Savitribai Phule Pune University, Pune

Ganeshkhind, Pune-411007 (MS) India

Skill Development Centre (SDC),

Bachelor of Vocation
(B. Voc.)

Course Structure

(Framed as per National Educational Policy 2020)

For
Manufacturing Technology
(Semester - III and IV)

(Effective from June 2025 and onwards)

Semester – III

Subject Code	Course Name	Course Type	Type of Course	Credits	Total Hrs	Internal Marks	External Marks	Total
MT - 201- MJ	Manufacturing Automation -I	Department Specific Core-	Theory	2	30	25	25	50
MT - 202- MJ	Manufacturing Technology -II	Department Specific Core-	Theory	2	45	25	25	50
MT - 203- MJP	Robotics Laboratory	Department Specific Core	Practical	2	60	25	25	50
MT - 221- VSC	PLC (Programmable Logic control)	VSC Department Specific Core	Theory/ Practical	2	30	25	25	50
MT - 231- OJT	OJT (On job Training)	Department Specific Core	Practical	2	30	25	25	50
MT - 241- MN	Hydraulic and Pneumatic Systems	Department Specific Core Minor Theory	Theory	2	45	25	25	50
MT - 242- MNP	Hydraulic and Pneumatic Lab	Department Specific Core Minor Practical	Practical	2	45	25	25	50
MT - 201- IKS	Ancient Indian Trade and Commerce	Department Specific Core-	Theory	2	45	25	25	50
OE- 201- MT	Introduction to Constitution	General -Open elective other faculty	Theory	2	30	25	25	50
AEC- 201- MAR	Marathi	Ability Enhancement Course (AEC)	Theory	2	30	25	25	50
CC- 201- PE, NSS, NCC	Physical Education	Co-Curricular	Theory/ Practical	2	30	25	25	50
Total				22 Credits	420	275	275	550

Semester – IV

Subject Code	Course Name	Course Type	Type of Course	Credits	Total Hrs	Internal Marks	External Marks	Total
MT-251-MJ	Manufacturing Automation -II	Department Specific Core-	Theory	2	30	25	25	50
MT - 252-MJ	Lean Manufacturing Systems	Department Specific Core-	Theory	2	45	25	25	50
MT-253-MJP	Automation Practical's	Department Specific Core	Practical	2	60	25	25	50
MT - 271-VSC	HMI and SCADA	VSC Department Specific Core	Practical	2	30	25	25	50
MT - 281-OJT	OJT (On job Training)	Department Specific Core	Practical	2	30	25	25	50
MT - 291-MN	Measurement & Instrumention	Department Specific Core Minor Theory	Theory	2	45	25	25	50
MT - 292-MNP	Instrumentation Practical's	Department Specific Core Minor Theory	Practical	1+1	45	25	25	50
SEC - 251-MT	Life Skills	Department Specific Core-	Theory/ Practical	1+1	45	25	25	50
OE-251-MT	Introduction to Human Rights and Duties	General - Open elective other faculty	Practical	2	30	25	25	50
AEC-251-MAR	Marathi	Ability Enhancement Course (AEC)	Theory	2	30	25	25	50
CC-251-PE,NSS, NCC	Physical Education	Co-Curricular	Theory/ Practical	2	30	25	25	50
Total				22 Credits	420	275	275	550

(MT -201-MJ) Manufacturing Automation -I

Total Duration: 30 Hours Credits: 2

1. Automation Fundamentals – 10 Hours

- Introduction to **Automation**: Definition, importance, and objectives
- Real-world **applications of automation** in industry and manufacturing
- **Expectations from automation**: Speed, precision, consistency, safety, and cost-effectiveness
- Overview of **Process Automation** and **Factory Automation**
- **Types of Plant Control**:
  - Categories of control systems in the industry
  - **Open Loop vs. Closed Loop** control
  - **Continuous, Discrete, and Mixed Process** control systems
- **Automation Hierarchy**:
  - Large control system hierarchy in industries
  - Data quality, quantity, and control levels
- **Control System Architecture**:
  - Evolution from traditional to modern control architectures
  - Comparative analysis of different architectures
- **Communication Basics**:
  - **OSI Reference Model** Overview
  - **Transmission Media**:
    - Copper, Coaxial, Twisted-Pair, and Fiber-Optic cables
    - Cable connectors and standards
    - Importance of proper **grounding/earthing**
  - **Fiber-optic Components** and Parameters

2. Open Control Networks – 10 Hours

- **RS-232 Interface**:
  - Overview, standard structure, common issues, and troubleshooting techniques
- **RS-485 Interface**:
  - Overview, signal standard, typical applications, and troubleshooting
  - Current loop systems and RS-485 converters
- **TCP/IP Overview**:
  - Protocol layers, especially the **Internet Layer** and packet transport
- **Modbus Protocol**:
  - Modbus structure and communication methods
  - Modbus-based control and troubleshooting techniques
- **Industrial Communication Networks**:
  - Overview and comparison of various industrial-level communication protocols:
    - **AS-I**, **CAN**, **DeviceNet**
    - **Industrial Ethernet**
    - **Profibus** (PA/DP/FMS)
    - **Foundation Fieldbus**

