STUDY, EVALUATION SCHEME & SYLLABUS

For

B. Voc
Production Technology

Based on

AICTE Model Curriculum

(EFFECTIVE FROM THE SESSION: 2019-20)
## Evaluation Scheme

### B. Voc Production Technology

#### NSFQ Level 5 SEMESTER- I

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GV: General Vocational; VP: Vocational Practical; OJT: On Job Training; SSC: Sector Skill Council
### NSFQ Level 6 SEMESTER- III

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### NSFQ Level 7 SEMESTER- V

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### NSFQ Level 7 SEMESTER- VI

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Level 5 (Semester I)  
(5.GV.01) Machine Tool Technology

Unit 1: Centre Lathe

The centre lathe and its principle of working, Types of lathes, Lathe specification and size, Features of lathe bed, Head stock and tail stock, feed mechanism and change-gears, carriage saddle, Cross slide, Compound rest, Tool post, Apron mechanism, lathe accessories, Chucks, Face plate, Angle plate, Driving plate, Lathe doges, mandrils, Steady rest, Lathe attachments, Lathe operations-plane and step turning, Taper turning, Screw cutting, Drilling, Boring, reaming, Knurling, Parting off, Under cutting, Relieving, Types of lathe tools and their uses, Brief description of semi-automatic lathes such as capstan and turret lathes, their advantages and disadvantages over centre lathe, types of job done on them. General and periodic maintenance of a centre lathe

Unit 2: Shaping, Planing & Slotting Machines

Working principles of planer, shaper and Slotter, Differences and similarities among them, quick return mechanism applied to the machines. Types of work done on them, types of tools used, their geometry, General and periodic maintenance of a shaper. DRILLING & BORING MACHINES: Types of tools used in drilling and boring. Classification of drilling and boring machines, principle of working and constructional details of simple and radial drilling M/C and general and periodic maintenance. Operations like facing, counter boring, tapering.

Unit 3: Milling Machines

Types of milling machines, constructional features of horizontal milling M/C. general maintenance of the machine, types of milling cutters, milling operations like plane milling, space milling, angular milling form milling, straddle milling, gang milling, Negative rake milling, cutting speed and speed for different tools in up and down milling. Simple, compound and differential indexing, milling of spur gears and racks

Unit 4: Grinding Machines

Common abrasives, grinding wheel materials, Bonds, Grain and grit of abrasive, Grain structure and shapes of common wheels, various speeds and feeds, Use of coolants, Methods of grinding, Types of grinding machines, precision finishing operations like honing. BROACHING MACHINES: Types of work done on broaching machine. Simple types of broaches and their uses, Types of broaching machines

Unit 5: Jigs and Fixtures

Object of Jigs and Fixture, Difference between jigs and fixtures, Principle of location, Principle of clamping, Locating and clamping devices. Types of jigs -Simple open and closed (or box) jigs. Drill jigs-bushes (Fixed, Liner, Renewal, and Slip). Template, Plate jigs. Channel jigs, Leaf jigs, Simple example of milling, turning, grinding, horizontal boring fixtures and broaching fixtures. Welding fixtures
COOLING PROCESS: Cooling and cutting fluids, difference between coolant and cutting fluid, function and action of cutting fluids, Requirement of good cutting fluids, their selection for different materials and operations

AUTOMATION OF MACHINE TOOLS: Introduction to CNC lathe (Computer Numerical Control Lathe) and FMS (Flexible Manufacturing System) Introduction only.

Reference Books:
1. Production Technology: Jain & Gupta
2. Workshop Technology Vol. II: Hazra&Choudhary

(5.GV.02) General Mechanical Engineering - I

Unit 1: Strength of Materials & Power Transmission

Stress, strain, elastic constraints, stress in circular shaft subjected to pure torsion only, Riveted and bolted joints.

