring the idea to life. Whether it's code, carpentry, or culinary, a project is a created idea. When the project is nearly complete and it's time to begin putting the project into the hands of real people. Once your project is perfected through testing, it's time to come up with a way to make money from it. Growth -

	Get the word out about the thing.
5. Strong digital Skills	
Duration : 20Hrs.	
Write strong and effective emails for communication.	Write memos and e-mail to customers, co-workers, and vendors to provide them with work updates and to request appropriate information.
Use digital tools like laptops, palmtops, mobiles, fax machines, printers, projectors, conferencing tools effectively.	Operate all types of digital tools like laptops, palmtops, mobiles, fax machines, printers, projectors, conferencing tools effectively.
Strong understanding of emerging technologies.	Attributes that feature in the emergence of novel technologies are: (i) radical novelty, (ii) relatively fast growth, (iii) coherence, (iv) prominent impact, and (v) uncertainty and ambiguity. The framework for operationalising emerging technologies is then elaborated on the basis of the proposed attributes.
Good understanding of information security aspects.	Understanding and adhering to the Information security aspects of the organization based on ISP. Information Security Policy (ISP) is a set of rules enacted by an organization to ensure that all users or networks of the IT structure within the organization's domain abide by the prescriptions regarding the security of data stored digitally within the boundaries the organization stretches its authority.
Convert textual content into graphs, images, charts, diagrams and flow charts.	Create or convert textual contents into graphical representation, charts, diagrams and flow charts. Learn to make graphs and charts in MS excel. Use of digital camera and other imaging tools. Use of MS-Powerpoint for developing diagrams and flowcharts.
6. Self-Management	
Duration : 20Hrs.	
Having a personal vision and goals	Decision making pertaining to the concerned area of work. Decision making process.
Being able to evaluate and monitor his/her own performance	Identifying the strengths - SWOT Analysis. Define Swot analysis, Important of swot analysis, characteristics of swot analysis, Example of swot analysis related with Trade development in detail
Having knowledge and confidence in your own ideas and vision	Apply, analyze, and evaluate the information gathered from observation, experience, reasoning, or communication, as a guide to thought and action.
Articulating your own ideas and vision	Use of multi-model strategies of articulation such as audio

	visual tools, kinaesthetic learning tools, etc.
Taking responsibility	7 thoughts on taking responsibility at workplace- 1. There is always a price to pay. 2. Build your self-esteem.3. Give yourself the permission to work as you want.4. Taking actions 5. Understand the limits of your responsibility. 6. Don't forget to take responsibility in everyday worklife. 7. Aim to be your best self.
7. Plan and organize the work related to the occupation Duration : 20Hrs.	
Use documents, drawings and recognize hazards in the work site.	Prepare and organize service feedback files/documents.
Plan workplace/ assembly location with due consideration to the operational stipulation.	The best way is to plan for workplace/ assembly location is to think of any emergency situation before it happens. Think clearly and logically in a crisis, so it is important to do so in advance with due consideration of the operational stipulation.
Communicate effectively with others and plan project tasks.	Question-answer session to be conducted appropriately in order to understand the nature of the problem and make a diagnosis of the task.
Assign roles and responsibilities of the co-trainees for execution of the task effectively and monitor the same.	Guidelines for delegating roles and responsibilities to co-trainees: 1. Identify key opportunities for delegation, 2. Establish a clear set of objectives for each task, 3. Play to your coworker's strengths, 4. Construct a timeline, 5. Use follow-up tasks to keep your workers on point, 6. Establish authority and respect, 7. Use a feedback loop to make future delegation easier.
8. Effective communication (written and verbal) Duration : 10Hrs.	
Interact with stakeholders, whether it is internal in an organization or external with partners or clients, is fraught with opportunities for misunderstanding.	Communication process & elements of communication. Maintain clear communication with colleagues (by all means including face-to-face, telephonic as well as written). Pass on information to stakeholders in line with organisational requirements both through verbal as well as non-verbal means. Principles of effective communication, body language, handling nervousness/ discomfort and dealing with barriers.
Prepare and give formal presentations and informal presentations during meetings.	Different Types of Communication Aids: Projected/ Non Projected using different types of board in a class room session. Black board, White board, Flannel board, Magnetic board etc. Application, use & maintenance of OHP, Digital Camera, LCD projector and Smart board. Preparation of slides in MS-

	Powerpoint and presentation of the slides. Handle FAQ session during meetings.
9. Emotional intelligence Duration : 10Hrs.	
Work well, interact successfully with others.	Work with colleagues to integrate work. Work in ways that show respect for colleagues.
Work with clients.	Getting it right from the very beginning, you'll most likely see things flourish. Spending ample time collecting information, allow client to share their knowledge and participate in the project.
Connect with people from different cultural backgrounds.	Adopt a flexible attitude, learn about the culture beforehand, expect differences, understand hierarchies, be upfront about difficulties in communication, be respectful & tolerant and be patient.



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ANNEXURE-I

List of Tool & Equipment			
General Installation: (For a batch of 20 Candidates)			
Sl. No	Name of the Equipment	Specification	Quantity
CORE MODULE 1: APPLIED ELECTRONICS & APPLICATIONS			
1.	Electronic work benches	Electronic work bench consist of Measuring and Testing Instruments- DMM, DSO, LCR Meter, Function Generator, Signal Generator, Regulated Power supply with display with all accessories fitted on Workbench.	8 nos.
2.	Analog electronics trainer kit with applications	Analog Trainer Kit consist of Dual power supply(+ve and –ve) Active components testing rig for Transistor, UJT, FET, etc Voltage regulator (+ve and –ve) power supply LED Indicators and Toggle Switches. With ac 230v 50 Hz Power supply. With accessories.	10 nos.
3.	Digital electronics trainer kit with applications	LED s 16 nos Seven segment LED display 4 digit BCD Toggle switches 16 Nos Clock generator, Pulse generator, Logic Probe. Bread board area. Fixed power supply 5Vdc. IC sockets	10 nos.
4.	Electronic billing machines	Keyboard and display Printer section Power supply unit	5 nos.
5.	LED light stacks of different sizes	LED light stacks of different sizes	20 nos.
6.	Soldering Iron	25W 230v ac	20 nos.
7.	Soldering and De-soldering Station	Microcontroller based 700W and 24V/50W ESD safe With accessories	5 nos.
8.	DMMs – Hand held 10 Nos and Bench top – 5 Nos	i. Handheld DMMType : Autoranging Digital Multimeter, Display : 3 5/6 Digit, Counts : 6000, AC Voltage Range : 600Mv/6/60/600/750V ii. Bench Top DMM : Large LCD Display. Auto Power OFF. Data	15 nos.