    - **HART** Protocol and Smart Instrumentation
  - Understanding physical layer aspects, wiring rules, and practical considerations

---

3. Basics of Industrial Mechatronics Systems – 5 Hours

Topics Covered:

- **Introduction to Industrial Mechatronics**
- **Robot Anatomy** and Key Attributes
- **Types of Robot Control Systems**
- **End Effectors** and their applications
- **Sensors in Robotics** and their roles
- Overview of **Industrial Applications of Robots**
- Introduction to **Robot Programming**

4. Basics of Sensors in Industrial Mechatronics Systems – 5 Hours

- Overview of **Transducers, Sensors, and Actuators**:
  - Classification and working principles
  - Criteria for selection based on applications
  - Signal conditioning and calibration methods

Reference Books:

1. **Samuel M. Herb**, *Understanding Distributed Processor Systems for Control*, International Society of Automation, 1st Edition, 1999
2. **Poppovik Bhatkar**, *Distributed Computer Control in Industrial Automation*, CRC Press, 2nd Edition, 1990
3. **S. K. Singh**, *Computer Aided Process Control*, Prentice Hall of India, 1st Edition, 2004
4. **Krishna Kant**, *Computer Based Process Control*, Prentice Hall of India, 2nd Edition, 2010
5. **N.E. Battikha**, *The Management of Control System: Justification and Technical Auditing*, International Society of Automation, 1st Edition, 1992
6. **Bela G. Liptak**, *Instrument Engineer's Handbook – Process Control*, Chilton Book Company, 3rd Edition, 1969

(MT -202-MJ) Manufacturing Technology - II

Total Duration: 30 Hours Credits :2

Chapter 1: Joining Processes – *6 Hours*

- **Welding**:
  - Terminological elements of welding
  - Advantages and disadvantages of welding
  - Classification of welding and allied processes
  - Safety recommendations in welding
  - Common welding defects
- **Brazing**:
  - Methods of brazing and applications
- **Soldering**:
  - Basic operations and materials used in soldering

Chapter 2: Machining Processes – *6 Hours*

- **Machining**:
  - Definition and approach
  - Classification of machining processes
  - Machining mechanism and cutting tool geometry
  - Tool materials, heat generation during cutting, and use of cutting fluids
- **Grinding**:
  - Internal and external surface grinding
  - Centerless grinding
  - Designation and selection of grinding wheels
  - Trueing and balancing of wheels
- **Other Machining Processes**:
  - Reaming, Honing, Polishing, and Lapping – purpose and applications

Chapter 3: Heat Treatment of Steel – *6 Hours*

- Classification of **ferrous and non-ferrous materials**
- **Properties of engineering materials**
- **Constituents of iron and steel**
- **Allotropy of iron**
- Phase transformation during heating and cooling
- **Iron-Carbon equilibrium diagram**
- **Heat Treatment Objectives** and techniques:
  - Normalizing, Annealing, Spheroidization
  - Hardening, Tempering

- Case Hardening (Carburizing, Nitriding, etc.)
- Heat treatment of tool steels and high-speed steels

Chapter 4: Powder Metallurgy – *12 Hours*

- Introduction and significance of powder metallurgy
- Steps in **Powder Metallurgy Process**:
  - Production of metal powders
  - Characteristics and types of powders
  - Mixing/blending
  - Compacting
  - Sintering and secondary operations
- Advantages and limitations
- Industrial **applications** of powder metallurgy (e.g., automotive parts, tools, aerospace)

Inspection and Quality Control –

- **Introduction to Metrology and Quality Control**
- **Tolerances and Interchangeability**:
  - Size, limits of size, zero line and deviation
  - Upper and lower deviation
  - Mean and fundamental deviation
- **Fits**:
  - Definitions: allowance, clearance, interference, and transition fits
  - Hole basis and shaft basis systems
- **Surface Finish**: Importance and methods of measurement
- **Quality Control and ISO 9000** standards

Reference Books:

1. **S. K. Hajra Chaudary** – *Elements of Workshop Technology, Vol. II*, Media Promoters & Publishers
2. **R. K. Jain** – *Production Technology*, Khanna Publishers
3. **R. K. Rajput** – *Manufacturing Technology*, Laxmi Publications
4. **M. P. Grover** – *Modern Manufacturing Processes*, John Wiley (2002)
5. **P. N. Rao** – *Manufacturing Technology Vol. I & II*, Tata McGraw Hill (2009)
6. **V. D. Kodgire & S. V. Kodgire** – *Material Science and Metallurgy for Engineers*, Everest Publishing House
7. **P. C. Sharma** – *Production Engineering*, Dhanpat Rai Publications

(MT -241-MN) Hydraulic and Pneumatic Systems

Course Title: Hydraulics and Pneumatics

Total Duration: 30 Hours Credits : 2

Chapter 1: Introduction to Hydraulics and Pneumatics – *9 Hours*

- **Introduction to Fluid Power Systems**:
  - Scope and applications
  - Types of hydraulic systems
  - Classification of fluid power systems
- **Basic Components**:
  - Hydraulic and pneumatic system elements
  - Comparison of hydraulic vs pneumatic systems
- **Fluid Properties**:
  - Density, specific gravity, specific weight, specific volume
  - Dynamic & kinematic viscosity
  - Capillarity, surface tension, compressibility, vapor pressure
- **Pressure Measurement**:
  - Concepts of fluid pressure, pressure head, pressure intensity
  - Absolute vacuum, atmospheric pressure, gauge pressure, absolute pressure
  - Total pressure and center of pressure
  - Pressure measuring devices: simple and differential manometers, Bourdon pressure gauge
- **Hydraulic & Pneumatic Principles**:
  - Boyle's Law, Pascal's Law
  - Properties of hydraulic oil
  - Construction, working principle, and symbols of various pumps