Unit 2: Shear Force & Bending Moment

Elementary idea of Shear force and bending moment for concentrated, uniformly distributed loads on simply supported beam cantilever and overhanging beam, Simple Shear force and bending moment diagrams, Relationship between shear force and bending moment

Unit 3: Power Transmission: Pulleys, Gears & Shaft

Classification of Pulleys, Types of Belts, Simple calculation of pulley diameter, Classification of Gears, Simple calculation of number of teeth and speed, Power transmission by solid and hollow shaft

Unit 4: Hydraulics & Hydraulic Machines

Properties of fluids, pressure of fluid and its measurement. Flow of fluids, velocity and discharge, Bernoulli’s theorem and its application in venturimeter, flow through pipe, head loss due to friction

Unit 5: Water Turbines & Pumps
Capacity & Working of Turbines- Pelton and Reaction, reciprocating and centrifugal pump

Reference Books:
**Unit 1**

**Production Machine Tools:** Machine tools used for quantity production, semi-automatic multi tools centre lathe. Auto-lathes, sliding head types, Single spindle automatics, Multi-spindle automatics, Mechanical copying systems, Hydraulic servo copying systems for lathe, Electric copying systems.

TRANSFER MACHINES: Types of productions. Types of layout, Economic justification of transfer machines, Inline transfer, drum type transfer machines. Automatic loading & Transferring methods, Machining heads, Automatic inspections, Tool servicing, Transfer press linked lines.

**Unit 2**


**Unit 3**

**Surface Treatment & Finishing:** Meaning of the terms surface treatment and its purpose, Elements of surface treatment cleaning protecting, Colouring, Altering surface properties.


AUTO CONTROL OF SIZE: Auto sizing, Mechanical calliper for turning operation, Pneumatic sizing of external cylindrical ground work, Pneumatic slide position measuring device, Digital slide position measuring device, Auto sizing device for centre-less grinding operation. Friction rollers, Optical measurement

**Unit 4**

**Cutting Tools For Machining:** Elements of machining process, Single point tools -Basic angles, Chip formation, Effect of manipulating factors such as velocity, size of cut, effect of tool geometry, Tool material, Cutting fluids and contamination in them, Work piece material, Tool life model, Machining economics, Specific power consumption

Basic principles of multipoint tools, Linear travel tools, Broaches, Gear shaper cutters, Axial feed rotary tools-Twist drill, Reamers, Core drills, Counter bores and counter sinks, Multiple diameter tools, Hobs,

Characteristics of tools materials,. Tool materials, Tool steels, High speed steel, Cast cobalt alloys. Carbides or cintered carbide, Ceramics, Carbide tools
Surface treatment of cutting tools- Its advantage, Tin coated high speed steel diamonds. Cubic boron nitrides, Specialised knowledge of steel cutting

Unit 5

Press Tools: Factors affecting press tool design, Shearing, Bending, Drawing, combination tools, Progression tools, Rubber die formatting, high energy forming, Explosive forming

SPECIFICATION OF QUALITY & RELIABILITY: Quality, Specification Designing for production Standardisation, Preferred numbers, Limits and fits, Tolerance build up, Geometric tolerances. Limit gauging

Reference Books:

(i) Production Engineering: PC Sharma
(ii) Production Technology: CK Singh

(5.GV.04) Metrology and Measuring Instruments

Unit 1

Introduction: Meaning and scope of metrology in field of engineering, Standards and types of measurements (Line and Wave, length, Primary, Secondary and Tertiary measurement concept only). Limits, Fits and Tolerances, Interchangeability, precision and accuracy, Sources of error

PRINCIPLES AND CLASSIFICATIONS OF MEASURING INSTRUMENTS:

(i) Principles of Electrical measuring Instruments.

Unit 2:

Comparators
General principles of constructions, balancing and graduation of measuring instruments, characteristics comparators, use of comparators, difference between comparators, limit gauges and measuring instruments. Classification of comparators, construction and working of dial indicator, mechanical comparator, mechanical-optical, zeissoptotest, electro limit, electromechanical electronics, pneumatic comparators, gauges, tool makers microscope.

