

**National Vocational & Technical Training Commission
(NAVTTTC)**

**Curriculum for
Certificate in Mechatronic Technician
(Duration: 2 Years)**

March 2015

Contents

1. Course Title

Mechatronics Technician

2. Job Profile

Mechatronics technician could find themselves in industry engaged with maintenance and operation of plant equipment such as boilers, compressors, turbines, instrumentation, automation and control of advanced industrial processes using such tools as PLC and microcontroller-based control systems, process simulation for plant modifications, defense and R&D applications, engineering management, or a variety of similar areas.

3. Overall Objectives of the Course

Following are the objective of this training to enables youth to plan, execute and evaluate work related tasks within the scope of their occupational activity

- Plan, execute separately, check and correct the electromechanical sub-system and where necessary evaluate in writing the theory and procedure of main system
- Take a quick action with absolute technical understanding of Mechatronics equipment.
- Have a good working knowledge of Mechatronics and its associated equipment
- Understand basic engineering principles required to implement in Process/ manufacturing industry
- Essential conformance to safe working through OHSE (occupational health and safety environment)
- Safe and smooth operation of process / Mechatronics equipment and its sub-system and set / adjust its control parameters.
- Safe operation of starting up and shutting down of plant and its operating machinery
- Ensure and develop the hierarchy of fault diagnosis to derive the conclusion for error rectification of Mechatronics system
- Awareness about manual response on plant in the event of computer failure

3.1 Synopsis and Details (Competencies Gained after Completion of Course)

- Localize, identify causes and sources, correct where possible and/or document malfunctions to be passed on to the appropriate experts for resolution, or (where appropriate) exchange or replace defective components.
- Recognize potential or impending malfunctions and contact expert assistance in order to keep the production line functioning and to prevent production loss
- Perform routine, preventive maintenance
- Explain the principal operations of the mechatronic subsystems in a complex system and explain how these subsystems work together
- Read the technical documents, reports and outlines specific to the system and subsystems, and be able to consult with experts
- Work effectively as a team-member and coordinate the activities with upstream and downstream operations
- Follow safety regulations required for operation of the system

3.2 Job Opportunities

Graduate can be employed in some of the following sectors

- Process industry
- Computer and Electronic manufacturing industry.
- Manufacturing and production house
- Pharmaceutical Industry
- Chemical industries
- Packaging and shipping complex
- Food and beverages companies
- Entrepreneurship

3.3 Trainee Entry Level:

- Matric (science)
- Matric (tech)
- TSC

3.4 Minimum Qualification of Trainer/Instructor

- B.E / B-Tech. in Mechatronics , Electronics(having minimum 2 years of relevant experience)
- DAE in Mechatronics/Automation/Electronics/Instrumentation/Mechanical)

3.5 Medium of Instruction

English /Urdu

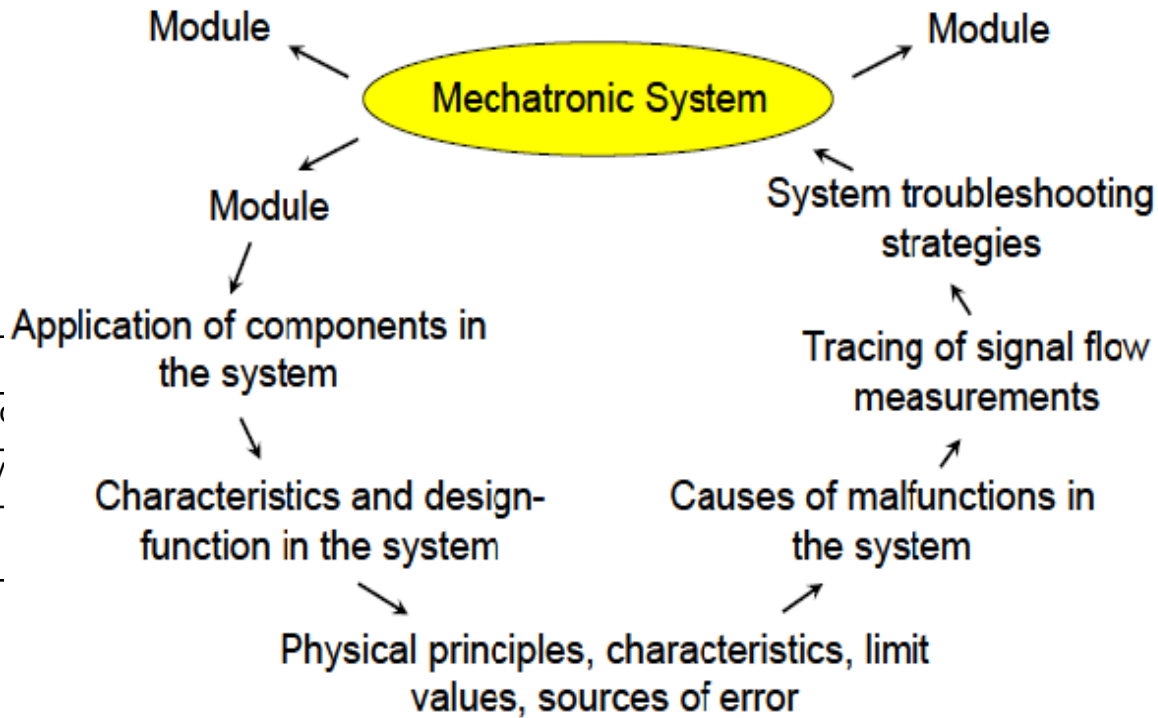
4. Sequence of Module

The Industrial & academic experts have defined **NVQF level** of Mechatronics Technician course as **Level 2**, which consists of seven (7) key technical modules and should be delivered in the following sequence of Modules;

5. Course philosophy / Strategy

- Students learn about individual components and system characteristics within the context of an actual mechatronic system.
 - At the beginning of this course, students should first be presented with a complex system.
 - By visiting and focusing on an actual machine as a whole, students understand clearly why they are learning the subject material.

Teaching Philosophy – System Approach



6. Overview

At Institute (Includ
At OJT/Company
Total Duration

about the Curriculum for Mechatronic Technician

	Hours Allocation
	1600
	1600
	3200

Module Title & Aim	Learning Units	Theory Hours	Workplace Hours	Time Frame of The Modules
Module A: Maintain Electrical System Aim: Understand Mechatronics related electrical system	A-1 Maintain electrical system installation of mechnronics system	5	18	23
	A-2 Maintain electrical wiring system of mechatronics system	5	19	24

maintenance. It also deals with basic electrical wiring, trouble shooting in the system, identification and handling of tools and equipment to perform electrical maintenance	A-3 Maintain electric equipment of mechnronics system	5	19	24
	A-4 Maintain switch gears	5	19	24
	A-5 Diagnose faults in electrical system	5	19	24
	A-6 Repair electrical system	5	19	24
Module B: Maintain Hydraulic System	B-1 Perform commissioning of hydraulic system	5	18	23
Aim: Understand Hydraulic system maintenance. It also deals with basic Hydraulic concepts, Tests performance and verification of system, maintenance of energy flow and repairing of hydraulic system installed in process industry.	B-2 Maintain fluid parameters	5	19	24
	B-3 Maintain energy flow in hydraulic system	5	19	24
	B-4 Diagnose fault in hydraulic system	5	19	24
	B-5 Replace equipment in hydraulic system	5	19	24
	B-6 Repair hydraulic system	5	19	24
Module Title & Aim	Learning Units	Theory Hours	Workplace Hours	Time Frame of The Modules
Module C: Maintain pneumatic system	C-1 Perform commissioning of pneumatic system.	6	22	28

Aim: Understand Pneumatic system maintenance in process industry. It also deals with basic Pneumatic concepts, Test performed and verification of system. Maintenance of temperature & Perform repairing in pneumatic system	C-2 Verify Pneumatic system parameters	6	23	29
	C-3 Diagnose fault in Pneumatic system	6	23	29
	C-4 Replace equipment in Pneumatic system	6	23	29
	C-5 Repair pneumatic system	6	23	29
Module D-Maintain PLC system Aim: Understand PLC system maintenance in process industry. It also deals with basic concepts of PLC, basics of programming, testing performance & verification of PLC system and performing PLC repair and maintenance.	D-1 Apply tug out on PLC system	3	12	15
	D-2 Clean attachments in PLC system	3	13	16
	D-3 Check Input Output (I/O) modules for operation	3	13	16
	D-4 Test performance of sensor	3	13	16
	D-5 Perform PLC Test	3	13	16
	D-6 Maintain PLC temperature	3	13	16
	D-7 Replace PLC hardware	3	13	16
	D-8 Diagnose faults in PLC system	3	13	16
	D-9 Replace part in PLC system	3	13	16

Module Title & Aim	Learning Units	Theory Hours	Workplace Hours	Time Frame of The Modules
Module E: Install Mechatronics system Aim: Understand Mechatronics system Installation in industrial plant. It also deals with basic concepts, Testing and verification of the system, maintenance of energy flow and repair of hydraulic system installed in process industry.	E-1 Install system wiring	2	9	11
	E-2 Install electrical devices	2	10	12
	E-3 Install piping system	2	10	12
	E-4 Install Mechanical system	2	10	12
	E-5 Install hydraulic equipment	2	10	12
	E-6 Install pneumatic equipment	2	10	12
	E-7 Install electronics equipment system	2	10	12
	E-8 Insert sensors in system	2	10	12
	E-9 Install functional correlation in system	2	10	12
	E-10 Perform system calibration	2	10	12
	E-11 Test off load system performance	2	10	12

	E-12 Test full load system performance	2	10	12
Module Title & Aim	Learning Units	Theory Hours	Workplace Hours	Time Frame of The Modules
Module F: Perform Preventive Maintenance Aim: Understand and Apply preventive maintenance of Mechatronics system. It also deals with basic concepts of maintenance scheduling, indoor clean-ups, shutting the system off and turning it on, verification, service assorted equipment and repair minor faults of the system.	F-1 Follow system maintenance plan	3	10	13
	F-2 Shut down mechatronics system	3	10	13
	F-3 Perform indoor clean-ups	3	10	13
	F-4 Perform Lubrication in system	3	10	13
	F-5 Inspect safety installation	3	10	13
	F-6 Service Electrical Devices	3	10	13
	F-7 Service piping system	3	10	13
	F-8 Service pneumatic equipment system	3	10	13
	F-9 Service hydraulic equipment	3	10	13
	F-10 Service Electronics equipment	3	10	13
	F-11 Start up system after Preventive Maintenance	3	10	13
Module G: Demonstrate Safety	G-1 Adopt personal safety measures	10	37	47

