सूक्ष्म, लघु एवं मध्यम उद्यम मंत्रालय
DEVELOPMENT COMMISSIONER
MINISTRY OF MICRO, SMALL & MEDIUM ENTERPRISES

MSME TECHNOLOGY CENTRE

MODEL CURRICULUM

Qualification Name:

MECHATRONICS SYSTEM DESIGNER

Qualification Code:

Version: 1.0

NSQF Level: 5

Model Curriculum Version: 1.0

Submitted By:
MSME TECHNOLOGY CENTRE
O/o DC MSME, Ministry of Micro, Small and Medium Enterprises
Govt. of India
A-Wing, 7th Floor, Nirman Bhawan, Maulana Azad Road,
New Delhi-110108
Contact No. +91-674-2654700,
Email- msmetcab@gmail.com

NOS / MODULE: FUNDAMENTALS OF MECHATRONICS SYSTEM

NOS / MODULE CODE: MSME/SMSD/01

COURSE OUTCOMES:

- Understand Mechatronics Measurement and control systems.
- Explain signal conditioning and data acquisition.
- Describe different Mechatronics system models and controls.
- Describe actual Mechatronics systems.
- Brief about Digital electronic systems

THEORY HOURS: 60 **PRACTICAL HOURS: 30** **THEORY MARKS: 100** **PRACTICAL MARKS:**

Unit No.	Unit Name	Unit level outcomes	Contents (chapters/topics)	TH Hours	PR Hours	Marks
I	Introduction To Mechatronics, measurement systems and control systems	At the end of this unit students should be able to- ● Define scope of Mechatronics Measurement systems. ● Discuss advantages & disadvantages of mechatronics ● Understand various control system	Introduction Mechatronics & Measurement Systems – Definition and scope, advantages and disadvantages of mechatronics, components of mechatronics systems, examples of mechatronics systems, introduction to measurement systems, applications of measurement systems, measurement system performance. Control systems – classification of control systems, open-loop control systems, closed- loop control systems, automatic control systems.	10	4	20
II	ELECTRICAL AND ELECTRONICS USED IN MECHATRONICS	At the end of this unit students should be able to- ● Understand the working of electronic components. ● Describe semiconductor devices ● Describe types of diodes ● List advantages & disadvantages of digital electronics. ● Explain construction & working of half & full adder.	Different types of switches: Push button, selector switch, toggle switch, rocker switch Control switch gears: contactor, relay, solid state relay Protective switch gears: MCB, MCCB, ELCB, RCCB, ACB Electronic components, active components – tube devices, semiconductor devices, passive components – resistors, inductors, capacitors, electronic devices – general aspects, semiconductors, intrinsic semiconductor, extrinsic semiconductor, P-N junction diode, BJT, FET, UJT. Digital Electronics – advantages and disadvantages of digital electronics, digital circuit, number systems, digital coding, logic gates, universal gates, half adder, full adder, Boolean algebra, De Morgan's theorem, flip flop circuits, counters, registers.	12	10	20

III	SIGNAL CONDITIONING & DATA ACQUISITION	At the end of this unit students should be able to- ● Summarize the need of signal conditioning. ● List types of amplifiers ● Describe analog to digital conversion ● Discuss different transmission systems.	General measurement system components, signal conditioning and its necessity, process adopted in signal conditioning, mechanical amplification and electrical signal conditioning, functions of signal conditioning equipment, amplification, types of amplifiers. Data acquisition systems, analog to digital conversion, digital to analog conversion, data signal transmission – Mechanical transmission, hydraulic transmission, pneumatic transmission, magnetic transmission.	14	6	20
IV	SYSTEM MODELS AND CONTROLLERS	At the end of this unit students should be able to- ● Understand basic system models. ● Describe different system building blocks. ● Explain different controllers. ● Differentiate between different types of controllers.	Basic system models, mechanical system building blocks, electrical system building blocks, fluid system building blocks, thermal system building blocks, system models, controllers – PD controller, PI controllers, PID controllers, digital controllers.	12	6	20
V	MECHATRONIC SYSTEMS	At the end of this unit students should be able to- ● Describe the design process of mechatronics system ● Differentiate between traditional and mechatronics designs ● Describe mechatronics systems.	General aspects, design process, traditional and mechatronics designs, embedded systems, description of some mechatronics systems – engine management systems, automatic washing machine, list of some other mechatronics systems.	12	4	20

NOS / MODULE: DEMONSTRATE APPLICATION OF INDUSTRIAL AUTOMATION SENSORS

NOS / MODULE CODE: MSME/SMSD/02

COURSE OUTCOMES:

After completion of course Student should be able to

- Describe and explain different measurement techniques.
- Explain and demonstrate Mechanical Measuring instruments.
- Classify & describe various Electrical measuring devices.
- Describe applications of smart sensors in various fields.