---

Chapter 2: Hydraulic Circuits – *9 Hours*

- **Valves: Construction, Working & Symbols**:
  - Pressure control valves: direct acting, pilot operated, pressure unloading, reducing, counterbalancing, sequence valves
  - Direction control valves: poppet and spool valves, 2/2, 3/2, 4/2, 5/3 configurations
  - Check valves and pilot-operated check valves
  - Actuation methods and center positions
- **Flow Control Valves**:
  - Pressure-compensated and non-pressure-compensated types
- **Hydraulic Actuators**:
  - Classification and working of rotary actuators
- **Hydraulic Circuits**:
  - Meter-in, meter-out, bleed-off circuits
  - Unloading, two-cylinder synchronizing, regenerative, and dual pump unloading circuits
  - Counterbalance and sequencing circuits (time and pressure dependent)

Chapter 3: Pneumatic Circuits – *9 Hours*

- **Pneumatic System Overview**:
  - Applications and layout of pneumatic systems
  - Advantages and limitations
- **Compressor Selection**:
  - Criteria and types used in pneumatic circuits
- **Speed Control and Sequencing Circuits**:
  - Speed control for double-acting cylinders and bidirectional air motors
  - Position-based sequencing circuits
  - Time delay circuits

Chapter 4: Applications of Hydraulic and Pneumatic Systems: 3 hours

  - Industry-specific uses
  - Pros and cons of both systems in automation

Reference Books:

1. S. R. Majumdar – *Oil Hydraulic Systems: Principles and Maintenance*, Tata McGraw-Hill
2. S. R. Majumdar – *Pneumatics Systems: Principles and Maintenance*, Tata McGraw-Hill
3. Peter Rohner – *Fluid Power Logic Circuit Design*, The Macmillan Press Ltd.
4. Festo K. G. – *Pneumatic Tips*, Festo, Germany
5. Andrew Parr – *Hydraulics and Pneumatics*, Jaico Publishing House
6. Mc Clay Donaldson – *Control of Fluid Power: Analysis and Design*, Ellis Horwood Ltd.
7. Ojha, Berndtsson, Chandramouli – *Fluid Mechanics and Machinery*, Oxford University Press
8. P. N. Modi & S. M. Seth – *Hydraulics and Fluid Mechanics including Hydraulic Machines*, Standard Book House
9. Joji B. – *Pneumatic Controls*, Wiley India
10. Stewart – *Hydraulics and Pneumatics*, Taraporewala Publications

(MT -242-MNP) Practical: Hydraulic and Pneumatic system Lab

Marks : 50 **Credits: 2**

LIST OF EXPERIMENT

1. **Fundamental principles of hydraulics & pneumatic**
2. **Application of hydraulics & pneumatic**
3. **Study of symbols, schematic diagrams and standards**
4. **Study of sources of hydraulic & pneumatic power**
5. **Transmission and conditioning of oil /air**
6. **Study of direction control valve**
7. **Study of hydraulic & pneumatic actuators**
8. **Building of simple hydraulic & pneumatic circuits**
9. **Study of safety aspects in hydraulic & pneumatic circuits**
10. **Fundamental principles of hydraulics & pneumatic**
11. **Application of hydraulics & pneumatic**
12. **Study of symbols, schematic diagrams and standards**
13. **Transmission and conditioning of oil/air**
14. **Study of pressure measurement and control**
15. **Study of direction control valve**
16. **Building of advanced hydraulic & pneumatic circuits**
17. **Trouble shooting in hydraulic & pneumatic circuits**
18. **Study of safety aspects in hydraulic & pneumatic circuits**

(MT -203-MJP) Practical: Robotics Laboratory

Marks : 50 **Credits: 2**

List of Practical's:

 Exercise on Modular Automation Production System (MAPS) Assembly module, printing module, conveyor module, dispensing module, linear pick and place module etc
 Study of classification of robots
 Study of kinematics of robots
 Programming techniques
 Application of robot control aspects for various systems
 Understanding of robots inter-joints, kinematics and controls mythology
 Demonstrate knowledge in control systems of robot
 Demonstrate knowledge in operating industrial robot
 Maintenance of these systems
 Programming of stacking module to index the part out to the linear indexing module and check for the type of parts.
 Programming of Rotary Indexing Module with memory array for the station address.
 Programming and control of screwing module and integrating with the printing module to form a closed loop system.
 Programming & control of Linear Indexing Module.
 Program to manual triggered rotary indexing module to rotate by a slot and carry out the Screwing operation and move it to next position.
 Program for Auto conveyor transit / return for material transfer with timer and Feedback control.
 Program to manual triggered rotary indexing module to rotate by two slots and carry out the Printing operation followed by placing the part in the conveyor module using the Linear pick & place.
 Program the pusher module to by-pass metal / Non-metal components and then carry out the capping operation and place the part for the next station using the rotary pick & place.
 Program to sensor trigger/manual triggered and to make the Linear indexing module to index by two positions capping module to carry out the capping process and returning back to the initial position.