		Hold. Backlight. Sampling Rate 3 times per second. Input Impedance 10M. AC Frequency Response 40-400Hz.	
9.	Function Generators / Signal Generators	<p>Function Generator:</p> <ul style="list-style-type: none"> • 10 MHz multi waveform signal generator • Sine, Triangle, Square output waveforms • Frequency readout in Hz, KHz, MHz. • Output Attenuation upto 40 dB <p>150 MHz Signal Generator:</p> <ul style="list-style-type: none"> • 150MHz Maximum Frequency • 1 ppm High Accuracy, Less Distortion • Double Independent Outputs • AM, FM, FSK, PSK Modulation • User can set accurate pulse width, burst signal as numbers • USB Device, RS-232. 	5 Each
10.	CRO	<p>Highest Sensitivity up to 1mV/div (After Expand) Full band Trig Auto Sweep Circuit</p> <ul style="list-style-type: none"> • Flex Trig mode (Select either CH1 or CH2 Signal / External Signal) • Alt-Trig View 2 in relative Signal • Ext Trig Input • Power Supply : AC 200 ±10%V <p>Band Width AC 10Hz ~ 30MHz (-3dB) DC ~ 30MHz (-3dB) Y Deflection</p> <ul style="list-style-type: none"> • 5mV / div ~ 20V / div Rise Time • Oscilloscope 18ns, Mag x 5 Accuracy <p>With standard accesories</p>	6 nos.
11.	DSO	<ul style="list-style-type: none"> • Bandwidth: 100 MHz • 2-Channel, Sample rate: 1GS/s • Input Impedance: 1MΩ ± 2%, in parallel with 20pF±5pF • 7 inch LCD display • Power Supply: 230V AC, 50/60Hz, 	4 nos.
12.	DC power supplies	<ul style="list-style-type: none"> • Power Supply: 230V AC, 50/60Hz • 0-30V DC output • 0-5A Load current 	6 nos.
13.	IC Tester	<ul style="list-style-type: none"> • Alphanumeric LCD display • 24 Keys • Digital IC pins range14-40 DIP, 	2 nos.

		<p>Analog IC 6-20 pin DIP</p> <ul style="list-style-type: none"> • Digital 74xx series TTL ICs, 40 and 45 series CMOS ICs, Microprocess, Peripheral ICs. • Analog IC: Op-Amp, Comparator, Opto-coupler, Timer, ADC and DAC etc. • ZIF Sockets 20 pin analog 40 pin for Digital 	
14.	LCRQ Bridge	<ul style="list-style-type: none"> • Microprocessor based Fully Automatic L, C, R & Q Measurement • Auto ranging with Direct Digital Readout • 4 Terminal Measurement Technique • Series or Parallel Equivalent Measurement • Special Input Terminal for Fast and Easy • Insertion and Removal of Test Component 	5 nos.
15.	LED Projector / LCD Projector	<ul style="list-style-type: none"> • WXGA native resolution of 1280 X 800 pixels, • brightness of 500 ANSI Lumens, and • a contrast ratio of 8000:1. 	2 nos.
16.	Altium Designer Electronic simulation software for Schematic, Simulation and PCB OR Equivalent software tool	Electronic circuit simulator, schematic, capture PCB design, etc	20 user license
17.	Desktop computers (Latest Configuration)	Intel Processor i5 core or latest and Intel or compatible Motherboard with latest specification desktop PC.	20 nos.
18.	MFD Printer	<ul style="list-style-type: none"> • Auto Document Feeder (ADF), Auto Duplex Printing • Print, scan, copy • 5-inch Colour Touchscreen LCD Display • WiFi, LAN, USB, Connectivity 	1 no.
19.	Scanner	<ul style="list-style-type: none"> • 4800 x 4800 dpi scanning • USB powered • Built-in kickstand • Detachable lid • Easy Photo Scan 	1 no.
20.	Antivirus software	With internet security, Parental	As required

		control, Firewall settings, spyware and malware protection, email, web security and ransomware protection etc.	
21.	On Line UPS 5KVA	Output Power: 5 KW, Recharge Time: 8 Hours Backup Time: 3 Hours for 10 Desktop PC Pure sine wave Online double conversion Battery: 10 batteries 12 V DC 75 AH.	1 no.
22.	Class room furniture	Class room table and chairs	20 Chairs
23.	White Board	6X4 size	1 No
24.	Instructor chair	Instructor chair - Executive	1 no.
25.	Instructor table	Instructor table-Executive	1 no.
26.	Raw Materials	As per practical list all required Electronic components and bill of materials	As Required

CORE MODULE 2: POWER ELECTRONICS AND DRIVES

1.	Power Electronic Trainer		05 nos.
2.	AC Drive Trainer		05 nos.
3.	Servo drive trainer		05 nos.
4.	Lap top and software with latest configuration		10 nos.
5.	Inverter Trainer		05 nos.
6.	UPS trainer		05 nos.
7.	Solar power System with Tracking Trainer		05 nos.
8.	Battery charger with batteries		05 nos.
9.	Tachometer Digital		05 nos.
10.	Digital Megger	500 volts	05 nos.
11.	Electrical work station		05 nos.
12.	Safety tools for Electrical maintenance		As per requirement
13.	High voltage breaking tester		05 nos.
14.	DSO		05 nos.
15.	DMM		20 nos.
16.	DC Power supply		10 Nos.
17.	Motor control logic simulation panel		05 nos.
18.	AC motor fault simulation panel		05 nos.
19.	DC Motor fault simulation panel		05 nos.
20.	Motor breaking modules / Resistors.		05 nos.
21.	Relays testing work station		05 nos.
22.	LED / LCD Projector.		01 no.

23.	AC/DC motors of different capacity		10 no each.
24.	Soft starter with motor		02 nos.
25.	Distribution transformer 3 phase		01 no.
26.	Safety demonstrator		02 nos.
27.	De- sectible machine trainer kit		02 nos.
28.	Air Circuit Breaker/VCB		01 no
29.	Panel with various protection relays like overload, over voltage, reverse Current, phase sequence etc (electronic or solid state,		02 nos.
30.	CT and PT		02 each
31.	Digital optical Techo meter		02 nos.
32.	Raw Materials: MCBs, ELCBs, MCCBs, Switches, wires, cables , semiconductor fuses, commutation chokes, output chokes etc.		As per requirement

CORE MODULE 3: EMBEDDED CONTROLLERS AND APPLICATIONS

1.	8051 Microcontroller Trainer Kit	Atmel 89S52 Controller with following facility. Ports: 4 Parallel Ports with connectivity facility. Serial Port: RS232 serial port with DB9 Display: 2X16 LCD and 4 digit 7 Segment Display. Analog Input: POT for analog input Motor interfacing facility. Reset switch and +5V and +12V facility.	10 Nos.
2.	ATMEGA 16 (AVR)Microcontroller Development Board	ATMEGA 16 Controller with following facility. Ports: Parallel Ports with connectivity facility. Serial Port: RS232 serial port with DB9. Display: 2X16 LCD and 4 digit 7 Segment Display. Analog Input: POT for analog input. Motor interfacing facility. Reset switch and +5V and +12V facility.	10 Nos.
3.	ADC Application Module	+5V operative ADC Module with 8 pin digital output as well as single pin serial output with I2C mode.	5 Nos.
4.	DAC Application Module	+5V operative DAC Module.	5 Nos.