THEORY HOURS: 60 PRACTICAL HOURS: 60 THEORY MARKS: 100 PRACTICAL MARKS:100

Unit No.	Unit Name	Unit level outcomes	Contents (chapters/topics)	TH Hours	TH Hours	Marks
I	SCIENCE OF MEASUREMENT	After completion of unit Student should be able to ● Describe units and standards. ● Discuss errors in measurement. ● Explain characteristics of transducers. ● Classify the transducers	Units and Standards – Calibration techniques –Errors in Measurements – Generalized Measurement System – Static and dynamic characteristics of transducers – Generalized Performance of Zero Order and First Order Systems - Response of transducers to different time varying inputs – Classification of transducers	18	10	5
II	MECHANICAL MEASUREMENTS	After completion of unit Student should be able to ● Describe functioning of different temperature measuring instruments. ● Explain working of different gauges.	Temperature: Filled thermometer – Bimetallic thermometer – monometers – elastic transducers – Bourdon gauge – bellows – diaphragm. Vacuum: McLeod gauge, thermal conductivity gauge – Ionization gauge, flow measurement: orifice, venture, nozzle, pilot tube, turbine flow meter, hot wire Anemometer.	18	20	10
III	ELECTRICAL MEASUREMENTS	After completion of unit Student should be able to ● Explain working of different transducers. ● Differentiate between different transducers. ● List functions of transducers. ● Explain working of different types of flow meters	Resistive transducers – Potentiometer– RTD – Thermistor – Thermocouple – Strain gauges – use in displacement, temperature, force measurement – Inductive transducer – LVDT – RVDT – use in Displacement – Capacitive transducer – Piezoelectric transducer – Digital displacement transducers. Flow measurements - Turbine flow meter, Magnetic flow meter, Ultrasonic flow meter	18	25	15

IV	ELECTRONIC SENSORS	After completion of unit Student should be able to ● Explain types of proximity sensors ● Explain working and operation of proximity sensors	Proximity sensors: Inductive proximity sensor, Capacitive proximity sensor, Photo- electric proximity sensor, Through beam proximity sensor, retro-reflective proximity sensor, diffused scan proximity sensors, Ultrasonic proximity sensor, magnetic proximity sensor			
V	SMART SENSORS	After completion of unit Student should be able to ● List smart sensors ● Differentiate between smart sensors and others ● Explain Nano sensors. ● Give applications of smart sensors.	IOT based level sensor, pressure sensor, temperature sensor, flow meter, vibration sensors Radiation Sensors - Smart Sensors - Film sensor, MEMS & Nano Sensors – applications - Automobile, Aerospace, Home appliances, Manufacturing, Medical diagnostics, Environmental monitoring.	18	20	10

NOS / MODULE: DEVELOP AUTOMATION LOGICS USING PLC

NOS / MODULE: MSME/SMSD/03

COURSE OUTCOMES:

- Understand the relay logic and its working detail.
- Understand about various types of programming languages.
- Describe the techniques used to write a PLC programme in software.
- Explain different types of PLC.
- Explain the hardware components of a PLC.
- Explain PLC programming, installation, operation and maintenance

THEORY HOURS: 30 PRACTICAL HOURS: 90 THEORY MARKS:--- PRACTICAL MARKS: 100

Unit No.	Unit Name	Unit level outcomes	Contents (chapters/topics)	TH Hours	PR Hours	Marks
I	Introduction	At the end of this unit students should be able to- ● Understand the concept of industrial automation. ● List the advantages and disadvantages of automation. ● Describe different control systems.	Introduction to industrial automation. Advantage of automation. Application of PLC in industrial automation. Overview of different control systems. PLC block diagram, different types of PLC, PLC input devices, PLC output devices, PLC wiring,	6	15	15
II	Details of electrical hardware control (manual control)	At the end of this unit students should be able to- ● Understand & draw various electrical symbols. ● Draw and explain one line diagram for different situations. ● List the different field devices. ● Understand the working of field input and output devices.	Introduction to electrical hardware control. Study of electrical symbols and application in one line diagram. Details of field input and output devices.	3	15	15
III	Relay hardware logic control	At the end of this unit students should be able to- ● Explain the working of a relay. ● Describe the construction of a relay. ● Explain the importance of relay. ● Give applications of relay in industrial circuits.	Working principle of relay. Application of actuators in various industrial control circuits	6	15	15
IV	Programming	At the end of this unit students should be able to-	Programmable logic controller introduction to programmable logic controller.	6	15	15