Aim: Demonstrating skill and knowledge of personal health, safety, infrastructural safety, firefighting, first aid procedures, quality and environment related regulations in industrial workplace.	G-2 Adopt equipment safety measures	10	37	47
	G-3 Demonstrate Workplace Safety	10	37	47

Module Title & Aim	Learning Units	Theory Hours	Workplace Hours	Time Frame of The Modules
Module 6: Computer Skills I Aim: Learn to use Computer effectively	See Annexure A	0	40	40
Module 3: English Skills I Aim: To enhance students understanding about English language for reading, listening and speaking	See Annexure-B	40	0	40
Module 5:Life Skills I Aim: Add values to technical skills through intra- personal and inter-personal skills	See Annexure-C	30	0	30
Secondary skills and activities I Aim: To add value in monthly assessment and extra curriculum activities	See Annexure-D	0	190	190

Module4: English- II Aim: To improve their writing capacity and enable them to speak English language fluently	See Annexure-B	40		40
Module13: Computer Skills II Aim: Get awareness of latest drawing and designing tools through computer applications used in the industry	See Annexure-A	0	40	40
Module Title & Aim	Learning Units	Theory Hours	Workplace Hours	Time Frame of The Modules
Module14: Life Skills- II Aim: Add value to technical skills	See Annexure-C	30	0	30
Secondary skills and activities II Aim: To add value in monthly assessment and extra curriculum activities	See Annexure-D	0	190	190

Module 10: On-the-Job Training Aim: Gain real workplace understanding, skills and experience Orientation of real workplace environment, skills and experience	10.1 Company orientation 10.2 Health, Safety & Environment overview 10.3 Personal protective equipment (PPE) 10.4 Central Documentation Department 10.5 Maintenance / operations 10.6 Production & process control (PPC)			1600 Hrs. (1 Year)
Module 20: On the Job Training Aim: Deepen the understanding and skills for the concepts taught in the modules and building skills for self - learning.	20.1 Review of OJT of phase I 20.2 Quality Assurance / Quality Control 20.3 Inventory Management 20.4 Maintenance / operation /Documentation 20.5 Commissioning and operation of Mechatronics system 20.6 Trouble shooting and problem solution			
Module 30 : Review and Preparation Aim: To review the content and assess through examination for output and quality of the trained person	1. Review ,recap and reflection 2. Final examination preparation		40	20

7. Mechatronics Technician Teaching and Learning Guide

7.1 Module A Title: Maintain Electrical System

Objective of the Module: Understand Mechatronics related electrical system maintenance. It also deals with basic electrical wiring, trouble shooting in the system, identification and handling of tools and equipment to perform electrical maintenance

Duration		Practical		
143hrs		113 hrs		
Learning Unit	Learning Outcomes	Learning Elements	Duration	Tools / Equipment / Material
A-1 Maintain electrical system installation of mechatronics system	Trainee Should be able to. <ul style="list-style-type: none"> Operate power tools Operate electrical testing and measuring instrument according to SOPs Maintain tools test and measuring instrument for 	<ul style="list-style-type: none"> Interpret electrical drawing / manual Describe electrical quantities Differentiate Alternating and direct current 	Total 23 Theory 5 Practical 18	Multimeter, Drill Machine, Screw Drivers, Pliers, wire cutters, strippers DC Power Supply, Different types Resistors , Capacitors, Inductors , Diodes & Transistors

	<p>proper working / operation</p> <ul style="list-style-type: none"> • Diagnose fault in electrical system according to the recommended steps/ method prescribed in service manuals instructions • Remove Faulty Unit from electrical system implementing necessary safety measures 	<ul style="list-style-type: none"> • Identify electrical tools • Use test and measuring instrument • Calculate electrical quantities in circuits • Interpret electrical component specifications • Describe necessity of earthing system • State characteristics of semi-conductor components and circuits • Identify current path in D.C power supplies • State characteristics of analogue and digital electronic circuits • Demonstrate: <ul style="list-style-type: none"> • Measurement of electrical and thermal quantities • Testing of passive electrical components and 		
--	---	--	--	--

		devices <ul style="list-style-type: none">• Removing of faulty electrical component		
--	--	---	--	--

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment material required	Learning Place
A-2 Maintain electrical wiring system of mechatronics system	Trainee Should be able to. <ul style="list-style-type: none"> • Terminate electrical wiring as per SOPs • Connect wires and cables according to the diagram • Maintain installed cables / conductors / conduit / enclosures and supports of electrical systems as per SOPs • Protect phase reversal 	<ul style="list-style-type: none"> • Identify parts of electrical installation • Calculate cable resistance and current carrying capacity • Enlist types of electrical joints • Describe single and three phase electrical power distribution systems • State trouble shooting methods in electrical wiring • State power losses in electrical circuit • Demonstrate procedure of maintaining electrical system: <ul style="list-style-type: none"> ○ Check ○ Check Alignment ○ Inspect fuses and circuit breakers ○ Inspect phase reversal 	Cables of Different voltage, colour codes, Current rating and Current carrying capacity. Fuse and Circuit breakers of different ampere ratings. Megger.	Class room and Institute laboratory

<p>A-3 Maintain electric equipment of mechatronics system</p>	<p>Trainee Should be able to:</p> <ul style="list-style-type: none"> • Measure efficiency of electrical machine as per OEM • Diagnose fault in electrical equipment following service manuals instructions • Remove Fault from electrical equipment adopting safety measures • Replace motors in electrical system considering compatibility • Replace D.C Power source /supply in the system considering compatibility 	<ul style="list-style-type: none"> • Define working principal of A.C machines used in process industry • Describe construction of A.C/D.C/ Servo and Stepper Motors machine used in process industry • Calculate speed and efficiency of electric motors • Interpret motor characteristics chart / curve • Demonstrate process to maintain electrical equipment by: <ul style="list-style-type: none"> ○ Testing of electrical machine ○ Diagnosis of fault ○ Removal of fault ○ Replacing D.C. Power source 	<p>AC , DC Motors , Servo Motors & Stepper Motor AC/ DC Generators Service Manuals. Tachometer DC Power source.</p>	<p>Class room and Institute laboratory</p>
--	---	--	---	--

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment material required	Learning Place
A-4 Maintain switch gears	Trainee Should be able to. <ul style="list-style-type: none"> • Perform cold test of fuse, circuit breaker, contractor, switch and relay for normal working • Perform Live test on fuse, circuit breaker, contractor, switch and relay for normal working • Replace switchgears 	<ul style="list-style-type: none"> • Describe principles electro magnetism • Enlist electrical switch gears • Interpret data of electrical switch gear • Demonstrate, removal of switch gears and replacement of switch gears 	Solenoid ,Fuse, Circuit Breakers, Magnetic Contactors and Relays of different ratings	Class room and Institute laboratory

	<p>in mechatronics electrical installation considering their compatibility</p>			
<p>A-5 Diagnose faults in electrical system</p>	<p>Trainee Should be able to.</p> <ul style="list-style-type: none"> • Verify panel wiring for normal operation • Diagnose electrical fault in mechatronics electrical installation using prescribed diagnostic methods • Diagnose mechanical 	<ul style="list-style-type: none"> • Define Electrical panel • Describe the basis for testing the function of electrical equipment in electrical system • Demonstrate trouble shooting method in mechatronics electrical system • Describe diagnostic tools and equipment • Describe integrated fault diagnostic system 	<p>Multimeter ,Screw Drivers & Phase Tester. Transistor & IC Transistor.</p>	<p>Class room and Institute laboratory</p>

	<p>fault in electrical installation of mechatronics system using prescribed diagnostic methods</p>			
Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment material required	Learning Place

A-6 Repair electrical system	Trainee Should be able to. <ul style="list-style-type: none"> • Interpret wiring diagram and panel diagram • Check Electrical Panels for normal working • Perform diagnosis tests in electrical system for fault diagnose implementing prescribed methods in system manual • Rectify the trouble in electrical system for normal operation • Test electrical system performance after repairing for normal operation 	<ul style="list-style-type: none"> • Describe common faults in electrical system • Describe Troubleshooting techniques in electrical circuits • Demonstrate procedure of troubleshooting in the electrical system: <ul style="list-style-type: none"> ○ Checking ○ Diagnosis ○ Rectification ○ Performance test 	Electrical Panel Layout and Wiring Diagrams. Multimeter, Set of Screw drivers and Pliers. Soldering Iron	Class room and Institute laboratory
-------------------------------------	--	---	--	-------------------------------------

7.2 Module B Title: Maintain Hydraulic System

Objective of the Module: Understand Hydraulic system maintenance. It also deals with basic Hydraulic concepts, Tests performance and verification of system, maintenance of energy flow and repairing of hydraulic system installed in process industry.