5.	Stepper Motor Controller	+5 V , +12V operative stepper motor controller	5 Nos.
6.	Programmer	Multipurpose IC Programmer for different IC pins from 8 pin DIP to 40 PIN DIP with USB connectivity.	5 Nos.
7.	ISIS Proteus Simulator	ISIS Simulator for real time simulation with different tools list of Electronics and Electrical, voltage sources, communication tools, display tools facility.	10 User
8.	Auto CAD – Electrical or equivalent Electrical CAD software tool	CAD tool having ability to draw Electronic circuits Different lines and tools with different specifications and to verify the correctness in the tool.	20 users
9.	Desktop PC with latest configuration	Windows/ Linux operating System computer with minimum 4GB RAM and serial port and parallel port connectivity. Network operative and Internet facility.	20 Nos.
10.	Bluetooth Audio Evaluation Board	Bluetooth based Audio player with 8W speaker.	5 Nos.
11.	GSM Modules	GSM Modules to place different SIM cards.	5 Nos.
12.	GPS Modules	Latest version of GPS Module to support the AVR/ ARDUINO boards.	5 Nos.
13.	Zigbee Modules (Pair)	Latest version of Zigbee Modules.	5 Nos.
14.	PIR Modules	Standard PIR Modules.	10 Nos.
15.	Regulated Power Supply	0-15 V, 0-5 Amp and 0.001 ripple factor.	5 Nos.
16.	Soldering Iron	Standard type	20 Nos.
17.	Soldering Station	Standard type with Soldering, de-soldering , Hot air blower, pedal operated facility	2 Nos.
18.	Stepper Motor controller module	Stepper motor with interfacing circuits.	10 Nos.
19.	Bluetooth Master Slave Module	Standard Bluetooth Master Slave Modules.	10 Nos.
20.	Wi-fi Module	Standard WI-fi modules	10 Nos.
21.	Sensors: Soil Moisture Sensor, Ultrasonic sensor, Vibration sensor, Color Sensor, Tilt sensors, Humidity Sensor Module, IR Sensors, Finger Print sensor, Heart Beat sensor, Gas Sensor	Standard devices	Each 10 Nos.
22.	RF ID Receiver Module	Standard devices	5 Nos.

23.	5V/30A RELAY MODULE WITH OPTO COUPLER	Standard devices	10 Nos.
24.	STM32 DEVELOPMENT WITH 2.4" TFT	STM 32 Development Kit with all the standard interfacing facility used such as Input Keyboard, LCD Display, LED Display, Serial port, Parallel Port, Analog input facility.	2 Nos.
25.	Laserjet Printer with A3 size	Laser Printer with USB port, wired and wireless connectivity, A4 and A3 paper feeds, high resolution printing.	1 No.
26.	5KVA UPS	5KVA UPS with 1 Hr backup	1 No.
27.	Server Computer	Latest Server configuration	1 No.
28.	5 Rack Book Shelf (Cob board)	Standard Quality Book shelf	5 Nos.
29.	Computer Table	Computer Table with separate compartment for CPU and Keyboard and Mouse pad.	10 Nos.
30.	Computer Chairs	Cushioned seat and back rest with adjustable Height , armed with 5 wheels base.	20 Nos.
31.	Instructor Table	3' X 2.5' Table, top with smooth finishing, 3 shelf draw on left side and Single cabinet on right side.	2 Nos.
32.	Instructor Chairs	Standard chair with arms.	2 Nos.
33.	AC Machines	2 Tons AC with fan and swift.	4 Nos.
CORE MODULE 4: FIELD INSTRUMENTS AND CONTROLS			
1.	Soldering and De soldering Station		10 Nos.
2.	DMMs		10 Nos.
3.	Function Generators		05 Nos.
4.	CRO		05 Nos.
5.	D.C. regulated power supply (+/- 15V/+/-30V)power supplies		10 Nos.
6.	Transducers Trainers	Trainer Consist of <ul style="list-style-type: none"> • Temperature sensor module • Pressure sensor module • Air-Flow sensor module • Proximity sensor module • Photo electric sensor module • Strain sensor module • Weight /load cell sensor module • Displacement/position sensor module 	05 Nos.

		With accessories	
7.	Instrumentation signal condition Trainer	Input Transducers: Resistance Transducers for applications in angular or linear position: Linearly sliding potentiometer. Rotary carbon-track potentiometer. Rotary coil potentiometer. Precision servo-potentiometer. The Wheatstone Bridge circuit. Applications of temperature: NTC (Negative Temperature Coefficient) Thermistors. RTD Sensor (Platinum Transducer with Temperature dependent Resistance). Temperature sensor IC "Integrated Circuit LM 335". Type "K" Thermocouples. Applications of light: Photovoltaic Cell. Phototransistor. Photodiode PIN. Photoconductive Cell. Linear position and force: Linear Variable Differential Transformer LVDT. =	05 Nos.
8.	Displacement measurement Trainer	LVDT range +/- 10mm Digital display with accessories	05 Nos.
9.	Strain measurement Trainer	Consist of Strain gauge bridge cantilever type, load 500gms, Display unit with accessories	05 Nos.
10.	Vibration measurement Trainer	Contact and contactless speed measurement RPM 0-3000.	05 Nos.
11.	PHOTO TRANSDUCER TRAINER	Input Transducers: Resistance Transducers for applications in angular or linear position: Linearly sliding potentiometer. Rotary carbon-track potentiometer. Rotary coil potentiometer. Precision servo-potentiometer. The Wheatstone Bridge circuit. Applications of temperature: NTC (Negative Temperature Coefficient) Thermistors. RTD Sensor (Platinum Transducer with Temperature dependent Resistance). Temperature sensor IC "Integrated Circuit LM 335". Type "K" Thermocouples. Applications of light: Photovoltaic Cell. Phototransistor. Photodiode PIN. Photoconductive Cell. Linear position and force: Linear Variable Differential Transformer LVDT. =	05 Nos.
12.	Tachometer Digital (DIFFERENT TYPES)	LVDT range +/- 10mm Digital display with accessories	06 Nos.
13.	Speed measurement trainer		05 Nos.
14.	Proximity sensors trainer		05 Nos.
15.	Different types of Hygrometer (02no. EACH)		06 Nos.