		● Demonstrate the hardware configuration of PLC ● Understand the addressing of inputs and outputs in PLC ● Explain the environment of PLC software.	Hardware configuration of PLC Addressing concept of PII PIQ of signal modules.			
V	Practices with software	At the end of this unit students should be able to- ● Demonstrate the software installation ● Develop the programme in the PLC with different formats. ● Understand the output of a programme. ● Use the different internal peripherals of PLC. ● Demonstrate the networking of the PLC.	Software installation and application. Introduction to programming language-LAD, FBD, STL. Details of bit, byte, word and memory. Application of block operands-comparator, timer, counter. Interfacing of i/o with signal module. Demo board practice. Networking between profibus PLC and remote PLC	6	30	40

NOS MODULE: DEVELOP HYDRAULICS & PNEUMATICS CIRCUIT FOR MECHATRONICS SYSTEM

NOS / MODULE CODE: MSME/SMSD/04

COURSE OUTCOMES:

After completion of course Student should be able to

- Understanding the basic Hydraulics & Pneumatics system components.
- Draws a basic pneumatic components (compressor, receiver, drain valves, check valves, pneumatic cylinders) and pneumatic circuit diagram with symbols
- Able to understand the working principle and symbolic representation of different energy supply elements.
- Understand hazards of hydraulic and pneumatic circuits and be able to work safely.
- Understand the concepts of Hydraulic and Pneumatic as applied to commercial and industrial control.
- Understand the concepts Electro-Pneumatic and Electro-Hydraulics
- Draw a hydraulic circuit diagram, understand the basic elements. Know the properties of the basic elements used in the hydraulic system.
- Explain types of hydraulic pumps, the basic functions and features

THEORY HOURS: 60 PRACTICAL HOURS: 60 THEORY MARKS: 100 PRACTICAL MARKS: 100

Unit No.	Unit Name	Unit level outcomes	Contents (chapters/topics)	TH Hours	PR Hours	Marks
I	INTRODUCTION TO HYDRAULICS & PNEUMATICS	At the end of this unit Student should be able to ● List different energy supply elements related to hydraulics & pneumatics. ● Identify the hydraulics & pneumatic power system elements. ● Select appropriate elements / components / symbols for the given process. ● Select different standard elements ● Recommend variation within the standards, symbols. ● Describe the functioning of different elements, systems ● Differentiate between systems	Merits of Fluid power & its utility for increasing productivity through Low Cost Automation, Transmission of Fluid Power through various types of Cylinders), Symbolic representation of Pneumatic elements (CETOP), Compressors and Air supply system including airline installations, Signaling & control system. Introduction to Industrial Hydraulics, Hydraulics Power System elements and standard symbolic Representation (CETOP symbols).	12	12	15
II	CONTROL ELEMENTS	At the end of this unit Student should be able to ● Perform basic mathematical calculation required for cylinder speed.	Pneumatic & hydraulic control elements (control valves & hydraulic pumps, accessories), Basic circuits for controlling single & double acting cylinders, Basic circuits, Advantages of Hydro-Pneumatics and its	12	12	20

		● Select appropriate Hydraulic Pump ● Describe the functioning of different control valves. ● Identify different type of control valves & accessories. ● Discuss applications & advantages of hydro - pneumatic systems	applications, Hydraulics system and their classification.			
III	HYDRAULICS & PNEUMATICS BASIC CIRCUITS	At the end of this unit Student should be able to ● Design the conceptual circuit diagram. ● Simulate the circuit diagrams. ● Identify different electrical, pneumatic, hydraulic elements ● Apply logic & creativity to design circuits. ● Analyze the simulation results. ● Communicate the simulation results	Hydraulics circuits Hydraulic Motors, Hydraulic Fluids and effective contamination control. Advanced pneumatic circuits for controlling multi-cylinders (operable & inoperable circuits), Electro pneumatics with relay logic, Application of fluidics a non-moving part logic.	12	12	25
IV	ADVANCED CONTROLS & CIRCUITS	At the end of this unit Student should be able to ● Design the programmable circuit sequence ● Analyze stepper control outputs. ● Explain servo controls applications. ● Design circuits with proportional valves. ● Design cartridge valves.	Programmable sequential control using pneumatic modular elements, Stepper controls. Electro hydraulics system, Servo valves and proportional valves, Design of Cartridge Valves,	12	12	25
V	SAFETY, TROUBLESHOOTING & REMEDIES	At the end of this unit Student should be able to ● Troubleshoot faults in system components. ● Follow safety standards. ● Suggest remedy for the fault.	Safety in hydraulics & pneumatics systems, Troubleshooting and remedial measures in Hydraulics & Pneumatics systems.	12	12	15