Duration	Theory	Practical
143 hrs	30 hrs	113 hrs

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment material	Learning Place
B-1 Perform Commissioning of hydraulic system.	<p>Trainee Should be able to.</p> <ul style="list-style-type: none"> • Verify hydraulic cylinder performance for normal working • Test filters performance for clogging • Verify performance of hydraulic gauges and Valves for normal working • Verify performance of hydraulic Pumps for normal working • Verify performance of solenoid valves 	<ul style="list-style-type: none"> • Interpret hydraulic drawing / manual • Define measuring units in hydraulics, Hydrostatics, hydrodynamics, Fluids and Viscosity • State static and dynamic characteristics of instruments • Calculate fluid pressure in hydraulic system • Draw hydraulic cycle • Describe Fluid parameters • Explain working of industrial hydraulic system parts • Classify hydraulic systems • Identify fluid control components • Describe the purpose of fluid conductors/pipes • Demonstrate procedure of commission of 	<p>Hydraulic Pumps, Hydraulic Cylinder and Hydraulic Gauges. Fluid Meter & Oil of required density</p>	Class room and Institute laboratory

		hydraulic system: <ul style="list-style-type: none"> ○ Verification ○ Testing of performance of hydraulic gauges ○ Testing of performance of hydraulic pumps 	a 1 8	
Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment material	Learning Place
B-2 Maintain fluid parameters	Trainee Should be able to <ul style="list-style-type: none"> • Verify Regulators for proper working • Verify Fluid Reservoir for proper working. • Verify Pressure gauges for proper working • Maintain Fluid Viscosity/density /pressure / temperature for normal system operation 	<ul style="list-style-type: none"> • Describe Hydraulic system components. • Describe working of hydraulic components. • Define Core Concepts of fluid Parameters • Explain basic Equations of fluid behavior. • Define flow types. • Characteristics of the hydraulic oils. • Interpret hydraulic circuit drawings 	T o Hydraulic Circuit t drawings. a Oils of different Viscosity l and Density. 2 Pressure gauge. 4 T h e o r y 5 P r a c t i c	Class room and Institute laboratory

			a 1 9	
B-3 Maintain energy flow in hydraulic system	Trainee Should be able to <ul style="list-style-type: none"> • Save energy losses within predetermined tolerance • Check Sensors performance according to their sensing limitations 	<ul style="list-style-type: none"> • Explain force transmission in hydraulic system. • Thermal properties of mater • working principle of instrument used in energy flow system • Working of Filters • Functions of hydraulic Sensors 	T o f a l l 2 4 T h e o r y 5 P r a c	Hydraulic Sensors, Filters for hydraulic system. Class room and Institute laboratory

			ti c a 1 9	
B-4 Diagnose fault in hydraulic system	<p>Trainee Should be able to</p> <ul style="list-style-type: none"> • Check fluid leakage from Hydraulic system by implementing prescribed fluid leakage checking methods • Diagnose faulty equipment/part in hydraulic system conductors implementing prescribed methods in system manual 	<ul style="list-style-type: none"> • Define faults Procedures in hydraulic System • State principles of energy conversion • Enlist components of hydraulic circuit with their applications. • Describe the operation and performance of equipment in hydraulic circuit • Demonstration of faults <ul style="list-style-type: none"> ○ Check leakage in pipes ○ Solenoid valve ○ Isolation valves ○ Pressure gauges ○ Pipe fittings ○ Hydraulic safety 	T S y s t e m l a y o u t d i a g r a m s L e a k a g e T e s t e r . S o l e n o i d , i s o l a t i o n v a l v e s . P i p e f i t t i n g s a n d h y d r a u l i c s a f e t y . 4 T h e o r y 5 P r a c t i c e	Class room and Institute laboratory

			ca 1 9	
B-5 Replace equipment in hydraulic system	<p>Trainee Should be able to</p> <ul style="list-style-type: none"> Remove Faulty equipment from hydraulic system according to the instructions in system manual Replace correct equipment in hydraulic system according to the system manual 	<ul style="list-style-type: none"> Standard procedure of replacing a faulty part in Hydraulic System. 	<p>Hydraulic System Manuals Set of wrench and spanners. Pipe cutter.</p> <p>2. 4</p> <p>Th e o r y 5</p> <p>P r a c t i c a l 1 9</p>	Class room and Institute laboratory

B-6 Repair hydraulic system	Trainee Should be able to <ul style="list-style-type: none"> • Follow procedures to repair equipment of hydraulic system. • Verify hydraulic system parameters as per system manual • Repair equipment of hydraulic circuit prescribed methods in system manual 	<ul style="list-style-type: none"> • Knowledge about repairing specialties. • Demonstrate the procedure for repair. <ul style="list-style-type: none"> ○ Pipes ○ Cylinder ○ Pumps ○ Gauges ○ valves ○ fixtures 	Pressure gauge, Pipe cutter, Pipes, Cylinder, Pumps, Gauges, valves & fixtures. Set of wrench and spanners.	Class room and Institute laboratory
------------------------------------	---	---	--	-------------------------------------

7.3 Module C: Maintain pneumatic system

Objective of the Module: Understand Pneumatic system maintenance in process industry. It also deals with basic Pneumatic concepts, Test performed and verification of system. Maintenance of temperature & Perform repairing in pneumatic system

Duration	Theory			Pr
144 hrs	30 hrs			1
Learning Unit	Learning Outcomes	Learning Elements	Duration	Tools / Equipment material
C-1 Perform commissioning of pneumatic system	<p>Trainee Should be able to</p> <ul style="list-style-type: none"> • Apply pneumatic pressure as per system requirement • Verify pneumatic cylinder performance for normal operations. • Test filters performance for clogging • Verify performance of gauges for normal operation • Verify performance of 	<ul style="list-style-type: none"> • Define measuring units of pressure • Differentiate measuring units of pressure • Convert pressure quantities from one unit into another • Describe precautionary measures while maintaining pneumatic system. • Interpret Pneumatic drawing / manual 	<p>Total 28</p> <p>Theory 6</p> <p>Practical 22</p>	<p>Air Compressor and different valves used in Pneumatic System Pneumatic Cylinder , Pneum Gauges and Fluid Meter. Thermocouple type meter</p>

	<p>pneumatic Pumps, solenoid for normal operation</p>	<ul style="list-style-type: none"> • Define physical properties of air • Describe Volume and pressure in pneumatic system • Relate Pressure , Volume and temperature in Gases • Describe working of air compressor • Enlist equipment of a typical pneumatic system • Describe working of pneumatic equipment • Describe the method of compress air Preparation • Describe procedure of compressed air and vacuum production • Demonstrate operating procedure of; <ul style="list-style-type: none"> ○ Pumps 		
--	---	--	--	--

		<ul style="list-style-type: none"> ○ Solenoid valve ○ Gauges ○ Pneumatic Safety instrument ○ Seals 		
C-2 Verify Pneumatic system parameters	Trainee Should be able to <ul style="list-style-type: none"> ● Verify physical condition of pneumatic system performance for normal operation ● Verify performance of pneumatic system for normal operation ● Test compressing equipment parameter implementing recommended testing methods ● Adjust equipment controls for desired parameters 	<ul style="list-style-type: none"> ● Describe method of pneumatic system performance test <ul style="list-style-type: none"> ● Methods of parameter testing in pneumatic system ● Demonstrate <ul style="list-style-type: none"> ○ working principles, ○ operating procedure ○ Performance test of various parameters of pneumatic system 	Total 29 Theory 6 Practical 23	Pressure gauge & system manual

C-3 Diagnose fault in Pneumatic system	Trainee Should be able to <ul style="list-style-type: none"> • Determine air leakage in pneumatic system by implementing leakage testing methods • Verify Pneumatic equipment performance for normal operation 	<ul style="list-style-type: none"> • Describe the working of pneumatic equipment • Describe leakage diagnostic method in pneumatic system • Demonstrate the procedure of detecting leakage in pneumatic system 	Total 29 Theory 6 Practical 23	System layout and circuit diagrams Leakage Tester. Solenoid, isolation valves. Pipe fittings Pneumatic safety.
C-4 Replace equipment in pneumatic system	Trainee Should be able to <ul style="list-style-type: none"> • Select compatible equipment to be mounted in pneumatic system • Remove desired equipment from Pneumatic system • Mount equipment in Pneumatic system 	<ul style="list-style-type: none"> • Describe method of equipment removal from pneumatic system • Locate faulty equipment in pneumatic system • Demonstrate the installation & removal procedure of pneumatic system • Describe equipment insertion method in pneumatic system 	Total 29 Theory 6 Practical 23	Pneumatic System Manuals of wrench and spanners. Pipe cutter.

C-5 Repair pneumatic system	Trainee Should be able to <ul style="list-style-type: none"> • Locate fault in the pneumatic system by applying prescribed techniques • Repair faulty pneumatic equipment as per repair manual • Replace faulty part in pneumatic system by applying SOP 	<ul style="list-style-type: none"> • Describe steps of trouble shooting in pneumatic system. • Demonstrate instruments required for repairing in pneumatic system 	Total 29 Theory 6 Practical 23	Pressure gauge, Pipe cutter, Pipes, Cylinder, Pumps, Gau valves & fixtures. Set of wrench and spanners.
------------------------------------	--	---	--------------------------------------	--

7.4 Module D: Maintain PLC system

Objective of the Module: Understand PLC system maintenance in process industry. It also deals with basic concepts of PLC, basics of programming, testing performance & verification of PLC system and performing PLC repair and maintenance.