16.	Humidity measurement trainer		05 Nos.
17.	Mercury in glass thermometer (various ranges)		05 Nos. (consumable item)
18.	Bimetallic thermometer(various ranges)		05Nos.
19.	Liquid , Gas , and Vapourpressure thermometer(3nos. EACH)		09 Nos.
20.	Thermostatic switches various ranges		05Nos.
21.	OVEN		02 Nos.
22.	MUFFALE FURANCE		02 Nos.
23.	Temperature Transducer Trainer (consisting of, RTD'S, thermisters and different types Thermocouples.)		05 Nos.
24.	Temperature DIGITAL INDICATING transmitter(input RTD,TC) 02 NOS EACH		04Nos.
25.	Measuring and control of temperature Trainer		02Nos.
26.	Digital temperature calibrator,		05Nos.
27.	Smart temperature transmitter(electronic-HART/field bus type)		02 Nos.
28.	Thermal Imager		02 Nos.
29.	Optical pyrometer		02Nos.
30.	Radiation pyrometer		02Nos.
31.	Conductivity meter		02 Nos.
32.	pH meter		2 Nos.
33.	Process recorders (different types)		04 Nos.
34.	Digital manometer		05Nos.
35.	C type, bourdon type , Bellows type , diaphragm type and Capsule type pressure gauges -3nos. each	C type bourdon tube , Bellows type , diaphragm type and Capsule type pressure gauges	15 Nos.
36.	Pressure switches of various ranges	0-5kg/sq,cm 0-10kg/sq.cm	05Nos.
37.	DIGITAL Aneroid barometers		02Nos
38.	Dead weight tester	Dead weight Tester with accuracy 0.25 or below. With dead weight 1-100 kg	01No.
39.	Differential pressure transmitter(pneumatic)	Supply 20psi Output 3-15 psi	02 Nos.
40.	Digital pressure Indicating with transmitter. (different types and range)	Pressure ranges 0-1kg/sqcm, 0-5kg/sq.cm, 0-10kg/sq.cm	05Nos.

		Output : 4 to 20 mA	
41.	Differential pressure transmitter(electronic-HART/field bus type)	Pressure ranges 0-1kg/sqcm, 0-5kg/sq.cm, 0-10kg/sq.cm Output : 4 to 20mA	02 Nos.
42.	Pressure transducers Trainer.	Consists of Pressure transducer -0 to 100 psi Pressure vessel-0 to 100 psi Pressure guage 0 to 150 psi Electronic signal conditioning unit LCD Display unit	05 Nos.
43.	Experimental set up for pressure measurement and control trainer	Pressure range 0 to 10 kg/sq.cm Transmitter Digital panel meter PID controller unit	02 Nos.
44.	HART calibrator	HART calibration instrument with serial communication port with accessories	02 Nos.
45.	LOW PRESSURE calibrator	Dual range, select from 10/30 inH2O or 20/60 inH2O or 35/100 inH2O range combinations Precision: 0.005 % of reading from 10 % to 100 % Full Scale (FS) Control stability: 0.004 % of each range Resolution to 0.0001 inH2O	02 Nos.
46.	Thermal conductivity VACUUM Gauge and McLeod gauge-TWO NOS EACH	Vacuum gauge McLeod gauge	04 Nos.
47.	Air compressor.	Capacity 100 liters	02 Nos.
48.	Vacuum tester with pump, Vacuum gauge, Vacuum transmitter	Measuring ranges from -1.0 bar up to 0..60 bar.	02 Nos.
49.	Instrument test bench FOR PRESSURE		02 Nos.
50.	Positive displacement flow meters (different types) - 2 no each		06 Nos.
51.	Differential flow elements trainer		02 Nos.
52.	Liquid Flow measurement and control trainer		02 Nos.
53.	Air/ gas measurement and Flow control trainer		02 Nos.
54.	Mass flow meter(different type)- 1 no each		03 Nos.
55.	Turbine, Magnetic AND ultrasonic flow meters--2no. Each	Turbine, Magnetic and ultrasonic flow meters--2no. Each	06 Nos.
56.	Instrument test bench FOR FLOW		01No.
57.	Integrated direct level indicator trainer (Hook type, sight glass type, float type,air purge type		02Nos.

	etc.)		
58.	Integrated ELECTRONIC TYPES level indicating Transmitting trainer		02 Nos.
59.	Level DPT transmitter(interface)(HART/Fieldbus/profibuscompatible)-- 1no.each		02 Nos.
60.	Experimental set up for liquid LEVEL measurement and control trainer		02 Nos.
61.	Solid Level measurement and control trainer		02 Nos.
62.	Electronic ON- OFF Controllers for Temperature, Pressure, Level, - Two No each		06 Nos.
63.	PROCESS CONTROL TRAINER Consisting of instrument panel, Computer and interface system. With HART/Field bus devices, for the operations of FEEDBACK, feedforward, cascade, ratio controlling- ONE NO EACH		04 Nos.
64.	Real digital PID controller training kit		02Nos.
65.	Programmable logic controller trainer with application	Modular Siemens S700 Controller with 64 KB or Above memory, <ul style="list-style-type: none"> • 24 V DC 16 DI/ 16 DO, • Current type & Voltage signal 8 AI/8 AO. • Simulation I/O panel. • PLC based Application for Closed Loop process Control model • TIA portal Ladder programming software for Siemens PLC 	02Nos.
66.	Multifunction process control system trainer (different types)-- no each	Pressure, flow, level, temperature control trainer	02 Nos.
67.	Different type of control valves such as gate valves, globe valves, Ball valves, diaphragm valves, butterfly valves with Pneumatic actuator and positioner.	Gate valves, globe valves, Ball valves, diaphragm valves, butterfly valves with Pneumatic actuator and positioner.	05 Nos.
68.	Electrical actuator(solenoid, stepper, motorized, servo type) with manipulator element	Electrical actuator solenoid, stepper, motorized, servo type with manipulator element	04 Nos.
69.	FIELD converters DIFFERENT TYPES -2no. each.	Power supply: 12 to 45V DC Output current: 4 to 20mA	06 Nos. Each
70.	Hydraulic actuator with final control element		02 Nos.
71.	Cutsectionmodelsofvarioustype ofcontrolvalve-1no.each.-	Cut section models of various type of control valve-1no.each.-	05 Nos.