NOS / MODULE: CREATE & MODIFY THE ELECTRICAL CIRCUIT & MECHANICAL DRAWING USING CAD SOFTWARE

NOS / MODULE CODE: MSME/SMSD/05

COURSE OUTCOMES:

- Use the fundamental features and precision drafting tools in Electrical CAD to develop accurate technical drawings.
- Present drawings in a detailed and visually impressive manner.
- Generate and update customizable reports, and use folders to organize drawings.
- Customize the application to meet your specific design in Electrical CAD.
- Interpret drawings, draw interferences and workout other technical details

THEORY HOURS:------ PRACTICAL HOURS: 90 THEORY MARKS: ----- PRACTICAL MARKS: 100

Unit No.	Unit Name	Unit level outcomes	Contents (chapters/topics)	PR Hours	Marks
I	Introduction Of AutoCAD	At the end of this unit Student should be able to ● Understand Procedure to be adopted for computer aided drawings ● Describe coordinate system ● Understand the applications of coordinate system ● Use the AutoCAD workspace and user interface.	Introduction to AutoCAD Advantage of AutoCAD. Application of AutoCAD. Coordinate System Application of coordinate system	20	20
II	Basics of AutoCAD	At the end of this unit Student should be able to ● Optimize commands effectively ● Use more advanced editing and construction techniques. ● Add parametric constraints to objects.	Using Commands for Line, Circle, Arc, Fillet, Mirror, Offset, Array, Tan Tan Radius, Tan Tan Tan, Hatch, Gradient. Designs using AutoCAD	20	30
III	Introduction Of E-CAD	At the end of this unit Student should be able to ● List the steps of Computer aided electrical drawing ● Use the Electrical CAD workspace and user interface. ● Customize the application to meet your specific design in Electrical CAD.	Introduction of E-CAD Advantage of E-CAD Application of E-CAD Software Exploration	20	20
IV	Basics of E-CAD	At the end of this unit Student should be able to ● Draw various electrical circuits using CAD software. ● Build intelligent ladder diagrams and panel layouts.	Toolbars, Tool Pallets, Insert Component, Working With Project Manager, Implement Layers ,Text Wire & Ladder, Trim, Parent-Child Component Discussion, Multiple Wire Bus & Edit Component,	30	30

		• Insert and edit parametric PLC modules, nonparametric PLC modules, and Stand-alone PLC I/O points	Forward Reverse Control Circuit, Star Delta Control Circuit , Star Delta Control Power Circuit, Forward Reverse Control Circuit, Star Delta Control Circuit , Star Delta Control Power Circuit Attribute, Scoot ,Move, Dash-link, Reverse and Flip Schematic Report and insert PLC module in drawing Circuit Designs using E-CAD		

NOS /Module: Employability Skills

NOS /Module Code: MSME/ES/02

THEORY HOURS: 60 PRACTICAL HOURS: - THEORY MARKS: 100 PRACTICAL MARKS: -

Refer Standard Curriculum developed by NCVET. (60-hours-MC-Employability-Skills_v4-DGT (1).pdf)

NOS /MODULE: DEMONSTRATE OF ELECTRICAL MOTORS AND DRIVES

NOS / MODULE CODE: MSME/SMSD/06

COURSE OUTCOMES:

- Explain the working principles and construction of various electric motors, including DC motors, AC motors, synchronous motors, and induction motors.
- Understand the electromagnetic principles underlying motor operation.
- Describe the role of electric drives in controlling motor speed, torque, and position.
- Explain the components of drive systems, including controllers, power electronics, and feedback mechanisms.
- Understand the principles of motor control techniques, such as scalar control, vector control, and direct torque control (DTC).
- Explain the differences between open-loop and closed-loop control systems in motor drives.