*** List of experiment may vary depending on requirement.**

(MT -221-VSC) PLC (Programmable Logic control)

Marks:50 Credit : 2

Chapter 1: Definition, functions of PLC, Advantages, Architecture, Working of PLC, Scan time, Types & Specifications, Relay Logic, Ladder Diagram, Basic PLC, local and remote I/O expansion, special purpose modules, wiring diagrams of different I/O modules, communication modules, Memory & addressing - memory organization (system memory and application memory), I/O addressing, hardware to software interface Relay Logic Ladder Diagram, PLC

Chapter 2 :Programming , Programming devices, IEC standard PLC programming languages, LD programming - basic LD instructions, PLC Timers and Counters: Types and examples, data transfer & program control instructions, advanced PLC instructions, PID Control using PLC. Case study: PLC selection and configuration for any one process applications.

References Books:

1. Thomas Hughes, “Programmable Logic Controller”, International Society of Automation Publication, 4th Edition, 2004.

2. Gary Dunning, “Introduction to Programmable Logic controller”, Thomas Learning, Pck-edition, 2001.

3. John. W. Webb, Ronald A Reis, “Programmable Logic Controllers – Principles and Applications”, Prentice Hall Inc, 5th Edition, 2002.

(MT -201-IKS) Ancient Indian Trades and Commerce

Marks : 50 **Credits: 2**

Total Duration: 30 Hours
Aligned with: Indian Knowledge Systems (IKS), NEP 2020
Learning Objectives:
Students will :
Know the key terms, concepts, and timelines of ancient Indian trade (Knowledge).

Understand the socio-cultural and geographical contexts influencing trade (Comprehension).

Apply knowledge to identify traditional trade routes on map. (Application).

UNIT 1: Introduction to Ancient Indian Economy (7 hours)
1.1 Nature of the early Indian economy (Agrarian, pastoral, artisanal)

1.2 Role of barter and emergence of currency

UNIT 2: Local and Regional Trade Systems (8 hours)
2.1 Village markets and trade fairs

2.2 Guilds (Shrenis) and artisanal networks

2.3 Role of women in trade

UNIT 3: Trade Routes and Means of Transport (7 hours)
3.1 Ancient highways and trade centres

3.2 Riverine and coastal trade

3.3 Ports and maritime facilities

UNIT 4: Commodities and Trade Specializations (8 hours)

4.1 Agricultural produce, spices, textiles, metals

4.2 Trade in gems, ivory, perfumes

4.3 Craftsmanship and exports

Reference Books:

1. Sharma, R. S. (2005). *India's ancient past*. Oxford University Press.
2. Abraham, M. (1988). *Two medieval merchant guilds of South India*. Manohar Publishers.
3. Kosambi, D. D. (1956). *An introduction to the study of Indian history*. Popular Prakashan.
4. Majumdar, R. C. (1960). *Corporate life in ancient India* (3rd ed.). Mukhopadhyay.
5. Paranjape, M. (2022). *Indian culture and civilization: The IKS perspective*. Rupa Publications.
6. Pillay, K. K. (1975). *Indian history: Social and cultural*. University of Madras

(OE -201-MT) INTRODUCTION TO CONSTITUTION

Marks : 50 **Credits: 2**

Course Objectives: This course introduces students to the Constitution of lndia. The Constitution, being supreme law of the land, must be known to every citizen of India. It begins with the Preamble, which indicates the source and objects of it. We, the people of India, are the source of the Constitution and have resolved to constitute India into a sovereign, socialist, secular, democratic and republic. The Course has been designed for everyone to make acquaint themselves with their fundamental rights and of others. No right is absolute one; it is subject to others right, as well. Directive Principles of State Policy are nothing but rights, though not enforceable by any court. These Directive Principles are basically 'Fundamental Principles' in the governance of the country. Powers and freedoms come with responsibility, State 's responsibility to implement Directive Principles and citizens must perform their duties towards others, society and nation. Expected Course Outcomes: To introduce the philosophy of Constitution of India to students. To acquaint them with their freedoms and responsibilities.

UNIT I: PHILOSOPHY OF THE INDIAN CONSTITUTION (5 Hours)

a) Constitutional History of India b) Role of Dr. B.R. Ambedkar in Constituent Assembly c) Preamble - Source and Objects d) Sovereign and Republic e) Socialist and Secular f) Democratic - Social and Economic Democracy g) Justice - Social, Economic and Political h) Liberty - Thought, Expression, Belief, Faith and 'vVorship i) Equality - Status and Opportunity j) Fraternity, Human Dignity, Unity and Integrity of the Nation

UNIT 2: FUNDAMENTAL RIGHTS (10 Hours)

a) Right to equality b) Right to freedoms c) Right against exploitation d) Right to freedom of religion e) Cultural and educational rights f) Right to property g) Right to constitutional remedies

UNIT 3: DIRECTIVE PRINCIPLES OF STATE POLICY (10 Hours)