72.	Simulated Unit process control software trainer		04 Nos.
73.	Desktop Computers(latest configuration)with tables (For operating various system trainers) -Licensed operating system(latest version) -Latest MS Office(licensed version)	Intel Processor i5 core or latest and Intel or compatible Motherboard with latest specification desktop PC with keyboard, mouse, LED Monitor, Multimedia Speaker and mic, and accessories.	10 Nos.
74.	Laptop Computers (for convenient to field bus system/control system) with -Licensed operating system(latest version) -Latest MS Office(licensed version)	Intel i5 core 8 th generation or above, 8GB DDR4 or latest version RAM, storage 256GB SSD or Higher storage, Intel UHD graphics or latest, Display 17.3 Inch HD+LED backlit with 1600x900 resolution. Battery life 5 Hours or higher. Windows 10, 64-bit OS software, MS Office –latest version.	10 Nos.
75.	LCD multimedia projector with trolley	<ul style="list-style-type: none"> • WXGA native resolution of 1280 X 800 pixels, • brightness of 500 ANSI Lumens, and • a contrast ratio of 8000:1. 	01 No.
76.	MFD Printer(Scan/copy)	<ul style="list-style-type: none"> • Auto Document Feeder (ADF), Auto Duplex Printing • Print, scan, copy • 5-inch Colour Touchscreen LCD Display • WiFi, LAN, USB, Connectivity 	02Nos.
77.	Computer table with chair	Computer table with chair	10 Nos.
78.	UPS 5 KVA	Output Power: 5 KW, Recharge Time: 8 Hours Backup Time: 3 Hours for 10 Desktop PC Pure sine wave Online double conversion Battery: 10 batteries 12 V DC 75 AH.	02 Nos.
79.	Instrument control panel for wiring practice	Instrument control panel for wiring practice Different sizes	05 Nos.
80.	Cable glands for 2 different sizes	Cable glands for 2 different sizes	05 Nos.
81.	Workbencheswith chairs	1800x900x900mm	20 Nos.
82.	Class Room Chairs with Writing Pad/Tables	Class Room Chairs with Writing Pad type /or Tables	20 Nos.
83.	Work Benches with Chairs	Work Benches with Chairs	20 Nos.
84.	Table with Chair for Trainer/Instructor	Executive type Instructor Table Executive type Instructor Chair	02 Nos.
85.	Smart Single Loop controller		03 Nos.
86.	Smart Multi-Loop controller		03 Nos.

CORE MODULE 5: FIELD INSTRUMENTS AND CONTROLS			
1.	Rockwell ML1400 with DI, DO, AI, AO, Power supply along with 5 different application models for industrial applications	<ul style="list-style-type: none"> • PLC CPU – Modular type • Memory- 32 / 64 K (Program & Data Memory) • Communication Ports- Serial/USB, Ethernet • Digital Inputs: 16 binary, 24 V DC, +ve Logic • Digital Outputs: 16 binary, 24 VDC, +ve Logic • Analog Inputs: 8 Channels, Configurable as Voltage type signal (0 to 10 V dc), Current type signal (4mA to 20mA), resolution: 12bit / 16bit, Configurable as single-ended and differential mode. • Analog Outputs: 8 Channels, Configurable as Voltage type signal (0 to 10 V dc) and also Current type signal (4mA to 20mA), resolution: 12bit/16bit, configurable as single – ended and differential mode. • High Speed Counter(HSC) Module • Device net interface module or equivalent module for interface intelligent inputs and output devices. • Input / Output Simulation Panel: <ol style="list-style-type: none"> a) Consist of 16 binary digital input- 24 Vdc b) 16 binary digital output, - 24 Vdc c) 8 channel analog inputs for both current type signal (4mA to 20mA) and voltage type signal (0 to 10 V dc) d) 8 channel analog inputs for both current type signal (4mA to 20mA) and voltage type signal (0 to 10 V dc). • Bottle Filling automation application • Batch Process reactor model • Stepper motor interface model • Pick and place working model • Elevator working model 	5 nos.

2.	RSlogix 500 software licences	<ul style="list-style-type: none"> Compatible with windows 8.1 / 10 or latest operating system. Supports Ladder Diagram programming. 	10 nos.
3.	Control logix with DI, DO, AI, AO, Power supply along with 3 different application models interfaced to above controller	<p>Chassis type Control Logix Controller with 160KB or Above memory,</p> <ul style="list-style-type: none"> 24 V DC 16 DI/ 16 DO, Current type & Voltage signal 8 AI / 8 AO. Simulation I/O panel. <p>Application Models:</p> <ul style="list-style-type: none"> Servo Motor control AC / DC motor control Closed Loop Speed Control model AC/DC motor control 	5 nos.
4.	Compact logixwith DI, DO, AI, AO, Power supply along with 3 different application models interfaced to above controller	<p>Chassis type Compact Logix Controller with 160KB or Above memory,</p> <ul style="list-style-type: none"> 24 V DC 16 DI/ 16 DO, Current type & Voltage signal 8 AI/8 AO. Simulation I/O panel. <p>Application Models:</p> <ul style="list-style-type: none"> Servo Motor control AC / DC motor control Closed Loop Speed Control model AC/DC motor control 	3 nos.
5.	Rslogix5000 software licences	<ul style="list-style-type: none"> Compatible with windows 8.1 / 10 or latest operating system. Supports Ladder Diagram programming. 	12 nos.
6.	Allen Bradley based redundant system with CPU ,I/O modules with all network resources	<p>Chassis type AB PLC Redundant CPU Controller with 64 KB or Above memory, Redundant CPU</p> <ul style="list-style-type: none"> 24 V DC 16 DI/ 16 DO, Current type & Voltage signal 8 AI / 8 AO. Simulation I/O panel. 	2 sets
7.	Programing terminals	Compatible with Laptop PC	12 nos.
8.	Siemens S7-300 with DI, DO, AI, AO, Power supply along with 3 different application models for industrial applications	<p>Modular Siemens S700 Controller with 64 KB or Above memory,</p> <ul style="list-style-type: none"> 24 V DC 16 DI/ 16 DO, Current type & Voltage signal 8 AI/8 AO. Simulation I/O panel. <p>Application Models:</p> <ul style="list-style-type: none"> Servo Motor control 	5 nos.