THEORY HOURS: 60 PRACTICAL HOURS: 30 THEORY MARKS: 100 PRACTICAL MARKS:

Unit No.	Unit Name	Unit level outcomes	Contents (chapters/topics)	TH Hours	PR Hours	Marks
I	Introduction	At the end of this unit students should be able to- ● Understand the need of AC drives. ● Describe the role of AC drives in controlling industrial motors. ● List advantages and disadvantages of AC drives.	Introduction to ac drives. History of ac drives, their need and role in controlling motors, advantages and disadvantages of AC drives.	12		15
II	Electric motors	At the end of this unit students should be able to- ● Understand the construction and working of different types of motors. ● Discuss the applications of different types of motors.	Study of various kinds of motor :- ac motor 1. AC motor 2. DC motor 3. Servo Motor 4. Stepper Motor Their application and speed control.	12	8	15
III	Electrical drives	At the end of this unit students should be able to- ● List the advantages of Electrical drives	Electrical drives. Advantages of electrical drives. Parts of electrical drives, choice of electrical drives, status of dc and ac drives, Dynamics of electrical drives,	12	8	25

		• Select appropriate drive • Understand torque equations • Calculate time and energy loss in operations	Fundamental torque equation, speed torque conventions and Multi-quadrant operation. Equivalent values of drive parameters, components of low torques, nature and classification of load torques, calculation of time and energy loss in transient Operations, steady state stability, load equalization.			
IV	Drives programming	At the end of this unit students should be able to- • Explain the different control methods for AC drives • Explain the different control methods for servo motor drives • Explain the different control methods for Stepper motor	Controlling methods :- open loop scalar control closed loop vector control open loop sensor less control Pogrammining, commissioning, operation and testing of AC dive, Servo motor drive and stepper motor drive Troubleshooting and maintenance of drive	14	8	25
V	Types of operation	At the end of this unit students should be able to- • Describe the types of operations performed on the actual drive.	Start methods (auto flying/ dc magnet), ramp(ACCEL/ DECEL), dc hold control(DC hold speed/ DC current reference), breaking techniques(DC injection/ flux braking/ dynamic braking/ re-generation), digital control and analog control.	10	6	10

NOS /MODULE: APPLICATION OF EMBEDDED TECHNOLOGY FOR MECHATRONICS SYSTEM

NOS / MODULE CODE: MSME/SMSD/07

COURSE OUTCOMES:

- Understanding Embedded Systems: Explain the fundamental concepts of embedded systems, including their architecture, components, and applications.
- Describe the functionality and operation of microcontrollers and related hardware.
- Understand the principles of writing, debugging, and optimizing software for embedded systems.
- Understand standard communication protocols like UART, SPI, I2C, CAN, and their applications in embedded systems.
- Demonstrate the ability to interface hardware components with software systems.
- Understand architecture of PIC and ARM microcontroller.
- Ability to interface motors & sensors with microcontrollers.
- Understand the role and significance of embedded systems in mechatronics applications.

THEORY HOURS: 60 PRACTICAL HOURS: 60 THEORY MARKS: 100 PRACTICAL MARKS: 100

Unit No.	Unit Name	Unit level outcomes	Contents (chapters/topics)	TH Hours	PR Hours	Marks
I	Introduction to Embedded C and MPLABX compiler	After completion of unit Student should be able to ● The candidate will be able to prepare and maintain acknowledge-base of the known problems ● The candidate is able to develop systems by interfacing as well as developing the hardware. ● Basics of Programming ● Understanding Embedded C	● Introduction to Programming Language ● Concept of C/C++ ● Use of Decision Making Statement ● Use of structure and pointer ● Use of Arrays and Functions ● Introduction to MPLABX Compiler ● Methods of Compiling and Debugging ● Execution of program file on hardware	8	8	10

		• Memory Efficiency & Troubleshooting & Maintenance				
II	Introduction to PIC18F series MCU microcontroller	After completion of unit Student should be able to • The candidate will be able to understand embedded hardware • The candidate will be able to use basic communication protocols, understanding of circuits and architectures Architecture Of Microcontrollers	• Introduction to PIC Microcontroller • Application of PIC Microcontroller • Introductionto PIC18f4550 Family • Understanding the instruction set used for programming. Understanding method for writing program and debugging method	8	8	15
III	Interfacing with Peripherals to microcontroller	After completion of unit student should be able to • Understand internal and external peripherals of microcontrollers. • Understand interfacing of motors & sensors with microcontroller	Understanding the concept of peripherals • Types of Peripherals • Interfacing with internal peripherals such as Timer/Counter, Serial Communication, Interrupt, CCP, EEPROM memory, ADC etc. • Interfacing with external peripherals such as LED, LCD (Liquid Crystal Display), SSD (Seven Segment Display), DAC, RTC etc	10	10	15
IV	Introduction to communication protocols	After completion of unit Student should be able to • Explain the purpose and types of communication protocols (serial, parallel, synchronous, asynchronous) used in microcontrollers.	• I2C - Interfacing with microcontroller using bit-banking method, I2C devices – RTC, Memory, ADC-DAC, Port-Expander, • SPI (Serial Peripheral Interface), Bluetooth, WI-Fi and RFID. • Understanding Serial Communication • Bluetooth Communication • SPI Interface • Wi-Fi • I2C • Infrared	10	10	20