Duration	Theory	Practical
143 hrs	27 hrs	116 hrs

Learning Unit	Learning Outcomes	Learning Elements	Duration	Tools/Equipment material required	Learning Place
---------------	-------------------	-------------------	----------	-----------------------------------	----------------

D-1 Apply tug out on PLC system	Trainee Should be able to <ul style="list-style-type: none"> • Interpret PLC wires and cables according to schematic/ wiring diagrams in the panel • Set manual switches for desire operation • Tug out PLC from the system as per SOP 	<ul style="list-style-type: none"> • Understand PLC drawing / manual • Describe operation of PLC • Understand ladder logic diagram /symbol • Draw PLC wires and cable memorandum 	Total 15 Theory 3 Practical 12	PLC S7 300 / S7 1200 Wires and Terminals Set of Screw drivers. System Manual and System layout diagram	Class room and Institute laboratory
D-2 Clean attachments in PLC system	Trainee Should be able to <ul style="list-style-type: none"> • Maintain dust free environment around PLC as per SOPs • Perform cleaning of PLC as per SOPs 	<ul style="list-style-type: none"> • Enlist Cleaning agents and their usage for electronics equipment • Demonstrate the application of cleaning agent. 	Total 16 Theory 3 Practical 13	PLC Cleaning Agent recommended by manufacturer & Contact cleaner spray.	Class room and Institute laboratory

Learning Unit	Learning Outcomes	Learning Elements	Duration	Tools / Equipment material	Learning Place
D-3 Check Input / output (I/O) modules for operation	Trainee Should be able to <ul style="list-style-type: none"> • Perform network data communication • Verify I/O Modules for normal operation • Test performance of PLC for normal operation 	<ul style="list-style-type: none"> • Understand Ladder logic diagram • Recognize PLC Logic • Define I/O logic method • Design simple program to test on line PLC Performance 	Total 16 Theory 3 Practical 13	System Manual and diagrams	Class room and Institute laboratory
D-4 Test performance of sensor	Trainee Should be able to <ul style="list-style-type: none"> • Identify sensors used in PLC system • Verify Sensors for normal performance 	<ul style="list-style-type: none"> • Enlist sensors used in mechatronics system • Describe working principle of; <ul style="list-style-type: none"> ○ Inductive sensor ○ Capacitive sensor ○ Temperature sensor ○ Photo sensor ○ Level sensor 	Total 16 Theory 3 Practical 13	Capacitive Sensors, Inductive Sensors ,Ultrasonic sensor ,Optical Sensor and Magnetic Sensor	Class room and Institute laboratory

		Demonstrate function of assorted sensors			
D-5 Perform PLC Test	Trainee Should be able to <ul style="list-style-type: none"> • Connect computer with PLC • Perform Manual operation test • Configure PLC operation for designed program 	<ul style="list-style-type: none"> • Describe PLC Testing Procedure • Demonstrate PLC testing • Describe loop testing procedure 	Total 16 Theory 3 Practical 13	PLC Manual.	Class room and Institute laboratory

Learning Unit	Learning Outcomes	Learning Elements	Duration	Tools / Equipment material	Learning Place
D-6 Maintain CPU (PLC) temperature	Trainee Should be able to <ul style="list-style-type: none"> • Verify PLC temperature for prescribed limits • Apply measures to keep the temperature within limits 	<ul style="list-style-type: none"> • Describe precautionary measures to keep PLC temperature within control limits • Enlist reasons for PLC over heating • Enlist parts used to keep the 	Total 16 Theory 3 Practical 13	Aluminum heat sink & fan	Class room and Institute laboratory

		temperature of PLC under control			
D-7 Replace PLC hardware	Trainee Should be able to <ul style="list-style-type: none"> • Diagnose Hardware trouble in PLC • Remove faulty part from PLC unit • Replace Part/s in PLC 	<ul style="list-style-type: none"> • Interpret PLC Manual • Demonstrate procedure for replacement of faulty part from PLC system 	Total 16 Theory 3 Practical 13	Set of screw drivers and System manual diagrams. Specified PLC	Class room and Institute laboratory
D-8 Diagnose faults in PLC system	Trainee Should be able to <ul style="list-style-type: none"> • Check I/O Modules for optimum performance • Determine malfunctioning due to ladder logic program • identify fault of PLC system 	<ul style="list-style-type: none"> • Enumerate fault diagnostic technique in PLC System 	Total 16 Theory 3 Practical 13	System Manual diagrams & list of possible faults. Multimeter. Oscilloscope	Class room and Institute laboratory

D-9 Replace part in PLC system	Trainee Should be able to <ul style="list-style-type: none"> • Remove Faulty equipment from the system • Install desired equipment in the system • Replace parts in PLC system 	<ul style="list-style-type: none"> • Define procedure of PLC dismantling • Define procedure of PLC reassembling. 	Total 16 Theory 3 Practical 13	Set of screw drivers and System manual.	Class room and Institute laboratory
---------------------------------------	--	--	--------------------------------------	---	-------------------------------------

7.5 Module E: Install Mechatronics system

Objective of the Module: Understand Mechatronics system Installation in industrial plant. It also deals with basic concepts, Testing and verification of the system, maintenance of energy flow and repair of hydraulic system installed in process industry.

Duration	Theory	Practical
143 hrs	24 hrs	119 hrs

Learning Unit	Learning Outcomes	Learning Elements	Duration	Tools / Equipment material	Learning Place
---------------	-------------------	-------------------	----------	----------------------------	----------------

E-1 Install system wiring	Trainee Should be able to	<ul style="list-style-type: none"> • Describe mechatronics and its scope 	Total 11	Mechatronic System	Class room and Institute laboratory
	<ul style="list-style-type: none"> • Layout of the Foundations of Electrical equipment according to blue print • Perform basic sheet metal work according to prescribed tolerance given in blue print • Install earthing system applying prescribed method of earth installation • Install mechanical units of wiring applying prescribed method of installation • Install Electrical Wiring applying prescribed method of installation • Install electrical panel applying prescribed method of installation 	<ul style="list-style-type: none"> • Enlist types of industries getting benefits from mechatronics • Describe operation of mechanical systems. • Interpret mechatronics system wiring diagram. • Enlist material required to install electrical wiring • Procedure of Installing Mechatronics System <ul style="list-style-type: none"> ○ Foundation ○ Earthing System ○ Wiring 	Theory 2 Practical 9	Manuals for Wiring and other Mechanical Components Adjustments. Cable of different current capacity and colour codes. Set of screw drivers, pliers and wire strippers.	

	<ul style="list-style-type: none"> • Commission electrical Wiring for desired operation • Evaluate the whole procedure as per SOPs • 				
E-2 Install electrical devices	Trainee Should be able to <ul style="list-style-type: none"> • Induct Electrical equipment in the mechatronics system applying prescribed method of equipment 	<ul style="list-style-type: none"> • Enlist material/devices required to install in mechatronics electrical system • Demonstrate 	Total 12 Theory 2 Practical 10	Breakers and Sensors Multi-meter, Set of screw drivers and pliers.	Class room and Institute laboratory

	<p>induction in the system</p> <ul style="list-style-type: none"> • Perform electrical sensors tests applying prescribed method of installation 	<p>Installation Procedure of:</p> <ul style="list-style-type: none"> ○ Electrical Equipment ○ Sensors 			
E-3 Install piping system	<p>Trainee Should be able to</p> <ul style="list-style-type: none"> • Inspect Piping Material according to specifications • Inspect fluid flow through piping as recommended in manual • Install piping system for mechatronics system applying prescribed method of installation 	<ul style="list-style-type: none"> • Demonstrate knowledge about all piping Specification • Identify pipes by colour codes • Identify different piping materials. • Calculate pressure loss in pipes. • Interpret Piping diagram • Demonstrate the procedure of: 	<p>Total 12</p> <p>Theory 2</p> <p>Practical 10</p>	<p>Metal and PVC Conduit of different sizes, Pipe cutter and conduit supports.</p>	<p>Class room and Institute laboratory</p>

		<ul style="list-style-type: none"> ○ Selection of piping as per required specification n e.g. color and material ○ Selection of fluid as per SOPs ● Demonstrate the procedure of: <ul style="list-style-type: none"> ○ Selection of Pipe and fixtures 			
E-4 Install Mechanical system	Trainee Should be able to <ul style="list-style-type: none"> ● Check floor level as per system requirements 	<ul style="list-style-type: none"> ● Interpret the P&ID. ● Enlist Parts of hydraulic system 	Total 12 Theory 2	System Manual, Set of screw drivers, pliers & wrenches. Mechanical supports for the frame.	Class room and Institute laboratory

	<ul style="list-style-type: none"> • Install frame structure according to blue print. • Lay foundations of mechanical equipment according to blue print • Determine suitability of existing supports, brackets, clamps, adapters, etc. for proper load bearing • Induct mechanical parts in the system applying prescribed method of parts induction • Erect mechanical machinery as per manual • Commission mechanical Systems for desired operation • Verify operation of mechanical systems 	<ul style="list-style-type: none"> • Describe interpreting P&ID. • Describe procedures for Commissioning. • Describe the operating principals of heat generator, Heat exchanger, Pumps, turbine and valves • State the operation of coupling between drives and machines of mechatronics system • Installation procedure of <ul style="list-style-type: none"> ○ Frame structure ○ Foundation as per blue print ○ Erection and commissio 	<p>Practical 10</p>		
--	---	---	---------------------	--	--

	according to SOPs	ning			
E-5 Install hydraulic equipment	<p>Trainee Should be able to</p> <ul style="list-style-type: none"> • Install hydraulic Pump applying prescribed method of installation • Install hydraulic gauge applying prescribed method of installation • Maintain recommended oil level in hydraulic system up to normal limits 	<ul style="list-style-type: none"> • Describe importance of oil level maintenance in hydraulic system • Distinguish between oil grades of hydraulic system • Explain importance of sealing in hydraulic system • Demonstrate procedure of Hydraulic Equipment Installation: <ul style="list-style-type: none"> ○ Pump Installation ○ Solenoid Installation ○ Isolation Valve ○ Cylinders 	<p>Total 12</p> <p>Theory 2</p> <p>Practical 10</p>	<p>Pressure gauge, Pipe cutter, Pipes, Cylinder, Pumps, Gauges, valves & fixtures.</p> <p>Set of wrench and spanners.</p>	<p>Class room and Institute laboratory</p>
E-6 Install pneumatic equipment	<p>Trainee Should be able to</p> <ul style="list-style-type: none"> • Install assorted valves applying prescribed method of installation 	<ul style="list-style-type: none"> • Demonstrate standards Installation Procedure of: <ul style="list-style-type: none"> ○ Assorted 	<p>Total 12</p> <p>Theory 2</p> <p>Practical 10</p>	<p>Pressure gauge, Pipe cutter, Pipes, Cylinder, Pumps, Gauges, valves & fixtures.</p> <p>Set of wrench and</p>	<p>Class room and Institute laboratory</p>