		<ul style="list-style-type: none"> AC / DC motor control <p>Closed Loop Speed Control model AC/DC motor control</p>	
9.	Siemens S7-1200 with DI, DO, AI, AO, Power supply along with 3 different application models for industrial applications	<p>Modular Siemens S1200 Controller with 64 KB or Above memory,</p> <ul style="list-style-type: none"> 24 V DC 16 DI/ 16 DO, Current type & Voltage signal 8 AI/8 AO. Simulation I/O panel. <p>Application Models:</p> <ul style="list-style-type: none"> Servo Motor control AC / DC motor control <p>Closed Loop Speed Control model AC/DC motor control</p>	5 nos.
10.	Simatic Manager software licences	<ul style="list-style-type: none"> Compatible with windows 8.1 / 10 or latest operating system. Supports Ladder Diagram and STL programming. 	10 nos.
11.	Siemens LOGO PLC with AI, AO ,RTD and thermocouple modules	<p>Modular Siemens LOGO PLC with 8 KB or Above memory,</p> <ul style="list-style-type: none"> 24 V DC 16 DI/ 16 DO, Current type & Voltage signal 8 AI/8 AO. Simulation I/O panel. <p>Application Models:</p> <ul style="list-style-type: none"> Servo Motor control AC / DC motor control <p>Closed Loop Speed Control model AC/DC motor control</p>	5 nos.
12.	LOGO soft comfort software licences	<ul style="list-style-type: none"> Compatible with windows 8.1 / 10 or latest operating system. Supports Ladder Diagram and STL programming. 	10 nos.
13.	Programing terminals	Compatible with Laptop PC	12 nos.
14.	Mitsubishi PLCs along with software licences	<p>Mitsubishi micro PLC with 8 KB or Above memory,</p> <ul style="list-style-type: none"> 24 V DC 16 DI/ 16 DO, Current type & Voltage signal 8 AI/8 AO. Simulation I/O panel. 	5 nos.
15.	Delta PLCs along with software licences	<p>Delta micro PLC with 8 KB or Above memory,</p> <ul style="list-style-type: none"> 24 V DC 16 DI/ 16 DO, Current type & Voltage signal 8 AI/8 AO. Simulation I/O panel. 	5 nos.

16.	Programming terminals	Compatible with Laptop PC	5 nos.
17.	Safety devices and tools	<ul style="list-style-type: none"> • Hand gloves • Safety google • Gum boots Insulated Hand tools	As required
18.	LED Projector	<ul style="list-style-type: none"> • WXGA native resolution of 1280 X 800 pixels, • brightness of 500 ANSI Lumens, and • a contrast ratio of 8000:1. 	1 no.
19.	Classroom furniture	<ul style="list-style-type: none"> • Instructor Table with chair-1 No. • Work Bench Tables • Class room Table • Chairs 	20 sets

ELECTIVE 1: AUTOMATION USING PLC, SCADA & DCS

1.	Factory talk view studio software for SCADA/HMI	With 100 tags	10 nos.
2.	Programming Terminals	Compatible with Laptop PC	10 nos.
3.	Siemens TIA Portal Licenses for PLC, SCADA/ HMI, VFD with soft-starter	<ul style="list-style-type: none"> • Compatible with windows 8.1 / 10 or latest operating system. • Supports Ladder Diagram and STL programming. 	10 nos.
4.	HMI Panels (Siemens) with software	<ol style="list-style-type: none"> i. Display type: TFT touch screen ii. Display resolution: 800 x 480 or higher iii. Display size: 10 inches iv. Number of interface ports: two or more v. Ports types: serial, USB, Industrial Ethernet vi. Memory : 8MB or higher vii. Colour display viii. Supply voltage: 24Vdc ix. HMI programming software- Compatible with windows 8.1 / 10 or latest operating system x. Communication driver software for PLC and HMI. 	6 nos.
5.	HMI Panels (Allen Bradley) with software	<ol style="list-style-type: none"> i. Display type: TFT touch screen ii. Display resolution: 800 x 480 or higher iii. Display size: 10 inches iv. Number of interface ports: two or 	6 nos.

		<p>more</p> <ul style="list-style-type: none"> v. Ports types: serial, USB, Industrial Ethernet vi. Memory : 8MB or higher vii. Colour display viii. Supply voltage: 24Vdc ix. HMI programming software- Compatible with windows 8.1 / 10 or latest operating system x. Communication driver software for PLC and HMI. 	
6.	Real-time DCS System with model plant	<ul style="list-style-type: none"> • TDC 3000/TPN/TPS system architecture • Local control network for SCADA/HMI • Integrated Experion /TPS/TPN HMI features • DCS Plant with 6 closed loops for flow, level, pressure, temperature, humidity and Speed. 	1 no.
7.	Delta PLC, HMI, VFD and Servo with motors and Software	<p>Delta Micro PLC HMI Specification</p> <ul style="list-style-type: none"> i. Display type: TFT touch screen ii. Display resolution: 800 x 480 or higher iii. Display size: 6 inches Colour display iv. Number of interface ports: two or more v. Ports types: serial, USB, Industrial Ethernet vi. Memory : 8MB or higher vii. Supply voltage: 24Vdc viii. HMI programming software- Compatible with windows 8.1 / 10 or latest operating system ix. Communication driver software for PLC and HMI. x. VFD with servo drive application kit. 	5 nos.
8.	Mitsubishi PLC, HMI, VFD, Servo with motors and Software	<p>Mitsubishi Micro PLC HMI Specification</p> <ul style="list-style-type: none"> i. Display type: TFT touch screen ii. Display resolution: 800 x 480 or higher iii. Display size: 6 inches Colour display 	5 nos.

		<ul style="list-style-type: none"> iv. Number of interface ports: two or more v. Ports types: serial, USB, Industrial Ethernet vi. Memory : 8MB or higher vii. Supply voltage: 24Vdc viii. HMI programming software- Compatible with windows 8.1 / 10 or latest operating system ix. Communication driver software for PLC and HMI. <p>VFD with servo drive application kit.</p>	
9.	LCD/LED Projector	<ul style="list-style-type: none"> • WXGA native resolution of 1280 X 800 pixels, • brightness of 500 ANSI Lumens, and • a contrast ratio of 8000:1. 	1 no.
10.	LCD / LED Projector Screen with motorized control	Screen with Motorised control with 230Vac 50 Hz supply	1 no.
11.	Industrial Ethernet / LAN Networking Setup for PLC, SCADA and DCS control Systems	<ul style="list-style-type: none"> • Layer-3 Switch 24 port. • Ethernet Converter for PLC communication port • Compatible to SCADA and DCS Hardware. • LAN setup and cable layout in PLC Lab. 	1 no.
12.	24 port Ethernet Switch with PoE	<ul style="list-style-type: none"> • LAYER-2/LAYER 3 , 24 port switch with PoE 	2 sets
13.	DCS software of different vendors	<ul style="list-style-type: none"> • Honeywell redefined industrial automation with Experion PKS(Process Knowledge System) 	5 nos.
14.	DCS Controller hardware both dedicated and PLC based DCS multi user environment.	<ol style="list-style-type: none"> 1. Stand-alone DCS: TDC 3000/TPN/TPS system architecture, Local control network for SCADA/HMI, Integrated Experion /TPS/TPN HMI features. 2. PLC based Hybrid DCS: Hybrid Controller unit, Digital (24 V DC) and analog I/Os with 4 to 20 mA / 1-5 V dc standard signal. 3. SCADA for DCS controller. 	2 each
15.	Desktop PCs with latest configuration	Intel Processor i5 core or latest and Intel or compatible Motherboard with latest specification desktop PC.	20 Nos.
16.	5 KVA UPS	Output Power: 5 KW,	1 No.