			● RFID ● GSM ● PDH/SDH/Ethernet			
V	ARM Processor	After completion of unit Student should be able to ● Features and advantages of ARM processors ● Overview of ARM architecture and history ● Writing C programs for ARM-based systems ● Optimizing C code for ARM architecture ● Memory Management in ARM ● ARM Processor Peripherals ● ARM in Embedded Applications	● Introduction to ARM Processor ● Architecture of ARM7TDMI Processor ● Advantages of 32-bits over 8- bit controller ● LPC2148ARM within- built peripherals programming for 1. ADC, 2. DAC 3. RTC 4. UART 5. Timer/Counter 6. Interrupts 7. PWM 8. SPI based programming ● Interfacing External peripherals LCD display, keypad, sensor, relay, motors	10	10	15
VI	Introduction to Internet of Things	After completion of unit Student should be able to ● Explain the fundamental concepts, architecture, and components of IoT systems. ● IoT Applications in industrial automation. ● Understand the IOT communication protocols and networking ● Explain the role of sensors, actuators, microcontrollers, and single-board computers in IoT systems.	● Understanding IoT fundamentals ● Various Platforms for IoT ● Real time Examples of IoT ● Overview of IoT components and IoT Communication ● Technologies Challenges in IOT ● Study of IOT Cloud platforms ● Thing Speak API and Blynk, Adafruit I/O ● Interfacing Clouds and Arduino with Web ● services.	7	7	15
VII	Application of Embedded system in Mechatronics	After completion of unit Student should be able to ● Application of microcontroller to control conveyor system, batch process, automating mixing process, pick and place process	Develop program for automatic system using microcontroller for the following process ● Conveyor system ● Automatic mixing process of two ingredients ● Automatic Pick and place process	7	7	10

		● Developing programing, commissioning and testing.				

NOS /MODULE: ENGINEERING METROLOGY AND QUALITY CONTROL

NOS / MODULE CODE: MSME/SMSD/08

COURSE OUTCOMES:

After completion of course Student should be able to

- Understand Various Principles of Measurements.
- Identify various Length Standards & Knowledge of Limits, Fits & Tolerances.
- Explain and demonstrate various gauges like NPL gauge
- Understand, define ,explain and review Taylor's principles of gauge design and Fixed & Indicating Gauges
- Classify & describe various measuring machines like Floating carriage diameter measuring m/c etc.
- Predict and examine various modes and types of errors and also the demonstration of devices used for measurement.
- Evaluate and do analysis of parameters of screw threads
- Determine and describe various methods of measurements of gear terminology
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THEORY HOURS: 60 PRACTICAL HOURS: 30 THEORY MARKS: 100 PRACTICAL MARKS:

Unit No.	Unit Name	Unit level outcomes	Contents (chapters/topics)	TH Hours	PR Hours	TH Marks
I	PRINCIPLES OF MEASUREMENT & TOLERANCES	After completion of unit Student should be able to ● Understand the Principles of measurements. ● List the various length standards ● Knowledge of Limits, fits & tolerances ● Understand Design of Gauges	Definition of Metrology, difference between precision and accuracy. Sources of errors: Controllable and Random Errors, Effects of Environment and Temperature, Effects of support, alignment errors, errors in measurement of a quality which is a function of other variables. Introduction to Coordinate Measuring Machine (CMM). Length Standards: Line standards, end standards and wavelength standards, transfer from line standards to end standards. Numerical based on	15	6	25