Unit 3:

Surface Finish
Geometrical characteristics of surface roughness- Wavyness, lawflaws, Effect of surface quality on its functional properties. Factor affecting the surface finish, Drafting symbols for surface roughness, Evaluation of surface finish RMS and CLS values, Methods of measuring surface roughness qualitative and quantitative methods, Comparison of surface produce by common production methods.
Unit 4
Various Types of Instruments Used For:
1. (a) Physical Measurements such as- Length, distance, height, Thickness, Gaps, Curvature, Angle, Taper, Area, Undulations, Surface finish, Thread and Gear measurement (b) Liquid Level & Viscosity- Liquid level measuring methods and devices, Viscometer - Plate and cone Viscometer, Two float viscometer, Rheo viscometer

2. Mechanical Quantities: (a) Displacement, velocity, acceleration, space troque- Use of transducers and electronic count stroboscope, vibrating reeds and technometers (b) Pressure and Vacuum - Idea of atmosphere pressure, Gauge pressure and vacuum - Use of instruments such as manometers and those use elastic elements such as diaphragm, capsule Bellows, Bourdon tube and various transducers thermo couple, vacuum gauges (c) Strain - Use of Strain gauge and load cells (d) Mechanical Power - Dynomometers - absorption and transmission type both. (Reference Only)

TEMPERATURE MEASUREMENT: Various types of thermometers, thermocouples, pyrometers (Radiation and optical type both)

Unit 5

Inspection of Geometrical Errors:
Construction and working of auto collimeter, checking of straightness, flatness, squareness and parallelism, circularity (By dial gauge and telerod).

Maintenance Of Measuring Instruments: Defects likely to occur in measuring instruments and their remedies. General maintenance of measuring instruments

Reference Books:
1. Metrology: RK Jain
2. Mechanical Measurement: RK Jain

(5.VP.01) Metrology and Measuring Instruments lab.

Bridge Course to be merge with practical classes:
Introduction of scale, orthographic projection, simple drawing of mechanical components, and cut sections, significance of various types of lines used in engineering drawing, representation of material, brief idea of isometric projections

Types of thread, single start, multi start thread and their application
1. Measurement of angle with the help of sine bar/ Vernier Bevel protractor.
2. Study and sketch of various types of optical projectors.
3. Study and sketch of various types of comparators and use them for comparing length of given piece.
4. To measure the diameter of a hole with the help of precision balls.
5. To measure external and internal taper with the help of taper gauges, precision rollers.
6. To test the squareness of a component with auto-collimeter.
7. To measure the pitch, angle and form of thread of a screw.
8. To measure the geometry of a gear having involute profile.
9. To measure the straightness of the edge of a component with the help of auto-collimator.
10. To measure the length, breadth, thickness, depth, height with micrometer.
11. To measure the length, breadth, thickness, depth, height, with height gauge and Vernier calipers.
13. Calibration of height gauge/depth gauge.
15. Checking of accuracy of snap gauge with slop gauge.
16. Checking of accuracy of a plug gauge with micrometer.
17. Measurement of areas by polar planimeter.
18. Use of feeler, wire, radius and fillet gauges measurement of standard parameters.

(5.VP.02) Machine Tool Technology Lab.

(A) MACHINE SHOP
1. (a) Square thread cutting (internal and external) - 2 jobs
   (b) Multi-start thread cutting - 1 job
   (c) Eccentric Turning - 1 job
2. Making utility job - Planner, Shaper, Slotter - 1 job
3. Group work on milling machine involving up & down milling in:
   (a) Gang milling - 1 job
   (b) Spur gear cutting - 1 job
   (c) Helical gear cutting - 1 job

(B) FITTING SHOP
1. To make a cut and cup tool - 1 job
2. To make blank and pierce tool - 1 job
3. To make a male and female fitting jobs - 1 job
4. To grind a lathe/shaper/planer tool - 1 job
5. To make different types of keys - 3 jobs
6. To make complete gauge - 2 jobs