		Recharge Time: 8 Hours Backup Time: 3 Hours for 10 Desktop PC Pure sine wave Online double conversion Battery: 10 batteries 12 V DC 75 AH.	
17.	Hand held Digital Multimeter	Type : Autoranging Digital Multimeter, Display : 3 5/6 Digit, Counts : 6000 AC Voltage Range : 600Mv/6/60/600/750V	10 Nos.
18.	Magnetic screw driver PC tool set	840 screw driver set – magnetic type	10 set
19.	Safety devices and tools	<ul style="list-style-type: none"> • Hand gloves • Safety google • Gum boots • Insulated Hand tools 	As required
20.	Cat 6 Ethernet Cable	Cat -6	As required
21.	Ethernet Crimping Tools	SN28B crimping tool set	5 set
22.	Extension board with spike buster	6 port extension board with spike buster	10 set
23.	Class room furniture and Chairs	Class room furniture and Chairs	20 sets
24.	Instructor Table and Chair	Instructor Table and Chair	1 Set
25.	Air Conditioner as per Lab & Class room Area	1.5 ton capacity AC- 6 Nos as per requirements	As required
ELECTIVE 2: MECHATRONICS			
1.	Basic pneumatic training kit	Basic Trainer Kit consists of following componenets FRL Unit, Limit Switches, single and double acgtic cylinders, pressure switch, flow control switch, AND & OR Valves. Silent air compressor with storage 20 liters.	7 sets
2.	Advanced pneumatic training kit	The Trainer Kit consist of Following componenets <ul style="list-style-type: none"> • Working under10 bar operating pressure. • pneumatic components, Valves with push button type, rotary type , pilot operated. Trolley with frame & caster wheels Quick Push Pull connector Plastic Tubing (PU6) 3/2 way Direction Control valve 5/3 way Direction Control valve with Hand Lever Two Way Valve (AND Gate) Flow Control	7 sets

		valve Single acting cylinder 5/2 way Single Solenoid FRL Unit (Filter Regulator & Lubricator) Mounting Plates T Block Isolator Block Pneumatic Motor Starter valve Double acting cylinder. . Silent air compressor with storage 20 liters.	
3.	Basic electro-pneumatic training kit	Basic electro pneumatic trainer kit with 10 bar operating pressure. Electrically operating different solenoid valves and switches sensors and cylinders, FRL unit., 24 V DC power supply With electrical and pneumatic accessories. . Silent air compressor with storage 20 liters.	7 sets
4.	Advanced electro-pneumatic training kit	Micro PLC based Electro pneumatic trainer kit with 10 bar operating pressure. Electrically operating different solenoid valves and switches, proximity sensors (capacitive, photo- electric, magnetic, inductive types) and cylinders, FRL unit. 24 V DC power supply With electrical and pneumatic accessories. . Silent air compressor with storage 20 liters.	7 sets
5.	Basic hydraulic training kit	Basic Hydraulic Trainer Kit consist of <ul style="list-style-type: none"> • Self reciprocating cylinder • Manifold for distribution • Directional control valves. 4/2, 4/3 way • Engrossed with transverse and feed circuit • Wall mounting assemblies of hydraulic actuator • Contain hydraulic motor & hydraulic accumulator • Meter-in circuit, Meter-out and bleed-off circuit • Oil hydraulic power pack required for power supply • Double cylinder: bore diameter: 40 mm, stroke length: 75/100 mm • Single acting cylinder: bore diameter: 40 mm, stroke length: 75/100 mm 	7 sets
6.	Advanced hydraulic training kit	Hydraulic Trainer Kit with List of Components: Trolley with frame &	7 sets

		<p>caster wheels Hydraulic tank with filter & breather Single phase flange mounted electric motor Pressure Gauges Gear Pump Bell Housing Flexible Coupling Pressure Relief Valve Flow Control Valve Pressure Sequence Valve Pressure Reducing Valve 4/3 way manually operated direction control valve Single Acting Cylinder Double Acting Cylinder Check Valve Pilot Operated Check Valve Needle Valve Flow Meter Hydraulic Motor Valve Mounting Plate Hoses Quick Coupling. Hydraulic Power Pack.</p>	
7.	Basic electro-hydraulic training kit	<p>Basic Electro-hydraulic Trainer Kit consists of</p> <ul style="list-style-type: none"> • Micro PLC with DI and DO with accessories like, Programming software, Communication cable, etc. • QRC couplings provided tubing/hose pipes • Double acting cylinders: bore dia-40 mm, stroke length: 75/100 mm • Single acting cylinders: bore dia-40 mm, stroke length: 75/100 mm • Wall mounting assemblies of hydraulic actuators • Comprises hydraulic motor, solenoid valves and limit switches • Proximity type sensors • 24V DC Power supply with accessories • Manifold for distribution • Oil hydraulic power pack 	7 sets
8.	Advanced electro-hydraulic training kit	<p>Advanced Electro-hydraulic Trainer Kit consists of</p> <ul style="list-style-type: none"> • Micro PLC with Digital I/O, Analog I/O with accessories like, Programming software, Communication cable, etc. • QRC couplings provided tubing/hose pipes • Double acting cylinders: bore dia-40 mm, stroke length: 75/100 mm • Single acting cylinders: bore dia-40 mm, stroke length: 75/100 mm • Wall mounting assemblies of 	7 sets

		hydraulic actuators <ul style="list-style-type: none"> • Comprises hydraulic motor, solenoid valves and limit switches • Proximity type sensors • Proportional Valves and servo controlled valves • 24V DC Power supply with accessories • Manifold for distribution • Oil hydraulic power pack 	
9.	Desktop Computer systems for Fluid Simulation (hydraulics & pneumatics)	Intel Processor i5 core or latest and Intel or compatible Motherboard with latest specification desktop PC.	20 sets
10.	Fluid Simulation software for (hydraulics & pneumatics)	Automation studio – circuit design and simulation software or equivalent.	20 licenses
11.	Mechatronics Simulation software	MSC mechatronics simulation software- latest version	20 licenses
12.	Modular Production System – Distribution station		2 sets
13.	Modular Production System – Testing station		2 sets
14.	Modular Production System – Processing station		2 sets
15.	Modular Production System – material Handling station	PLC based Automated Material handling station with accessories	2 sets
16.	Modular Production System – Sorting station	Automated material sorting model with accessories	2 sets
17.	Modular Production System – Pick and place station	Pick and place working model with accessories	2 sets
18.	Modular Production System – Fluidic muscle station	Press fitting with accessories	2 sets
19.	Modular Production System – Storing station	Automated material storing model with accessories	2 sets
20.	Class room furniture (Tables & chairs)		20 each
21.	Programmable logic controller with software licenses		4 nos.
ELECTIVE 3: ROBOTIC CONTROL SYSTEMS			
1.	Industrial Robot for Material Handling applications	Made up of MS, capacity 5 – 150 Kg Maximum reach 0.5 – 2 m Material handling application Supply voltage 230Vac, 50Hz	2 Nos.
2.	Robotic trainer kits with accessories	Movable base 3-axis robot vehicle Trainer Kit with accessories	4 Nos.
3.	Pick and place robotic arm	<ul style="list-style-type: none"> • Pick and place robotic arm 	5 Nos.