	<ul style="list-style-type: none"> • Install filter regulator applying prescribed method of installation • Install Speed controller applying prescribed method of installation • Install cylinder applying prescribed method of installation 	<p>Valves</p> <ul style="list-style-type: none"> ○ Filter Regulator ○ Speed controller ○ Cylinder <ul style="list-style-type: none"> • Describe operation of Ball valve ,exhaust valve filter regulator, solenoid valve, speed controller and Cylinder 		spanners.	
E-7 Install electronics equipment system	<p>Trainee Should be able to</p> <ul style="list-style-type: none"> • Connect electronics equipment in mechatronics system applying prescribed method of installation • Install A.C Electronics drives in mechatronics system applying prescribed method of installation • Install D.C electronics drives in mechatronics system 	<ul style="list-style-type: none"> • Interpret electronic drawing / manual • Analysis Digital components and circuits • Draw block diagram for operation and flow chart of mechatronics equipment/drives • Demonstrate Installation procedure 	<p>Total 12</p> <p>Theory 2</p> <p>Practical 10</p>	<p>AC & DC Drives. Multimeter , Set of Screw drivers and pliers. System Manuals & diagrams</p>	<p>Class room and Institute laboratory</p>

	<p>applying prescribed method of installation</p> <ul style="list-style-type: none"> • Install display systems and indicators applying prescribed method of installation • Install monitoring devices and alarm systems applying prescribed method of installation 	<p>of:</p> <ul style="list-style-type: none"> ○ Electronic Equipment ○ AC/DC Electronic Drive ○ Display system and monitoring devices ○ Control Systems as per SOPs in mechatronics System 			
E-8 Insert sensors in system	<p>Trainee Should be able to</p> <ul style="list-style-type: none"> • Install sensing device in mechatronics system applying prescribed method of installation • Install calibration equipment in mechatronics system applying prescribed method of installation 	<ul style="list-style-type: none"> • Demonstrate Procedure to: <ul style="list-style-type: none"> ○ Install sensor ○ Calibrate sensors 	<p>Total 12 Theory 2 Practical 10</p>	<p>Sensors of different types and system manuals. Calibrating equipment with interface.</p>	<p>Class room and Institute laboratory</p>

E-9 Install functional correlation in system	Trainee Should be able to <ul style="list-style-type: none"> • • Install loops according to process industry principles • Perform loop test according to SOPs • 	<ul style="list-style-type: none"> • Identify plant sections • Demonstrate Procedure of: <ul style="list-style-type: none"> ○ Installation of Loops according to layout diagram ○ Loop test as per SOPs • Define mechatronics sub system 	Total 12 Theory 2 Practical 10	System manual.	Class room and Institute laboratory
E-10 Perform system calibration	Trainee Should be able to <ul style="list-style-type: none"> • Locate parts in mechatronics system to perform calibration of system as per manufacturers SOPs • Calibrate Mechatronics system to desired parameters recommended in the service manual 	<ul style="list-style-type: none"> • Describe Common parameters used on process plant • Demonstrate procedure of Mechatronics system's parameters calibration 	Total 12 Theory 2 Practical 10	System manual.	Class room and Institute laboratory

E-11 Test off load system performance	Trainee Should be able to	<ul style="list-style-type: none"> • State the sequence of commissioning of mechatronics equipment • Describe the use of calibrator • Procedural Steps for: <ul style="list-style-type: none"> ○ Off load electrical test ○ Off load electronic test • Procedural Steps for: <ul style="list-style-type: none"> ○ Off load Pneumatic test ○ Off load Hydraulic test 	Total 12 Theory 2 Practical 10	System SOPs to conduct of load test	Class room and Institute laboratory
--	----------------------------------	---	--------------------------------------	-------------------------------------	-------------------------------------

<p>E-12 Test full load system performance</p>	<p>Trainee Should be able to</p> <ul style="list-style-type: none"> • Perform offload electrical system tests recommended in the service manual • Perform off load pneumatic system tests recommended in the service manual • Perform off load hydraulic tests recommended in the service manual <p>Perform off load electronics systems tests recommended in the service manual</p>	<ul style="list-style-type: none"> • Safety guidelines for system commissioning • Procedural Steps for: <ul style="list-style-type: none"> ○ On load electrical test ○ On load electronic test • Procedural Steps for: <ul style="list-style-type: none"> ○ On load Pneumatic test ○ On load Hydraulic test <p>State the cause & effects of overloaded conditions</p>	<p>Total 12</p> <p>Theory 2</p> <p>Practical 10</p>	<p>System SOPs to conduct on load test</p>	<p>Class room and Institute laboratory</p>
--	--	--	---	--	--

7.6 Module F: Perform Preventive Maintenance

Objective of the Module: Understand and Apply preventive maintenance of Mechatronics system. It also deals with basic concepts of maintenance scheduling, indoor clean-ups, shutting the system off and turning it on, verification, service assorted equipment and repair minor faults of the system.

Duration	Theory	Practical
143 hrs	33 hrs	110 hrs

Learning Unit	Learning Outcomes	Learning Elements	Duration	Tools / Equipment material	Learning Place
F-1 Follow system maintenance plan	<p>Trainee Should be able to:</p> <ul style="list-style-type: none"> • Inform concerned Department accordingly • Follow Maintenance scheme accordingly 	<ul style="list-style-type: none"> • Interpret maintenance flow charts • Define the influence of process and changing operating conditions 	<p>Total 13</p> <p>Theory 3</p> <p>Practical 10</p>	Maintenance Plans provided with the system.	Class room and Institute laboratory
F-2 Shut down mechatronics system	<p>Trainee Should be able to</p> <ul style="list-style-type: none"> • Get shutting down approval from authority • Shut down Electrical system, applying SOP • Perform physical system verification correctly 	<ul style="list-style-type: none"> • Procedure of shutting down Mechatronics System as per SOPs 	<p>Total 13</p> <p>Theory 3</p> <p>Practical 10</p>	SOPs for the shutdown of system	Class room and Institute laboratory

	<ul style="list-style-type: none"> Shut down the system following shutting down scheme 				
F-3 Perform indoor clean-ups	<p>Trainee Should be able to</p> <ul style="list-style-type: none"> Clean attachments / equipment / drives/ units /cable /pipes /mountings apply 5S methods perform surrounding area clean up as scheduled Dispose of waste applying SOPs 	<ul style="list-style-type: none"> Demonstrate 5S (5 Steps) for industry housekeeping: <ul style="list-style-type: none"> Sort Set in Order Shine Standardize Sustain 	<p>Total 13</p> <p>Theory 3</p> <p>Practical 10</p>	SOPs to conduct 5S	Class room and Institute laboratory

F-4 Perform Lubrication in system	Trainee Should be able to <ul style="list-style-type: none"> • Maintain lubricant log up to date • Lubricate machine equipment as per SOPs • Lubricate mechanical parts equipment as per SOPs • Lubricate Hydraulic equipment as per SOPs • Maintain Lubricant according to prescribed level 	<ul style="list-style-type: none"> • Describe importance of Lubrication and its applying techniques • Interpret lubricant specifications • Classify industrial lubricants • Demonstrate Lubrication procedure of mechanical and hydraulic equipment 	Total 13 Theory 3 Practical 10	Oil of desired quality for the lubrication of parts	Class room and Institute laboratory
F-5 Inspect safety installation	Trainee Should be able to <ul style="list-style-type: none"> • Conduct Safety installation inspection compliance with (OSHA) • Document Safety inspection record up to date 	<ul style="list-style-type: none"> • Explain potential hazards, safety techniques and its proper documentation process/method 	Total 13 Theory 3 Practical 10	Check list to identify hazards and potential hazards OSHA manuals for safety installations.	Class room and Institute laboratory

Learning Unit	Learning Outcomes	Learning Elements	Duration	Tools / Equipment material	Learning Place
F-6 Service Electrical Devices	Trainee Should be able to: <ul style="list-style-type: none"> • Service Power supply according to recommendation in service manual • Service electrical equipment according to defined SOPs • Service and maintain display systems and indicators according to recommendation in service manual • Calibrate display systems & indicators according to recommendation in service manual 	<ul style="list-style-type: none"> • Describe Half wave, full wave and bridge rectifier circuit • Describe regulated power supply circuit • Describe switch mode power supply circuit • Demonstrate procedure to Service electrical equipment. <ul style="list-style-type: none"> ○ Power Supply ○ Measuring Instruments 	Total 13 Theory 3 Practical 10	System service manuals, Power supply, Multimeter, oscilloscope. Set of screw drivers and pliers	Class room and Institute laboratory

F-7 Service piping system	Trainee Should be able to: <ul style="list-style-type: none"> • Test piping system for Leakage/mechanical damages /loose fittings according to recommendation in service manual • Remove Leakage/mechanical damages /loose fittings from piping system according to recommendation in service manual 	<ul style="list-style-type: none"> • Enlist industrial pipe and fittings • Enumerate causes of piping leakage and remedial measures • Demonstrate: <ul style="list-style-type: none"> ○ Testing procedure of piping system ○ Maintenance of piping system 	Total 13 Theory 3 Practical 10	Pipes of different size, Pipe cutter and fittings.	Class room and Institute laboratory
Learning Unit	Learning Outcomes	Learning Elements	Duration	Tools / Equipment material	Learning Place

F-8 Service pneumatic equipment system	Trainee Should be able to <ul style="list-style-type: none"> • Test pneumatic system for failure /mechanical damages /loose fittings according to recommendation in service manual • Remove Leakage/mechanical damages /loose fittings from pneumatic system according to service manual 	<ul style="list-style-type: none"> • Enumerate causes of failure/mechanical damages and remedial measures • Demonstrate: <ul style="list-style-type: none"> ○ Testing procedure of pneumatic system ○ Maintenance of pneumatic equipment • Enlist Pneumatic parts and fittings 	Total 13 Theory 3 Practical 10	Service Manuals of the System	Class room and Institute laboratory
F-9Service hydraulic equipment	Trainee Should be able to <ul style="list-style-type: none"> • Test hydraulic system for failure / mechanical damages /loose fittings 	<ul style="list-style-type: none"> • Enlist hydraulic parts and fittings 	Total 13 Theory 3	Blower, Clog Remover	Class room and Institute laboratory

	<p>according to recommendation in service manual</p> <ul style="list-style-type: none"> Remove Leakage/mechanical damages /loose fittings from hydraulic system applying prescribed trouble shooting methods 	<ul style="list-style-type: none"> Numerate causes of hydraulic system failure/leakage Enumerate causes of failure/mechanical damages and remedial measures Demonstrate: <ul style="list-style-type: none"> Testing procedure of hydraulic system Maintenance of hydraulic equipment 	Practical 10		
Learning Unit				Tools / Equipment	Learning