Equal Justice and free legal aid b) Right to work and provisions for just and humane conditions of work c) Provision for early childhood, Right to education and SC,ST, weaker section d) Unifonn Civil Code e) Standard of Living, nutrition and public health f) Protection and improvement of environment g) Separation of Judiciary from executive h) Promotion of International peace and security

UNIT 4: FUNDAMENTAL DUTIES (5 Hours)

a) Duty to abide by the Constitution b) Duty to cherish and follow the noble ideals c) Duty· to defend the country and render national service d) Duty to value and preserve the rich heritage of our composite culture e) Duty to develop scientific temper, humanism ,the spirit of inquiry & reform f) Duty to safeguard public property and abjure violence g) Duty to strive towards excellence

Reference Books:

a)D. D. Basu, Introduction to the Constitution of India, LexisNexis

b) Granville Austin, The Constitution of India: Cornerstone of a Nation, Oxford University Press

c) Subhash Kashyap, Our Constitution, National Book Trust

d) M.P. Jain, Indian Constitutional Law, LexisNexis

(MT -231-OJT) On-Job Training

Marks : 50 **Credits: 2**

Objective:

To enhance student employability and entrepreneurial potential by providing real-world industrial exposure through **On-Job Training (OJT)** in leading manufacturing industries.

Overview:

The **B.Voc. in Manufacturing Technology** program includes **compulsory On-Job Training (OJT)** as an essential part of the curriculum. This initiative aims to bridge the gap between classroom knowledge and industry practices by immersing students in actual manufacturing environments.

Key Features of OJT:

- Conducted in **leading manufacturing industries** across various domains.
- Scheduled as part of the **Second Semester curriculum**.
- Aims to provide **hands-on skills, industrial work culture experience**, and **real-time problem-solving exposure**.
- Helps students build **industry connections**, identify **career interests**, and develop **job-ready competencies**.

Student Responsibilities:

1. Participation:

- Students must actively engage in OJT, follow company policies, and demonstrate professionalism throughout the training period.

2. Report Submission:

- At the end of the Second Semester, students are required to submit an **OJT Report** which must include:
  - **Industry Details** (Name, Location, Type)
  - **Training Duration and Department**
  - **Project Assigned and Skills Learned**
  - **Technical Activities and Tools Used**
  - **Project or Task Contributions**
  - **Key Learning Outcomes and Achievements**
  - **Suggestions or Reflections**

- The report must be **duly certified** by the **competent authority from the industry** (Supervisor/Manager).

3. Presentation:

- Students must deliver a **presentation** based on their report, highlighting:
  - Major tasks undertaken
  - Skills acquired
  - Challenges faced and how they were handled
  - Learning impact on their career path
- The presentation will be evaluated by faculty members or a designated academic panel.

Evaluation Parameters:

Criteria	Marks
Participation and Industrial Behavior	10
Quality and Content of Report	20
Presentation and Communication	10
Learning and Skill Development	10
Total	**50**

(MT -251-MJ) Manufacturing Automation -II

Marks : 50 **Credits: 2**

Chapter - 1: Introduction to Manufacturing Automation 04 Hrs.

Definition; Discussion on Pros and Cons of Automation; Benefits of Automation; Types of automation: Fixed automation, programmable automation, and Flexible automation- Typical Features and examples; Reasons for automating; Automation strategies.

Chapter - 2: Automated flow lines 10 Hrs.

Detroit type automation: Automated flow lines: the objectives of the use of flow line automation, types and their selection; General forms of Work Flow – criteria for selection; Methods of work part transport: Continuous, intermittent and asynchronous, Transfer Mechanisms; Examples of transfer mechanisms for linear travel and rotary transfer mechanisms; Buffer Storage, Controlling of automated flow lines.

Chapter - 3: Analysis of automated flow lines 6 Hrs.

Average production time and production rate; Mean time per cycle when machine breakdown occurs; Line efficiency; Cost per item produced; Analysis of transfer lines without storage –upper bound and lower bound approach; Partial automation: Reasons for using, Advantages and drawbacks; Production and Throughput: Examples; Effect of machine Jamming; Component Quality Control;

Chapter - 4: Automated assembly systems 10 Hrs.

Historical developments of the assembly process; Choice of assembly methods: Cost, Production Rate, Availability of Labour, and Market Life of the Product; Advantages of Automatic Assembly; Design for automated assembly; Components of automatic Assembly Machines; Transfer systems; Assembly Machines: In-Line, Rotary; Continuous and Intermittent Transfer; Indexing Machines: Factors affecting the choice; Various Indexing Mechanisms; Vibratory bowl feeders: Mechanics of Vibratory Conveying - its analysis; Effect of Frequency, Track Acceleration and Vibration Angle; Effect of Track Angle and Coefficient of Friction; Summary of Bowl Feeder Design; Spiral Elevators; General Requirements of Part Feeders; Non-vibratory feeders : Reciprocating Tube Hopper Feeder – its analysis; General Features. Centreboard Hopper Feeder: Analysis: Maximum Track Inclination, Total Cycle Time, Mean Feed Rate; Reciprocating Tube Hopper Feeder: Principle of Operation; External Gate Hopper Feeder: Its Analysis: Maximum Peripheral Velocity, Mean Feed rate; Rotary Disk Feeder: Indexing and Rotary Disk Feeder with continuous drive and their analysis: Load sensitivity, Efficiency and Mean Feed Rate.