	Trainer with Programming software tool	<p>controller unit</p> <ul style="list-style-type: none"> manipulator unit Grippers arm with fingers Sensors Drives Source of power (pneumatic and electrical)for robotic arm 	
4.	End of arm Tooling Robotic unit	End of arm Tooling Robotic unit consists of Gripper arms and fingers – 2 nos and clamps – 2 Nos. with control unit and accessories.	5 Nos.
5.	Automated Assembly Kit	Automated assembly robot Trainer Kit with accessories	1 No
6.	Press Tending Robot with Programming software tool	<ul style="list-style-type: none"> The PC-based RobotStudio Machine Tending PowerPac. Robot controller-based RobotWare 	5 Nos.
7.	Profile plate and stand	4 feet x 5 feet	4 nos.
8.	Plastic tubing	4mm, 6mm, 8mm, 10mm, 12mm	200 mtr.
9.	Power supply	230Vac 50 Hz, 24V DC output, 2A Load	10 nos.
10.	Set of cable	<p>Patch Cord with male banana connector</p> <p>Patch cord with female banana socket</p>	10 nos.
11.	Electrical limit switch light	4A DC, operating force 30N, Supply 24V DC.	4 nos.
12.	Plug in adopter	Set of male and female adaopter	4 nos.
13.	Proximity switches reed contact	Sensing distance 0-10mm, Supply voltage 10-30V, switching frequency: 5 Hz, NPN or PNP output	8 nos.
14.	Proximity switch capacitive	Sensing distance 0-10mm, Supply voltage 10-30V, switching frequency: 5 Hz, NPN or PNP output	4 nos.
15.	Proximity switch inductive	Sensing distance 0-10mm, Supply voltage 10-30V, switching frequency: 5 Hz, NPN or PNP output	4 nos.
16.	Proximity switch optical	Sensing distance 0-10mm, Supply voltage 10-30V, switching frequency: 5 Hz, NPN or PNP output	4 nos.
17.	T Connector	Push in fit type nylon T connector- 4mm, 6 mm, 8mm, 10mm and 12mm	60 nos.
18.	Connection component set	TP 400 COMPONENT SET	
19.	Pressure regulator with gauge	Range-10 kg/cm ² , oput adjustable, 1/2inch out port, pressure indicator	10 nos.
20.	Programmable logic controller	<ul style="list-style-type: none"> ML-1400 CONTROLLER PLC CPU – Modular type Memory- 32 / 64 K (Program & 	10 nos.

		<p>Data Memory)</p> <ul style="list-style-type: none"> • Communication Ports- Serial/USB, Ethernet • Digital Inputs: 16 binary, 24 V DC, +ve Logic • Digital Outputs: 16 binary, 24 VDC, +ve Logic • Analog Inputs: 8 Channels, Configurable as Voltage type signal (0 to 10 V dc), Current type signal (4mA to 20mA), resolution: 12bit / 16bit, Configurable as single-ended and differential mode. • Analog Outputs: 8 Channels, Configurable as Voltage type signal (0 to 10 V dc) and also Current type signal (4mA to 20mA), resolution: 12bit/16bit, configurable as single – ended and differential mode. 	
21.	Software tool for programming	PLC software RS-LOGIX 500 ,for ladder programming	10 license
22.	Programming cable,	RS-232/ Ethernet cable	10 nos.
23.	I/O Data cable	D-Type 25 pin cable-male and female connector to connect I/O modules	10 nos.
24.	Robot controller unit	<p>Consists of PLC control unit</p> <ul style="list-style-type: none"> • Displacement in all 3 planes and 4-axis • Capable of pick and place • Variable jaw area and pic objects of different shapes • Movement of height adjustable while lifting 	10 nos.
25.	Robot accessories – sensors, sensor modules, wiring terminals, key pads, collision sensors, different types of grippers, Batteries, etc.	Robot accessories – sensors, sensor modules, wiring terminals, key pads, collision sensors, different types of grippers, Batteries, etc.	As required (Approx 100no's)
26.	Class room furniture	<ul style="list-style-type: none"> • Instructor Table with chair-1 No. • Work Bench Tables • Class room Table • Chairs 	20 sets
27.	Instructors Table and chairs	Instructors Table-Executive Instructor Chairs-Executive	1 set
28.	Desktop PCs with latest configuration	Intel Processor i5 core or latest and Intel or compatible Motherboard with latest specification desktop PC. 17.5	10 Nos.

		Inch LED monitor, Keyboard, optical mouse, multimedia speaker, mic.	
29.	Computer Tables and chairs	Computer Tables and chairs	10 set
30.	White board for class room	6 width X4 hieght Feet	1 no.
31.	LCD/LED Projector	<ul style="list-style-type: none"> • WXGA native resolution of 1280 X 800 pixels, • brightness of 500 ANSI Lumens, and • a contrast ratio of 8000:1. 	1no.
32.	LCD Projector screen – motorised control	Screen with Motorised control with 230Vac 50 Hz supply	1 no.



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ANNEXURE-II

FORMAT FOR INTERNAL ASSESSMENT

Name & Address of the Assessor:			Year of Enrollment:											
Name & Address of ITI (Govt./Pvt.):			Date of Assessment:											
Name & Address of the Industry:			Assessment location: Industry / ITI											
Trade Name:		Examination:				Duration of the Trade/course:								
Learning Outcome:														
S No.	Maximum Marks (Total 100 Marks)		15	5	10	5	10	10	5	10	15	15	Total Internal Assessment Marks	Result (Y/N)
	Candidate Name	Father's /Mother's Name	Usage of PPE	Workplace Hygiene	Punctuality & Discipline	Ability to Read & Interpret Manuals/ Catalogues/Datasheets	Application of Knowledge & Skills	Ability to work in team and leadership skills	Communication and Interpersonal Skills	Attitude towards work	Quality in Workmanship	VIVA		
1														
2														