Level 5 (Semester II)
(5.GV.05) Industrial Management

Unit 1

Introduction

Growth of industry, The management of men, materials and machines, the art of management, Sources of capital- industrial individual enterprise, private partnership and private Ltd. Co., Joint Stock Co. shares, debentures, financial agencies and their role in promoting industries. Break even analysis.
Unit 2

**Private sector and public sector:**

Public sector enterprise, merits and demerits of public sector industry and private sector industry, Line, staff and functional organizations, reasons for the choice of various types of organization, functions of different departments, viz. stores, purchase and sales departments relationship between individual departments.

Unit 3

**Wages & incentives**

Definition of wages, real wage and nominal wage, systems of wage payment, incentives, financial and non-financial incentives, Essentials of a good wage plan, essentials of a good incentive scheme. Introduction to elements of cost & indirect expenses, Material cost, labour cost, fixed and variable overheads, components of cost, selling price, Factory expenses, administrative expenses, selling & distribution expenses, depreciation, obsolescence, interest on capital, Idleness, Repair and maintenance.

Unit 4

**Labour, industrial & tax laws:**

Evolution of industrial law, factory act, workmen compensation act, payment of wages act, employee’s state insurance act, Industrial dispute act. Role of technician in industry: Position of technician in various engineering departments, Role of a supervisor in industry, Foremanship, duties and qualities of a good foreman.

Unit 5

**Material management:**

Introduction, Scope of Material Management selective control techniques-ABC analysis, Material handling, inventory control, Essential steps in inventory control, quality standards.

**Reference Books:**

1. Industrial Engineering and Management, S.C. Sharma, Khanna Publishing House
2. Industrial Safety, S.C. Sharma, Khanna Publishing House
3. Industrial Engineering & Management: Banga, Sharma & Agrawal
4. Industrial Engineering Safety & Pollution (Hindi): HemendraDutt
Unit 1

(A) General Introduction: (a) Scope of subject "Workshop Technology" in engineering (b) different shop activities and broad division of the shops on the basis of nature of work done such as (i) Wooden Fabrication-carpentry (ii) Metal Fabrication (shaping and Forming, Smithy, sheet metal and Joining-welding, Riveting, Fitting and Plumbing).

GENERAL PROCESS: Classification and elementary idea of metal forming processes on the basis of the properties of deformability (Plasticity), fusibility and divisibility viz., Rolling, Forging, Drawing, Extruding, Spinning, Pressing, Punching, Blanking, Welding, Soldering, Brazing, Metal cutting processes-turning, Drilling, Boring, Shaping, Grinding, Riveting, Elementary idea of machines used for the above processes.

Unit 2

WELDING:
(a) Welding Arcs: Definition, arc initiation, arc structures, types of arc, metal transfer characteristics and influencing parameters, weld bead geometry, various types of electrodes used in various processes.
(b) Introduction to various welding processes with procedure equipment and applications such as (i) Electric arc welding and Gas welding (ii) Resistance welding. (iii) Thermit welding (iv) Carbon arc gauging. (v) Metal-Inert-Gas welding (MIG) (vi) Tungsten Inert Gas welding (TIG)

WELDING OF SPECIAL MATERIALS: (a) Welding of carbon steel, Low alloy steel and stainless steel, equipment, filler rods, weldability, procedures and precautions. (b) Welding of Grey Cast Iron (c) Welding of Aluminium (d) Welding of Plastics.