			line standards. Slip gauges – its use and care, methods of building different heights using different sets of slip gauges. Limits, fits and Tolerances**:** Different types of fits and methods to provide these fits. Numerical to calculate the limits, fits and tolerances as per IS 919-1963. ISO system of limits and fits; Gauges and its types, limit gauges – plug and ring gauges. Gauge Design – Taylor's Principle, wear allowance on gauges. Different methods of giving tolerances on gauges			
II	INSPECTION TECHNIQUES	After completion of unit Student should be able to ● Understand types of inspection ● Inspection the measurement by using various Instruments like Vernier caliper, Micrometer, Gauges etc.	**Types of Inspection**:-Inspection by Gauging: limit gauging, plug gauges, Ring gauges, position gauges Inspection by Measurement: Direct measurement such as Vernier Caliper, Vernier Height gauge, Vernier Depth gauge Outside Micrometer, Inside Micrometer, Depth Micrometer, Slip gauges (gauge blocks), length bars , Bevel protractor etc. Indirect Measurement such as Mechanical, optical, & pneumatic comparators, Angular Measurements- Sine bar, angle gauges, precision levels, Introduction to Autocollimator, Interferometers, NPL Flatness Interferometer etc.	15	8	25
III	SCREW THREAD MEASUREMENT & GEAR TECHNOLOGY	After completion of unit Student should be able to: ● Understand various features of Inspections. ● Inspection Straightness & Flatness of various surfaces. ● Understand screw thread & Gear Measurement . ● Calibrate thread	**Straightness and flatness**: Feature inspection such as flatness, roundness, straightness, parallelism, etc. Surface texture, different types of irregularities, Measurement of various surface roughness parameters. Tomlinson surface meter, Taylor-Hobson talysurf. **Screw Thread Measurement:** Error in threads, Measurement of elements of screw threads – major dia, minor dia, pitch, flank angle and effective diameter. Various thread gauges. **Gear Measurement:** Gear	15	8	25

		Measurement & Gear Measurement	terminology, measurement of gear thickness, Gear tooth Vernier caliper Parkinson gear tester.			
IV	QUALITY	After completion of unit Student should be able to : ● Understand Need of Quality & Assurance ● Knowledge of various sampling methods	**Introduction to Quality Assurance:** Need of quality, Aspects of quality, Quality specification, and Quality function Shewhart's control charts for variables: X bar and R charts, operating characteristics curves, producer's risk, consumer's risk, Sampling inspection, single double and multiple sampling plan.	15	7	25

NOS /MODULE: APPLICATION OF SCADA AND HMI IN MECHATRONICS SYSTEM

NOS / MODULE CODE: MSME/SMSD/09

COURSE OUTCOMES:

COURSE OUTCOMES:

- Understand functional relationships in mechatronic systems.
- Understand energy flow in electrical, pneumatic and hydraulic sub-systems.
- Plan and organize work flow
- Commission, troubleshoot and repair mechatronic systems
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THEORY HOURS: 60 PRACTICAL HOURS: 60 THEORY MARKS: PRACTICAL MARKS: 100

Unit No.	Unit Name	Unit level outcomes	Contents (chapters/topics)	TH Hours	PR Hours	Marks
I	INTRODUCTION, ROLE OF SCADA IN INDUSTRIAL AUTOMATION	At the end of this unit Student should be able to ● Understand the need of the SCADA system in automation. ● Differentiate between PLC & SCADA. ● Describe the application of the SCADA system.	Introduction to SCADA. What is industrial automation, advantages of automation, application of programmable logic controller, and need of SCADA system in automation	5	10	20

II	COMMUNICATION OF SCADA WITH PLC, CREATING PROCESS SCREENS	At the end of this unit Student should be able to ● Understand the procedure of installing the SCADA software. ● Create new applications in software. ● Work on a graphic designer window. ● Create and modify graphic displays with animation. ● Detect the fault in the production system by using the software	Installation of SCADA software, communication drivers for SCADA, creating a new SCADA application, types of projects in SCADA, activate & deactivate a project, working with graphic designer screen, create & edit process picture, Creating & editing graphic display with animation. fault finding systematic fault finding on a production system	7	14	20
III	CREATING DATA BASE OF TAGS	At the end of this unit Student should be able to ● Understand the details of process tags and internal tags. ● Apply the LAD programming on SCADA projects. ● Use the property setting of tags. ● Apply standard and other objects for the graphic design.	Tag management & tag selection dialog box, tag types, create & edit tags, details of process tag, internal tag, and property setting of tags, application of LAD program on SCADA projects. Application of Standard objects, window objects, smart objects.	6	12	20
IV	APPLICATION OF LAD PROGRAM ON SCADA PROJECTS	At the end of this unit Student should be able to ● Create a picture window related to any process. ● Develop multi screens. ● Apply a LAD programme to simulate the screen designed. ● Use the different tags in a project.	Use of LAD program, use of input, output & memory tags, creating new picture window, multi screens.	6	12	20
V	CREATING A PROCESS CONTROL WINDOW	At the end of this unit Student should be able to ● Understand the concept of a logging system. ● Understand the principles of the message system. ● Create online trend. ● Develop a new system. ● Interface field devices with the SCADA system. ● Simulate the designed	Alarm logging. Principles of message system. Archiving messages. Display messages in run time, creating an online trend. Creating & accessing real-time & historical trends. Use of all applications. Simulation of the project. Interfacing of various field devices with SCADA system.	6	12	20

		SCADA system.				