	Learning Outcomes	Learning Elements	Duration	material	Place
F-10 Service electronics equipment	<p>Trainee Should be able to</p> <ul style="list-style-type: none"> • Test electronics equipment performance according to recommendation in service manual • Remove faulty Electronics equipment/circuits from the mechatronics system according to SOPs • Service and maintain monitoring devices & alarm systems according to recommendation in service manual • Service and maintain signal conversions and 	<ul style="list-style-type: none"> • State function of electronic circuits • Differentiate between cold , hot and signal tests • Describe common electronic faults in mechatronic system and their maintenance. • Demonstrate techniques to trace out faulty components 	<p>Total 13</p> <p>Theory 3</p> <p>Practical 10</p>	Service manuals of the system, contact cleaner, blower, Multimeter and oscilloscope.	Class room and Institute laboratory

	transmitters				
	<ul style="list-style-type: none"> • Service positioners according to recommendation in manual 				
F-11 Start up system after preventive maintenance	Trainee Should be able to <ul style="list-style-type: none"> • Check mechatronics system if it is ready for start up • Startup system applying SOPs • Certify operation of the system according to SOPs 	<ul style="list-style-type: none"> • Enlist running system parameters • Demonstrate the procedure of system startup of mechatronic system. 	Total 13 Theory 3 Practical 10	SOPs for the system startup and maintenance	Class room and Institute laboratory

7.7 Module G: Demonstrate safety

Objective of the Module: Demonstrating skill and knowledge of personal health, safety, infrastructural safety, firefighting, first aid procedures, quality and environment related regulations in industrial workplace.

Duration	Theory	Practical
141 hrs	30 hrs	111 hrs

Learning Unit	Learning Outcomes	Learning Elements	Tools/Equipment material	Learning Place

<p>G1-Adopt Personal Safely measures</p>	<p>Trainee Should be able to:</p> <ul style="list-style-type: none"> • Take preventive action against potential hazards related to workplace by applying OSHAs • Use PPEs as per SOPs • Maintain personal hygiene according to SOPs • Demonstrate first aid procedure as per requirement 	<ul style="list-style-type: none"> • Define types of Common industrial PPEs • Describe precautionary measures related to personal safety • Explain importance of personal hygiene at workplace • Define types and describe usage of items in the first aid kit • Demonstrate use of Personal Protective Equipment (PPEs) as per SOPs • Describe first aid application procedure • Demonstrate procedure of first aid provision at workplace 	<p>PPE's used in different industries & for specific jobs</p> <p>Material safety data sheets (MSDS)</p> <p>Employer instructional manuals.</p>	<p>Class room and Institute laboratory</p>
---	---	--	--	--

G2-Adopt Equipment Safety Measures	Trainee Should be able to <ul style="list-style-type: none"> • Ensure implementation of SOPs related to equipment safety • Interpret OEM Manual of the equipment for safety precautionary measures 	<ul style="list-style-type: none"> • Explain safety precautions while working with tools and equipment • Describe interpretation of OEM Manuals • Demonstrate operational procedure of different fire extinguishers e.g. gas cylinder, sand buckets, foam etc. 	SOPs for the equipment and system safety. OEM manuals. Fire extinguisher for different kind of fires. Equipment checklist.	Class room and Institute laboratory
---	---	---	---	-------------------------------------

Learning Unit	Learning Outcomes	Learning Elements	Tools / Equipment material	Learning Place
---------------	-------------------	-------------------	----------------------------	----------------

<p>G3- Demonstrate Workplace Safety</p>	<ul style="list-style-type: none"> • Follow safety rules related to workplace safety • Follow safety Instruction against bio hazard according to OSHA • Dispose of waste according to SOPs • Handle and store hazardous workplace materials according to Prescribed handling instructions 	<ul style="list-style-type: none"> • Enlist mechanical shop safety precautions • Enlist electrical shop safety precautions • Describe Standards of OSHA for related industry • Enlist bio hazardous industrial material • Enlist PPEs while working with bio-hazardous material • Demonstrate usage of PPEs related to bio hazards material 	<p>PPE's used in toxic and noisy environment.</p> <p>Shutdown methods to be followed.</p> <p>Danger, shutdown, out of order, under maintenance, restricted area tags for demonstration.</p>	<p>Class room and Institute laboratory</p>
--	---	---	---	--

7.8 Module 10 Title: On-the-Job Training

Objective of the Module: Gain real work place understanding, skills and experience.

Duration		Theory		P
800 Hrs		0 hrs		8
Month	Week	Recommended rotation plan		
1	1	10.1: Company Orientation (Department wise)		Awareness site, proces
	2	HSE Procedures and regulations of local authority and the company		Heath, Safe policies; Ec company's
	3	Materials used and their selection		Importance demand co standards
	4	Monthly report writing		MS- Office system
2	5	10.2: Personnel protective equipment (PPE)		Use and im and safe w incident fr
	6	Health, Safety and Environment		Safety at W
	7			procedures product ma
	8	Monthly report Writing		define esca MS- Office Surface system
	9			
	10			

			11		Procedures plant mach assistance required MS- Office system
			12	Monthly report Writing	
4	13	10.4: Central Documentation Department	Plant documentation and control section its importance and methods of record keeping. Security and authentication of control and as-built documentation		
	14	Incoming Quality Control	Making spreadsheets and procedures of maintaining quality control data and files, Planning & scheduling department; Study equipment drawings, 15 catalogues, manuals		
	15				
	16	Monthly report Writing	MS- Office or computerized logging or reporting system		
5	17	10.5: Maintenance/ operation	Maintenance and repair work of plant machinery and provide assistance to existing maintenance/ operation team		
	18				
	19	Quality assurance of maintenance work	Checkandinvolvedintheactivitiesrelatedtothequalitycontrolinthelaboratoryaswell as on the process plant		
	20	Monthly report Writing	MS-Office or computerized logging or reporting system		
6	21	10.6: Production &Process control (PPC)	Manage to take the responsibilities and cooperate with other agencies working on the Plant. Get involved with operations and production planning department to do the daily Routine work. Respect the existing rules of traffic, pedestrians, plant, and its local areas of the process plant		
	22				
	23	Skills and concepts	Communication, measuring & marking skills, math's & drawing related to the process plant		
	24	Final report writing	Preparing final report with complete observations, learning and presentation; Recommendation with the relevant supervisors or staff for bright and better performance		

7.9 Module 20 Title: On-the-Job Training

Objective of the Module: Deepen the understanding and skills for the concepts taught in the modules and building Skills for self- learning.

Duration	Theory	Practical
800 Hrs	0 hrs	800 Hrs

Month	Week	Recommended rotation plan	Applied Knowledge and skills Related to
1	1	20.1: Review of OJT of phase I	Assessment and examine the previous OJT with better understanding of working techniques, process unit wise understanding
	2	Procedures and regulations of local and the company	Communication Skills, computerized skills of plant machinery, study of manuals
	3	Materials used and their selection	Importance and use of warehouse; Supply and demand concept, international codes and standards of materials
	4	Monthly report writing	MS- Office or computerized logging or reporting system
2	5	20.2: Quality Assurance/ Quality Control	Understanding about the ISO standards and other international certifications; HSE policies for on the job and off the job; Acceptable working procedures like PTW and other permit System. Understanding Emergency procedures, Surface Protection Methods
	6		
	7		
	8	Monthly report Writing	MS- Office or computerized logging or reporting system
	9	20.3: Inventory Management	5S, Segregation of items; Advance methods of spares and inventory control system; MS- Office or computerized logging system
	10		Making spreadsheets and procedures of maintaining quality control data and files,

3	11	Incoming Quality Control	Planning & scheduling department; Study equipment drawings, catalogues and reference manuals
	12	Monthly report Writing	MS- Office or computerized logging or reporting system
4	13	20.4: Maintenance/ operation/ documentation	Maintenance and repair work of plant machinery and provide assistance to existing maintenance team as well as operation personnel, learn and use the line tracing and Equipment system. Plant documentation and control section its importance and methods of record keeping. Security and authentication of control and as-built documentation
	14		
	15	Maintenance of equipment and machinery	Procedures and methods of maintenance on the plant machinery; And Provide technical assistance to the existing staff when required
	16	Monthly report Writing	MS- Office or computerized logging or reporting system
5	17	20.5: Commissioning and operation of Mechatronics system	Need and importance of Mechatronics system; Proper use of Mechatronics components system for plant operation; Best working practice to work on this system; Manage and maintain the equipment / system according to the SOPs of manufacturer or the company
	18		
	19	Quality assurance of maintenance work	Check and involved in the activities related to the quality control and quality assurance on the manufacturing unit or process plant as well
	20	Monthly report Writing	MS- Office or computerized logging or reporting system
6	21	20.6: Troubleshooting and problem solution	Keep deep observation through perfect knowledge of process and procedure on the plant. Actively participate in the solution of problem or fault findings; Manage and handle the emergency and provide assistance on the pant. Manage to take the responsibilities and cooperate with other agencies working on the plant. Get involved with operations and production planning department to do the daily routine work
	22		
	23	Skills and concepts	Communication, Measuring & Marking Out skills, Math's & Drawing related to the process plant / manufacturing unit. Respect the existing rules in the company premises traffic, pedestrians, plant assets, and its local areas beside the plant

24	Final report writing	Preparing final report with complete observations, knowledge and presentation. Recommendation with the relevant supervisors or staff for bright and better performance
----	----------------------	---

8. Assessment Guidance

Assessment is the process of collecting evidence and making judgments on whether competence has been achieved. This confirms that an individual can perform to the standard expected in the workplace as expressed in the nationally endorsed competency standards (where they exist), Good assessment practices should be adopted for sessional and final assessments. Such practices by vocational training providers during sessional and final assessments will form the basis of qualifying the trainees.

8.1 Difference Between Sessional and Final Assessments

Sessional assessment shall be on an all-time basis. Its purpose is to provide feedback on what students are learning:

- **To the student:** It will identify achievement and areas for further teaching and its level.
- **To the teacher:** It will evaluate the effectiveness of teaching, and guide to determine the future plan.