Unit 3

Carpentry: (a) Fundamental of wood working operations (b) Common Carpentry Tools-Their classification, size, specification (name of the parts and use only): (i) Marking and measuring tools (ii) Holding and supporting tools: (iii) Cutting and Sawing Tools: (iv) Drilling and Boring Tools (v) Striking Tools-Mallet and Claw hammer (vi) Turning Tools & Equipment (vii) Miscellaneous Tools

PATTERN & MOULDING: The pattern materials used, Types of pattern allowances and pattern layout, Colour scheme patterns defects, Types of cores and their utility. Elementary idea of patterns, green sand moulds and moulding, tools and equipment used in green sand moulding

Unit 4

Moulding and Pouring: Classification of mould materials according to characteristics, Types of sands and their importance test, parting powders and liquids, Sand mixing preparation, Moulding defects

MELTING AND POURING: Brief idea of refractory material and fluxes, Fuels and metallic materials used in foundry. Melting furnaces used in foundry such as pit furnace, Tilting and cupola furnaces, their construction and operation, metals and alloys. Additions to molten metal, Closing and pouring of the moulds, Coring-up, venting and closing, use of ladles, spur and risers, Defects due to closing and spurring, Basic idea of fettling operations. Surface treatment, Salvaging of castings, Factors determining soundness of casting.
FOUNDARY PRACTICE: Elementary idea of special casting processes-Shell mould casting, die casing, investment mould casting, centrifugal and continuous casting full mould casting. Elementary idea of mechanization of foundries

Unit 5

POWDER METALLURGY: Introduction, principle, scope and names of processes. Production of metal powders, compaction, sintering and sizing, Self-lubricated bearings. Advantages of the process and its limitations (Elementary concept only)


Reference Books:


(5.GV.07) Material Science & Materials

Unit 1

General:
Brief introduction to the subject and its scope in engineering field, classification of materials of industrial importance. Their chemical thermal, electrical, magnetic, mechanical and technological properties and their selection criteria for use in industry.

STRUCTURE OF METALS AND THEIR DEFORMATION:
Structure of metals and its relation to their physical, mechanical and technological properties, Elementary idea of arrangement of atoms in metals, molecular structures, crystal structures and crystal imperfections, Deformation of metals, effects of cold and hot working operations over them. Recovery re-crystallization and grain growth, solid solutions, alloys and inter metallic compounds, effect of grain size on properties of metals. PROPERTIES AND USAGE OF: (1) Metals: (a) Ferrous Metals (b) Non Ferrous Metals (2) Non-metallic Materials.

Unit 2:

Metals-Ferrous Metals

1. Classification of iron and steel. (b) Cast iron types as per I.S. - White, malleable, Grey (c) Steels: Classification of steels according to carbon content and according to use as per I.S. Mechanical properties of various steels and their uses. Availability of steel in market, Its forms and specifications (d) Alloy Steel: Effect of alloying various elements, viz Cr, Hi, Co, V, W, Mo, Si, and Mn, on mechanical properties of steel, Common alloy steels, viz, Ni-steel, Ni-Cr-steel, Tungsten steel, Cobalt steel,
Stainless Steel, Tool steel - High Carbon Steel, High Speed steel, Tungsten Carbide, Silicon manganese steel, Spring Steel, Heat Resisting alloy Steels etc.

Unit 3:

Non-Metallic Materials

Introduction to Plastic and Other Synthetic Materials: Plastics- Important sources-Natural and Synthetic, Classification, thermo-set and thermoplastic, Various trade names, Important Properties and engineering use of plastics. Market forms of Plastics

Heat Insulating Materials: Classification of Heat Insulating material, properties and uses of China clay, Cork, Slag wool, Glass Wool, Thermocole, Puff, Properties and uses of asbestos as filler material.

Hardware: General specification, uses and methods of storage of G.I. and C.I. steel, Copper, A.C. pressure conduits, R.C.C. spun, P.V.C. Pipes and their uses. General sheets specification (I.S.) and uses, Method of storage of G.I. sheets, M.S. sheets, General specification of pipe fitting

Unit 4

IDENTIFICATION AND TESTING OF METAL ALLOYS: Selection, specification forms and availability of materials.