NOS /MODULE: MECHATRONICS SYSTEM DESIGN

NOS / MODULE CODE: MSME/SMSD/10

COURSE OUTCOMES:

After completion of course Student should be able to

- Understand the Mechatronics kits and its components.
- Understand the interfacing of PLC with robotics.
- Understand the trouble shooting of all the kits.
- Discuss about input outputs of the kits.
- Understand the mechanical set up, electrical connection , pneumatics connection

THEORY HOURS: 30 PRACTICAL HOURS: 60 THEORY MARKS: PRACTICAL MARKS: 100

Unit No.	Unit Name	Unit level outcomes	Contents (chapters/topics)	TH Hours	PR Hours	Marks
I	DISTRIBUTION PROCESS	At the end of this unit Student should be able to ● Understand the mechanical construction of process. ● Describe working of process. ● Analyze relative movements in the process. ● Carryout fault finding. ● Develop programme for the process ● Compare output with the standard ● List different elements. ● Follow safety while working on the process.	Mechanics-Mechanical construction of a station, Pneumatics– Piping connections of pneumatic components, Vacuum technology, Pneumatic linear and rotary drives, Electrical– Correct wiring of electrical components, Sensors– Correct use of limit switches, PLC Programming and use of a PLC Structure of a PLC program, Commissioning – Commissioning of a production system, Fault finding Systematic fault finding on a production system	6	10	20
II	TESTING PROCESS	At the end of this unit Student should be able to ● Understand the mechanical construction of process. ● Describe working of process. ● Analyze relative movements in	Mechanical construction of a station, Pneumatics, Use of rodless cylinders Electrical, Correct wiring of electrical components, Sensors, Mode of operation and areas of application of optical and capacitive sensors with digital switching behavior, Mode of operation and areas of application of analogue sensors using the example of an analogue displacement encoder, Programming and use of a PLC	6	12	20

		the process. ● Carryout fault finding. ● Develop programme for the process ● Compare output with the standard ● List different elements. ● Follow safety while working on the process.	Programming of alternative (OR) branches Commissioning of a production system Fault finding Systematic fault finding on a production system			
III	HANDLING PROCESS	At the end of this unit Student should be able to ● Understand the mechanical construction of process. ● Describe working of process. ● Analyze relative movements in the process. ● Carryout fault finding. ● Develop programme for the process ● Compare output with the standard ● List different elements. ● Follow safety while working on the process.	Mechanical construction of a station Pneumatic grippers, Pneumatic linear and rotary drives Electrical– Correct wiring of electrical components, Correct use of limit switches Programming and use of a PLC Actuation of a handling device, Commissioning of a production system Systematic fault finding of a production system	6	12	20
IV	STORING PROCESS	At the end of this unit Student should be able to ● Understand the mechanical construction of process. ● Describe working of process. ● Analyze relative movements in the process. ● Carryout fault finding.	Mechanical construction of a station Piping connections of pneumatic components, Pneumatic grippers, Pneumatic linear drives, Correct wiring of electrical components, Connection of DC motors, Activation of DC servo motors, Usage of linear drives, Usage of motor controller, I/O activation of a drive controller, Correct use of limit switches Mode of operation and areas of application of optical and inductive sensors with digital switching behavior Programming and use of a PLC, Structure of a PLC program, Programming of positioning control systems, Programming	6	12	20

		● Develop programme for the process ● Compare output with the standard ● List different elements. ● Follow safety while working on the process. Systematic fault finding on a production system	a storage administration, Programming a Teach-function, Programming of alternative (OR) branches, Positioning of DC servo motor Usage of a parallel gripper Storage administration and organization			
V	SORTING PROCESS	At the end of this unit Student should be able to ● Understand the mechanical construction of process. ● Describe working of process. ● Analyze relative movements in the process. ● Carryout fault finding. ● Develop programme for the process ● Compare output with the standard ● List different elements. ● Follow safety while working on the process.	Mechanics – Mechanical construction of a station Piping connections of pneumatic components, Correct wiring of electrical components, Correct use of limit switches Programming and use of a PLC, Programming of alternative (OR) branches, Commissioning of a production system Systematic fault finding on a production system	6	12	20

NOS /Module: Employability Skills

NOS /Module Code: MSME/ES/02

THEORY HOURS: 60 PRACTICAL HOURS: - THEORY MARKS: 100 PRACTICAL MARKS: -

Refer Standard Curriculum developed by NCVET. (60-hours-MC-Employability-Skills_v4-DGT (1).pdf)