Assessors need to advise sessional assessments for both theoretical and practical work. Guidance is provided in the assessment strategy.

Final assessment is the assessment, usually carried out on completion of a course or module. This determines whether or not the student has "passed". It is - or should be - undertaken with reference to all the objectives or outcomes of the course, and is often fairly formal. Considerations of security - ensuring that the student who gets the credit is the person who did the work - assume considerable importance in final assessment.

8.2 Methods of Assessment

For lessons with a high quantity of theory, written or oral tests related to learning outcomes and/ or learning content can be conducted. For work place lessons, assessment will focus on the quality of planning and executing the related process along with the quality of the product and/or evaluation of the process.

Direct assessment

Direct assessment is the most desirable form of assessment. For this, evidence shall be obtained by directly observing the student's performance.

Examples for direct assessment of a Mechatronic will include:

Work performances, for example the application of fault Mechatronic diagnostic techniques

- Demonstrations, for example demonstrating the Mechatronics system flow with the help of DFDs, SFC and flow charts..
- Direct questioning, where the assessor will ask the student how to select the tool for step turning before any performance
- Paper-based tests, such as multiple choice or short answer questions at entrepreneurship, hygienic and safety issues, communicating and working with others and types of PLCs and programming.
- Practical competency sheet / Portfolio / Handouts as of evidence, such as compilation of all work done during the course.

Indirect assessment

Indirect assessment shall be used where the performance could not be watched and evidence is gained indirectly. Examples for indirect assessment of a Mechatronics Technician will include:

- Selection of accurate products on the basis of market survey.
- Taking all health and safety measures in workplace.
- Maintenance of Mechatronics system. The methods adopted to maintain the Equipment& tools and housekeeping.
- Indirect assessment should only be a second choice. (In some cases, it may not even be guaranteed that the work produced by the person being assessed).

8.3 Principles of Assessment

All assessments must be valid, reliable, fair and flexible:

Fairness means that there should be no advantages or disadvantages for any assessed person. For example, it should not happen that one student gets prior information about the type of work performance that will be assessed, while another candidate does not get any prior information. Provide all learners with an equal opportunity for and access to assessment

Validity means that a valid assessment assesses what it claims to assess. For example, if the ability to do a specific gear cutting, the assessment should involve performance criteria that are directly related to gear cutting techniques. An interview about setting of milling machine would not meet the performance criteria.

Reliability means that the assessment is consistent and reproducible. For example, if the preparation procedure of workplace/services area has been assessed, another assessor (e.g. the future employer) should be able to see the same work performance and witness the same level of achievement.

Flexibility means that the assessor has to be flexible concerning the assessment approach. For example, if there is a power failure during the assessment, the assessor should modify the arrangements to accommodate the students' needs.

8.4 Assessment Strategy for Mechatronic Technician

This curriculum consists of 7 modules:

Module A: Maintain Electrical System

Module B: Title: Maintain Hydraulic System

Module C: Maintain pneumatic system

Module D: Maintain PLC system

Module E: Install Mechatronics system

Module F: Perform Preventive Maintenance

Module G: Demonstrate safety

Suggestions for sessional assessment

- The sessional assessment for all modules shall be in two parts: theoretical assessment and practical assessment. The sessional marks shall contribute to the final qualification.

8.5 Suggestions of final assessment

Final assessment shall be in two parts:

- **Theoretical assessment**

The final theoretical assessment shall consist of multiple choice and short answer questions, covering all modules.

- **Practical assessment.**

For practical assessment, proper procedures of services, management of stock, health & safety shall be selected to assess the competencies of student expected to be gained after this training course.

(The final assessment marks shall contribute to the final qualification).

It is also proposed that the assessment may take place in such a way that covers each of the modules. Time and markings may be distributed according to the importance of module that is reflected from the time invested during teaching. The distribution of time and markings for assessment are given below:

Distribution of time and markings for assessment					
Modules	Total	Out of total hrs. / markings	Practical	Recommended Methodology	Scheduled of Assessment
Module A: Maintain Electrical system	6.5 hrs.	2.5 hrs. /	4	<ul style="list-style-type: none"> • Written MCQs • Checking the job • Viva voce 	Monthly Test
Module B: Maintain Hydraulic System	6.5 hrs.	2.5 hrs.	4	<ul style="list-style-type: none"> • Written MCQs • Checking the job 	Monthly Test

				<ul style="list-style-type: none"> • cking the job • Viva voce 	
Module C: Maintain pneumatic system	6.5 hrs.	2.5 hrs.	4	<ul style="list-style-type: none"> • Writt en MCQs • Che cking the job • Viva voce 	Monthly Test
Module D: Maintain PLC system	6.5 hrs.	2.5 hrs.	4	<ul style="list-style-type: none"> • Writt en MCQs • Che cking the job • Viva voce 	Monthly Test
Module E: Install Mechatronics system	6.5 hrs.	2.5 hrs.	4	<ul style="list-style-type: none"> • Writt en MCQs • Che cking the job • Viva voce 	Monthly Test
Module F: Perform Preventive Maintenance	6.5 hrs.	2.5 hrs.	4	<ul style="list-style-type: none"> • Writt en MCQs • Che cking the job • Viva voce 	Monthly Test
Module G: Demonstrate safety	6.5 hrs.	2.5 hrs.	4	<ul style="list-style-type: none"> • Writt en MCQs • Che cking the job • Viva voce 	Monthly Test

Total	45.5 hrs.	17.5 hrs.	28		
--------------	------------------	------------------	-----------	--	--

Few examples that examiner may use for the assessment are given below:

Modules		Practical	Theory
Module -A	Maintain Electrical System	<p>Trainee should be able to:</p> <ul style="list-style-type: none"> • Terminate electrical wiring as per SOPs • Connect wires and cables according to the diagram • Maintain installed cables / conductors / conduit / enclosures and supports of electrical systems as per SOPs 	<p>Trainee will be asked for:</p> <ul style="list-style-type: none"> • Identify parts of electrical installation • Calculate cable resistance and current carrying capacity • Enlist types of electrical joints • Describe single and three phase electrical power distribution systems • State trouble shooting methods in electrical wiring • State power losses in electrical circuit
A-2 Maintain electrical wiring system			

A-3 Maintain electric equipment		Trainee should be able to: <ul style="list-style-type: none"> • Test efficiency of electrical load if it is within prescribed tolerance • Diagnose fault in electrical equipment following service manuals instructions • Remove Fault from electrical equipment adopting safety measures • Replace motors in electrical system considering compatibility • Replace D.C Power source /supply in the system considering compatibility 	Trainee will be asked for: <ul style="list-style-type: none"> • Define working principal of A.C machines used in process industry • Describe construction of A.C/D.C/ Servo and Stepper Motors machine used in process industry • Calculate speed and efficiency of electric motors • Interpret Motor Characteristics chart/curve
		Modules	
Module –B	Maintain Hydraulic System	Trainee should be able to:	Trainee will be asked for:

<p>B-1 Perform Commissioning of Hydraulic System</p>	<ul style="list-style-type: none"> • Verify hydraulic cylinder performance for normal working • Test filters performance for clogging • Verify performance of hydraulic gauges and Valves for normal working • Verify performance of hydraulic Pumps for normal working 	<ul style="list-style-type: none"> • Interpret hydraulic drawing / manual • Define units in hydraulics, Hydrostatics, hydrodynamics, Fluids and Viscosity • State static and dynamic characteristics of instruments • Calculate fluid pressure in hydraulic system • Draw hydraulic cycle • Describe Fluid parameters • Explain working of industrial hydraulic system parts • Classify hydraulic systems • Identify fluid control components • Describe the purpose of fluid conductors
<p>B-2 Maintain fluid Parameters</p>	<p>Trainee should be able to:</p> <ul style="list-style-type: none"> • Verify Regulators for proper working • Verify Fluid Reservoir for proper working. • Verify Pressure gauges for proper working 	<p>Trainee will be asked for:</p> <ul style="list-style-type: none"> • Describe Hydraulic system components • Illustrate Working of hydraulic components. • Describe working of hydraulic components

Modules		Practical	Theory
Module -C	Maintain Pneumatic system	Trainee should be able to: <ul style="list-style-type: none"> Inspect the leakage in the system 	Trainee will be asked for: <ul style="list-style-type: none"> Describe the working of Pneumatic equipment Describe the diagnostic method in pneumatic system.
C-3 Diagnose fault in Pneumatic system			
C-5 Repair pneumatic system		Trainee should be able to: <ul style="list-style-type: none"> Diagnose cause/s of leakage in the system Replace faulty equipment in pneumatic system 	Trainee will be asked for: <ul style="list-style-type: none"> Enlist typical causes of leakage in pneumatic system Describe method of leakage detection in pneumatic system.
Module-D	Maintain PLC System	Practical	Theory
		Trainee should be able to:	Trainee will be asked for:

D-4 Test performance of sensor		<ul style="list-style-type: none"> • Verify Sensors for normal performance 	<ul style="list-style-type: none"> • Describe the working of sensors used in mechatronic system
Modules		Practical	Theory
Module - E	Install Mechatronics System	Trainee should be able to: <ul style="list-style-type: none"> • Layout of the Foundations of Electrical equipment according to blue print • Perform basic sheet metal work according to prescribed tolerance given in blue print • Install earthing system applying prescribed method of earth installation • Install mechanical units of wiring applying prescribed method of installation • Install Electrical Wiring applying prescribed method of installation • Install electrical penal applying 	Trainee will be asked for: <ul style="list-style-type: none"> • Describe mechatronics and its scope • Enlist types of industries getting benefits from mechatronics • Describe operation of mechanical systems. • Interpret mechatronics system wiring diagram. • Enlist the material require to install electrical wiring
E-1 Install system wiring			