References:

1. M. P. Groover, Automation, production systems and computer-integrated manufacturing, Prentice-Hall of India Pvt. Ltd, New Delhi, 1989.
2. G. Boothroyd, C. Poli and L.E. Murch, Automatic Assembly, Marcel Dekker Inc.,

New York and Basel, 1982.
3. G. Boothroyd, Taylor & Francis, Assembly Automation and Product Design, First Indian Edition – 2010
4. Mikell P Groover, Automation, production systems and computer integrated manufacturing, PHI.
5. Mike J P. Grower, Automation, Production Systems and CIM, PHI
6. R Thomas Wright and Michael Berkeihiser, Manufacturing and Automation Technology, Good Heart Willcox Publishers
7. Mikell P Groover, Industrial Robots – Technology Programmes and Applications, McGraw Hill, New York, USA. 2000.
8. Bolton W, Mechatronics, Pearson Education, 1999

(MT -252-MJ) Lean Manufacturing Systems

Marks : 50 **Credits: 2**

Chapter - 1: Gemba **6 hours**

Introduction, The Gemba Walk, 4 Steps to Realizing Gemba Success, Example Gemba Walk Schedule, Implementation of Gemba Walk, Gemba Reveals Waste, The 3 M's: Muda, Mura, Muri, Relation of Gemba with Lean Manufacturing, Relation of Gemba with 5S, tools used in Gemba process, Gemba Board.

Chapter - 2: Kaizen **6 hours**

Introduction, Kaizen = Continuous Improvement, Kaizen Principle, Kaizen in waste reduction & cost Reduction, Gemba Kaizen, Kaizen Concepts, Kaizen Event, 5S, The 5 M's, The Kaizen Group, Kaizen in Action, Kaizen tools.

Chapter - 3: Kanban **6 hours**

Introduction, Origins of Kanban, Benefits of Kanban, Reductions in Waste and Inventory, Flexibility, Cutting Costs, The Art of Kaizen, Five S's, Integrating Kanban, Principles of Kanban, Kanban in production control, Kanban in project management, Kanban in waste control.

Chapter - 4: Six Sigma and Total Productive Maintenance (TPM) **12 hours**

Introduction, History of Six Sigma, Benefits of Six Sigma, Six Sigma's Impact on Manufacturing, Foundational Principles of Six Sigma, Six Sigma Belief System, Implementing Six Sigma, Common QA tools, DMADV or DFSS, The Belts of Six Sigma: Levels of Certification, Difference between Kaizen & Six Sigma.
Introduction of TPM, Objectives of TPM, 8 Pillars of TPM, Overall Equipment Effectiveness, TPM: Step by Step, steps to implementing TPM Roadblocks to TPM Success, Difference between TPM & TQM.

References:

1. Terry Wireman, Total Productive Maintenance, Industrial Press
2. Tokutaro Suzuki, TPM in Process Industries (Step-By-Step Approach to TPM Implementation), Productivity Press
3. Mohamed Ben, Handbook of Maintenance Management & Engineering, Springer
4. Philip Kling, Process Kaizen: How to Document and Improve Any Process (and everything's a process), CreateSpace Independent Publishing Platform
5. R. K. Jain, Production Technology, Khanna Publishers.
6. R. K. Rajput, Manufacturing Technology, Laxmi Publications.
7. M. P. Grover, Modern Manufacturing Processes, John Wiley (2002).
8. P. C. Sharma, Production Engineering, Dhanpat Rai Publications
9. Industrial Maintenance, H.P. Garg, S. Chand.

(MT -291-MN) Measurement & Instrumentation

Marks : 50 **Credits: 2**

Chapter - 1: Introduction to Mechanical Measurements 6 hours

Types of measurement, instruments classification, Static characteristics: Range and Span, Accuracy and Precision, Reliability, Calibration, Drift, Sensitivity, Linearity, Hysteresis and Dead zone, Repeatability and Reproducibility, Threshold and Resolution. Dynamic characteristics: Response Speed, Fidelity and Dynamic errors, Overshoot. Measurement of error, Transducers

Chapter-2: Displacement Measurement and Pressure Measurement 6 hours

Displacement Measurement: Potentiometer, Capacitive transducer, RVDT, LVDT, Specifications of displacement transducers, Selection and applications of displacement transducer. Optical measurement scale and encoders Pressure Measurement: Low pressure gauges- Thermal conductivity gauge, McLeod Gauge, Thermocouple vacuum gauge, Ionization gauge and Pirani gauge; High Pressure gaugeBellows, Diaphragm, Bourdon tube, Electrical resistance type, Variable capacitor type, piezoelectric type and Photoelectric pressure transducers.

Chapter-3:Temperature Measurement and Flow Measurements 12 hours

Non-electrical methods of Temperature Measurement: Bimetal, Pressure thermometer and Liquid in glass thermometer Electrical methods of Temperature Measurement: RTD, Thermistor and Platinum resistance thermometer. Thermoelectric methods of Temperature Measurement: elements of thermocouple, law of intermediate temperature, law of intermediate metals, Seebek series, thermo emf measurement, Pyrometers: radiation and optical types.