E-4 Install Mechanical system		Trainee should be able to: <ul style="list-style-type: none"> • Check floor level as per system requirements • Install frame structure according to blue print. • Lay foundations of mechanical equipment according 	Trainee will be asked for: <ul style="list-style-type: none"> • Interpret the P&ID. • Enlist Parts of hydraulic system • Describe interpreting P&ID. • Distinguish B/w oil grades of hydraulic system • Define importance of sealing in hydraulic system
Modules		Practical	Theory
Module-F	Perform Preventive Maintenance	Trainee should be able to: <ul style="list-style-type: none"> • Maintain lubricant log up to date • Lubricate machine equipment as per SOPs • Lubricate mechanical parts equipment as per SOPs • Lubricate Hydraulic equipment as per SOPs • Maintain Lubricant according to prescribed level 	Trainee will be asked for: <ul style="list-style-type: none"> • Interpret lubricant specifications • Classify industrial lubricants
F-4 Perform Lubrication in system			

F-5 Inspect safety installation		Trainee should be able to: <ul style="list-style-type: none"> • Conduct Safety installation inspection compliance with OSHA. • Document safety inspection record up to date. 	Trainee will be asked for: <ul style="list-style-type: none"> • Explain the potential hazards • Describe rules for safety installation.
Modules		Practical	Theory
Module - G	Demonstrate safety	Trainee should be able to:	Trainee will be asked for:

<p>G-1 Adopt Personal Safely</p>	<ul style="list-style-type: none"> • Take corrective action against potential workplace health & safety hazards applying OHSAS • Utilize PPEs as per SOPs • Handle and store hazardous workplace materials according to Prescribed handling instructions • Comply with workplace legislation relating to health & safety • Maintain personal hygiene according to SOP • Deal with environmental safety issues according to Industrial environmental regulations. 	<ul style="list-style-type: none"> • Enumerate Common industrial PPEs • Describe safety precaution while working with electricity • State the assets safety norms
<p>G-2 Adopt Equipment Safety measures</p>	<p>Trainee should be able to:</p> <ul style="list-style-type: none"> • Implement prescribed safety for equipment to keep the equipment in working conditions 	<p>Trainee will be asked for:</p> <ul style="list-style-type: none"> • Enlist safety precaution while working with machine • Interpret Safety rules written in equipment manual • Enlist safety precautions during gas cylinder

Structure of the assessment team

The number of assessors must meet the needs of the students and the training provider. For example, where **two assessors** are conducting the assessment, there must be a maximum of **five students per assessor**. In this example, a group of 25 students shall therefore require assessments to be carried out over a five-day period.

Planning for assessment

Sessional assessment: assessors need to plan in advance how they will conduct sessional assessments for each module. The tables on the following pages are for assessors to use to insert how many hours of theoretical and practical assessment will be conducted and what the scheduled dates are.

Final assessment: Training providers need to decide ways to combine modules into a cohesive two-day final assessment program for each group of five students. Training providers must agree the settings for practical assessments in advance.

9. Important Notes

9.1 Assessment Context

This module has to be assessed in the class as well as on the job.

9.2 Critical Aspects

Candidates can competently and consistently perform all elements of the unit as specified by the criteria, including required knowledge, and be capable of applying the competency in new and different situations and contexts. Assessment must confirm that the candidates are able to:

- Work together with other people within the scope of their occupational activity and communicate professionally in English language
- While working apply health and safety procedures for smooth operation of plant and systems, and acting in a responsible manner with due consideration to environmental regulations
- Develop well-founded approaches for the identification of errors and rectification of malfunctions
- Using of technical regulations and provision when working with Mechatronics system
- Use the computer as a work tool for operation and troubleshooting of Mechatronics and its sub-system
- Use fire extinguishers
- Check and read the measurement values with digital and manual measuring tools
- Identify and use the fasteners
- Select, handle and use hand tools, workshop tools safely and properly
- Apply mathematical formulae & calculations to carry out daily jobs and also consider the technical and business management values
- Take ergonomic, economic, ecological and social aspects into account when planning and executing work
- Helping to minimize the negative impact of the work process on the environment by using the appropriate material, equipment and working practice
- Identify and demonstrate the drawings, understand description, operating instructions and other typical information related to the Occupation and can prepare such information in comprehensive form for the customers

9.3 Assessment / Exams Condition

Assessment will be held after the completion of every module, and the final examinations would be conducted after a completion of each

year. An assignment will be a part of final exams and must be prepared by the candidate.

3.1. The candidate will have to access:

- a. All tools, equipment, materials, books and documentation required including Mechatronics simulator or work station

2. The candidates will be permitted to refer the following documents.

- a. Relevant workplace procedures

- b. Relevant product and manufacturing specifications
 - c. Relevant drawings, operational and hardware reference manual of Mechatronics system
3. The Candidate will be required to:
- a. Orally or by other methods of communication, answer, questions by the assessor
 - b. Identify superiors who can be approached for the collection of competency evidence where appropriate
 - c. Present evidence of credit for any on-the-job training related course.

9.4 List of machinery / equipment / tools etc.

All the tools, instruments, equipment, machines, books and related consumables are listed below

List of Machinery/ Equipment/Tools (For a Class of 25 Students)

Name of Trade	Mechatronic (Technician)
Duration of Course	Two-year

Sr. No.	Description of Tools &Equipment	Quantity
1	IMS 24 Production line with 4 sub-systems.	01
2	IMS 1-2 Conveyor belt with dc drive	01
3	IMS 3 Mechatronics selection sub system.	01
4	IMS 4 Mechatronics Assembly sub system.	01
5	IMS 6 Mechatronics Testing sub system	01
6	IMS 7 Mechatronics Handling sub system	01
7	IMS Manual operating Device	01
8	Lucas Nulle (UniTrain) Electro Pneumatic Experimenter (SO 4203)-2A, 2B, 9C	01
9	Low noise mini compressor 100 Psi / 7kg-per-cm ² (P/N SE 2902-9K)	01
10	Low noise mini compressor 145 Psi / 10kg-per-cm ²	01

11	Basic unit for SIMATIC S7-300	04
12	Lab Soft Classroom Manager 4.0	01
13	Label printer	01
14	Process Control Training System	01
15	Mechatronics simulator station	04
16	Piping and Tubing Training System	08(25 students' group)
17	Pumps (+ve and -ve pressure) Training System	08(25 students' group)
18	Process Control Simulator ,SCADA Software	02
19	Calibration test bench for various Instruments	01
20	Programmable Logic Controller with Simulator	04
21	Spanner Set(mm size)	16(2 students' group)
22	Socket spanner(with ratchet handle, mm size)	16(2 students' group)
23	Gauge Manifolds(R-134a+R-22)	16(2 students' group)
24	Temperature meters(digital)	06(5students' group)
25	Sling Psychrometer, Hygrometers	06(5students' group)
26	Tube Cutters with scrapper	16(2 students' group)
27	Hand Tube Benders(different sizes)	10(3 students' group)
28	Compression fittings with ferrules and caps	10(3 students' group)
29	SST tubes and plastic tubes(different sizes)	10(3 students' group)
30	Cable ties (different size)	10 packets different sizes
31	Table/bench vise	As per tales/benches
32	Reaming Tool, thread taps and dies with handle	10(3students' group)
33	Hacksaw(for wood and metal)	16(2 students' group)
34	Screw Driver set,(Flat, Phillips, Star)	16(2 students' group)
35	Watchmaker screwdrivers set	16(2 students' group)
36	Steel Hammers	16(2 students' group)
37	Rubber Mallets(Small + medium)	16(2 students' group)
38	Grip Pliers	16(2 students' group)
39	Chisels for Metal &Wood(Flat, round & diamond point),Centre punch	16(2 students' group)

40	Scribers and dividers	16(2 students' group)
41	Steel rulers	16(2 students' group)
42	Pinching Pliers	16(2 students' group)
43	AVO meters	10(3students' group)
44	Adjustable power supply for AC and DC voltages	06(5students' group)
45	Pressure calibrator (druck) 0~ 20bar	06(5students' group)
46	Cable knife	16(2 students' group)
47	Scissors (small)	16(2 students' group)
48	Wire stripper	10(3students' group)
49	Crimping Tools and lugs	10(3students' group)
50	Allen keys (mm size) , star keys	16(2 students' group)
51	Snapping pliers(internal & external)	06(5students' group)
52	Electrical voltage tester	16(2 students' group)
53	Soldering iron and wire roll	06(5students' group)
54	Soldering sucker	06(5students' group)
55	Tweezers	10
56	Pliers set(combination, side cutter and nose)	16(2 students' group)
57	Measuring tapes	16(2 students' group)
58	Insulation tapes(different colors), Teflon tapes	16(2 students' group)
59	Adjustable wrench 6" ,8" , 12"	16(2 students' group)
60	Pipe wrench 6" ,8"	16(2 students' group)
61	Wire brush, paint brush ,emery paper	16(2 students' group)
62	Electrical and hand drill machine and their bits	03(10 students' group)
63	Number punch and alphabet punch	10(3 students' group)
64	Tool box	15 (2students' group)

9.5 Reference Books

S.No.	Book Names	Author Name	Edition	ISBN no.
1	Text book of Physics, Math's and chemistry used in the F.S.C.	Instructor Prepared Material		
2	A Text book of Electrical Technology	BL Theraja, AK Theraja	Vol 1 &2	
3	Electrical Engineering Tables, Standards, Formulas	Heinz O. Häberle		978-3-8085-3033-7
4	SCE Training Curriculum for Integrated Automation Solutions Totally Integrated Automation (TIA) SIMATIC S7-300/S7-1200	Siemens Industry		
5	Electrical and Electronics Principles and Technology	John Bird	5 th Edition	9780415662857
6	OHSAS international standards and SOPs for Mechatronics System.	OSHA manuals	Latest edition	
7	COSHH : A brief guide to the regulations	COSHH manuals	Latest edition	
8	Mechanical and Metal Trades Handbook	Ulrich Fischer & Roland Gomeringer MaxHeinHeinzle	3 rd or Latest Edition	978-3-8085-1913-4
9	Maintenance and operation manuals of different machines	Instructor Prepared Material		
10	Processing methods of Solids & Fluids from web service	Instructor Prepared Material		
11	A hand book of Analytical instruments	R S Khandpur		9780071487467