Variable area meter- Rota meter, Variable velocity meter – Anemometer, Special flow meter: Electromagnetic flow meter, hot wire anemometer, Turbine meter, Ultrasonic flow meter, Vortex shedding flow meter.

Chapter - 4: Control Systems 6 Hrs.

Block diagram of automatic control system, closed loop system, open loop system, feedback control system, feed forward control system, servomotor mechanism, Comparison of hydraulic, pneumatic, electronic control systems, Control action: Proportional, Integral, derivative, PI, PD, PID, Applications of measurements and control for setup for boilers, air conditioners, motor speed control

References:

1. D. S. Kumar, Mechanical Measurements & Control, Metropolitan Publications, New Delhi
2. R.V. Jalgaonkar, Mechanical Measurement & Control, Everest Publishing House, Pune
3. R. K. Jain, Mechanical & Industrial Measurements, Khanna Publications, New Delhi
4. A. K. Sawhney, Mechanical Measurements & Instrumentation, Dhanpat Rai & Sons, New Delhi

5. C.S. Narang, Instrumentation Devices & Systems, Tata McGraw Hill Publications
6. B. C. Nakra and K. K. Chaudhary, Instrumentation, Measurement and Analysis, Tata McGraw Hill Publication

(MT -271-VSC) HMI(Human Machine Interface)/SCADA

Marks : 50 **Credits: 2**

- Reading Analog Inputs from the PLC
- Programming outputs Analog Outputs
- SCADA Software Introduction (RS View)
- Configuring SCADA (RSView)
- Alarm, Reports and Trending with SCADA
- Protocols in SCADA Communications
- Introductions to HMI (Panel View)
- Programming HMI (Panel View)
- Reports
- VB Script
- Animation
- ODBC and OPC connectivity

HMI :

_ Basic concept of using HMI
_ Various specifications of hmi and basis of their selection
_ Creating an Application Using GP-pro software for proface.
_ Downloading an Application to hmi.
_ Preparing a hmi Terminal for Operation
_ designing the mimc screens in hmi
_ Configuring Communications drivers in hmi
_ Debuging the application
_ Configuring Basic Animation in hmi

Scada Indusoft (wonderware)

_ Getting Started with scadaSoftware
_ Configuring t Communications for scada
_ Configuring DDE Communications for scada
_ Configuring OPC Communications for an scada
_ Modifying the Tag Database
_ Modifying a Tag Monitor for an Project
_ Creating Graphic Objects for Project
_ Modifying Graphic Displays for Project
_ Configuring and Running Log Files

(OE -251-MT) Introduction to Human Rights and Duties

Credit: 2 **Marks: 50**

I) Basic Concept a) Human Values- Dignity , Liberty, Equality , Justice, Unity in Diversity, Ethics and Morals b) Meaning and significance of Human Rights Education
II) Perspectives of Rights and Duties a) Rights: Inherent-Inalienable-Universal- Individual and Groups b) Nature and concept of Duties c) Interrelationship of Rights and Duties
III) Introduction to Terminology of Various Legal Instruments a) Meaning of Legal Instrument- Binding Nature b) Types of Instruments: Covenant-Charter-Declaration-Treaty-Convention-ProtocolExecutive Orders and Statutes
IV) United Nations And Human Rights

a) Brief History of Human Rights- International and National Perspectives

b) Provision of the charters of United Nations
c) Universal Declaration of Human Rights- Significance-Preamble
d) Civil and Political Rights-(Art. 1-21)
e) Economic, Social and Cultural Rights-(Art.22-28)
f) Duties and Limitations-(Art. 29)
g) Final Provision (Art. 30)

(MT -253-MJP) Automation Practical

Credit: 2 Marks: 50

Experiments covering following aspects

Integrated Design Concepts: Mechanical, Electrical, and System Engineering

1. Design Concepts and Intermigrations

Understanding how mechanical, electrical, and system design integrate is crucial for developing automated systems and machinery. This includes translating motion, managing power transmission, controlling systems electronically, and achieving efficient performance through hybrid approaches.

---

2. Types of Motion

- **Linear Motion**: Movement in a straight line (e.g., piston movement).
- **Rotary (Circular) Motion**: Movement in a circle or rotation around an axis (e.g., motor shaft).
- **Simple Harmonic Motion**: Oscillatory motion like a pendulum or vibrating spring.
- **Quick Return Mechanism**: Converts rotary motion to reciprocating motion with unequal strokes, typically used in shapers.

Conversion of Motion

- Rotary to Linear (e.g., cam and follower)
- Linear to Rotary (e.g., rack and pinion)
- Reciprocating to Rotary (e.g., crankshaft in engines)

---

3. Mechanical Components

- **Transmission Elements**: Pulley, Gears, Gear Train, Linkages
- **Tools and Fasteners**: Screws, Nuts, Bolts, Rivets, Hand Tools
- **Measurement Instruments**:
  - Vernier Caliper
  - Micrometer Screw Gauge
  - Sine Bar
- **Mechanisms**: Levers, Screws, Press Fits, Latches

.

- Screwing
- Riveting
- Welding

- Press Fitting
- Use of Latches

---

4. Electrical Concepts

- **Supply Systems**:
  - Single-Phase
  - Three-Phase
- **AC-DC Conversion**:
  - Rectifiers and Inverters

AC Motors:

  - Single Phase
  - Three Phase
  - With Variable Frequency Drives (VFDs)
- **DC Motors**:
  - Brushed and Brushless (BLDC)
- **Stepper Motors**
- **Servo Motors**

Case Studies and Practical Applications

Mechanical-Electrical Integration Examples

1. **Elevator System**
   - Study of hydraulic and electrical mechanisms for vertical transport.
2. **Robotic Arm**
   - Control using hydraulic actuators, electrical sensors, and programmable logic.

Gear and Pulley Design

3. **Output Speed and Torque Matching**
   - Use of gear ratios, pulleys, and chain systems to achieve desired output.

(SEC-251-MT) Life Skills

Credit: 2 **Marks: 50**

1. Assignment based on Life skills.
2. Assignment based on Personality Development.
3. Assignment based on Time Management.
4. Assignment based on Team Building and Leadership.
5. Assignment based on Problem Solving and Decision Making skills
6. Assignment based on Effective Communication.

(MT-292-MNP) - Instrumentation Practicals

Marks : 50 **Credits: 2**

List of Experiments

1. Study of Basic Measurements and Measuring Instruments

- Objective: To understand the principles and operations of basic measuring instruments.
- Instruments Covered:
  - **Vernier Caliper**
  - **Micrometer Screw Gauge**
  - **Dial Gauge**
  - **Sine Bar**
- Parameters Measured: Length, thickness, angles, diameter, depth.

2. Study of Temperature Measurement using Various Temperature Sensors

- Objective: To learn how temperature is measured using different sensors and observe the characteristics of each.
- Sensors Covered:
  - **Thermocouple**
  - **RTD (Resistance Temperature Detector)**
  - **Thermistor**
  - **Infrared Temperature Sensor**
- Output: Temperature vs. Time graph, sensor calibration.

3. Study of Level, Force, and Pressure Measurement using Different Sensors

- Objective: To understand how industrial parameters like level, force, and pressure are sensed and converted into electrical signals.
- Sensors and Instruments:
  - **Ultrasonic/Capacitive Level Sensor**
  - **Load Cell (for Force Measurement)**
  - **Strain Gauge**
  - **Piezoelectric Pressure Sensor**
  - **Bourdon Gauge**
- Output: Voltage/Current vs. Parameter graphs.

4. Study of Displacement Measurement using Transducers

- Objective: To study the working and application of displacement transducers.
- Devices Covered:
  - **LVDT (Linear Variable Differential Transformer)**
  - **Potentiometric Displacement Sensor**

    - **Capacitive and Inductive Displacement Sensors**
- Output: Displacement vs. Output signal characteristics.

Note:

Additional sensor-based practicals can be included based on syllabus requirements, laboratory resources, and student interests.
Some suggested additions:

- **Speed and RPM Measurement using Proximity Sensors**
- **Humidity Sensor Calibration and Testing**
- **Flow Measurement using Turbine or Ultrasonic Flow Meters**
- **Vibration Measurement using Accelerometers**
- **pH Sensor Study**

(MT -281-OJT) On-Job Training

Marks : 50 **Credits: 2**

Objective:

To enhance student employability and entrepreneurial potential by providing real-world industrial exposure through **On-Job Training (OJT)** in leading manufacturing industries.

Overview:

The **B.Voc. in Manufacturing Technology** program includes **compulsory On-Job Training (OJT)** as an essential part of the curriculum. This initiative aims to bridge the gap between classroom knowledge and industry practices by immersing students in actual manufacturing environments.

Key Features of OJT:

- Conducted in **leading manufacturing industries** across various domains.
- Scheduled as part of the **Second Semester curriculum**.
- Aims to provide **hands-on skills, industrial work culture experience**, and **real-time problem-solving exposure**.
- Helps students build **industry connections**, identify **career interests**, and develop **job-ready competencies**.

Student Responsibilities:

1. Participation:

- Students must actively engage in OJT, follow company policies, and demonstrate professionalism throughout the training period.

2. Report Submission:

- At the end of the Second Semester, students are required to submit an **OJT Report** which must include:
  - **Industry Details** (Name, Location, Type)
  - **Training Duration and Department**
  - **Project Assigned and Skills Learned**
  - **Technical Activities and Tools Used**
  - **Project or Task Contributions**
  - **Key Learning Outcomes and Achievements**
  - **Suggestions or Reflections**

- The report must be **duly certified** by the **competent authority from the industry** (Supervisor/Manager).

3. Presentation:

- Students must deliver a **presentation** based on their report, highlighting:
  - Major tasks undertaken
  - Skills acquired
  - Challenges faced and how they were handled
  - Learning impact on their career path
- The presentation will be evaluated by faculty members or a designated academic panel.

Evaluation Parameters:

Criteria	Marks
Participation and Industrial Behavior	10
Quality and Content of Report	20
Presentation and Communication	10
Learning and Skill Development	10
Total	**50**

Important Notes:

- OJT is **mandatory** for successful completion of the semester.
- Students must maintain a **logbook or diary** during training to record daily activities.
- Any misconduct or lack of attendance may lead to disqualification or re-training.

.