Reference Books:
Material Science: RS Khurmi& RS Shedha

(5.GV.08) General Mechanical Engineering - II

Unit 1:

Basics of Thermodynamics

Basic definition of heat, work, Thermodynamic process, parameters of working body and their units, Equation of state, Universal gas constant, Relation between heat capacity and temperature. Determination of quantity of heat

Unit 2:

Laws of Thermodynamics

Elementary concept of laws of thermodynamics, first law and second law, Graphical representation of process, The work of expansion and compression of a gas, Change in the state of ideal gas-Isochoric, Isothermal and Adiabatic process, Carnot-cycle
Unit 3:
IC Engines
External & internal combustion engines, working of diesel and petrol engine, horse power of IC engines,

Unit 4:
Steam Generators & Condensers
Construction and working of Babcock & Wilcox boiler, Cochran boiler, Steam condenser & its types

Unit 5: Steam & Gas Turbines
Steam turbine, classification and principle of operation, gas turbine

Reference Books:
3. General Mechanical Engineering: Jk Kapoor
4. Mechanical Engineering: Khurmi& Gupta

(5.VP.04)Project
On the basis of learning and skill acquired in the academic year, a project to be taken up by the student strengthening his/ her vocational skills

(5.VP.05) Basic Electricity & Electronics - Lab
Bridge course:
Introduction to current, voltage, resistance, capacitance, impedance, diode, zener diode, transistors, amplifiers, electric cells

1. Study of series resistive circuits.
2. Study of parallel resistive circuits.
4. Preparation of Electrolyte for lead acid battery and its charging and measurement of Specific gravity with the help of hydrometer.
5. Charging and Discharging of a capacitor.
6. Verification of magnetic field of solenoid with Iron core and Air core.
7. Verification of Torque development in a current carrying coil in magnetic field.
8. Study of R.L.C. series circuit and measurement of power and power factor.
9. Study of current and voltage measurement using Ammeter and Voltmeter.
10. Study of current and voltage measurement using Galvanometer.
11. Study of current, voltage and resistance measurement using of Multi-meter
13. Study of working of single layer PCB manufacturing.
15. Study and interpreting circuit diagram and to check the continuity of connections.
Instrument Required:

1. Trainer kit for measuring TCR
2. Lead acid battery
3. Hydrometer
4. Trainer kit for measuring power and power factor in RLC circuits
5. Ammeter
6. Voltmeter
7. Multi-meter
8. Galvanometer
9. Energy Meter
10. PCB Manufacturing Facility

(5.VP.07) Mechanical Workshop Practice

1. SHEET METAL WORKING AND SOLDERING:
   a. (EX-1) Cutting, shearing and bending of sheet.
   b. (EX-2) To prepare a soap case by the metal sheet
   c. (EX-3) To make a funnel with thin sheet and to solder the seam of the same
   d. (EX-4) To make a cylinder and to solder the same

2. FITTING SHOP WORK:
   a. (EX-1) Hack sawing and chipping of M.S. flat
   b. (EX-2) Filing and squaring of chipped M.S. job
   c. (EX-3) Filing on square of rectangular M.S. Plate
   d. (EX-4) Drill a hole in MS Block & tapping the same
   e. (EX-5) Making a Bolt & Nut by Tap & Die set.

3. SMITHY SHOP WORK:
   a. (EX-1) To prepare square angular piece by M.S. rod
   b. (EX-2) To make square or hexagonal head bolt
   c. (EX-3) To make a screw driver with metallic handle
   d. (EX-4) To make ring with hook

4. Tin Smithy, Soldering, Brazing
   a. (EX-1) To prepare different types of joint such as lap joint single seam, double seam &
      cap joint-hem & wired edge.
   b. (EX-2) Utility article-waste paper basket or paper tray
   c. (EX-3) Study & sketch stakes / anvils.

5. WELDING SHOP WORK:
   a. (EX-1) Welding practice gas & electric arc welding
   b. (EX-2) Welding for lap joint after preparing the edge
c. (EX-3) Welding Butt joint after preparing the edge

d. (EX-4) Gas Cutting

e. (EX-5) 'T' joint welding after preparation of edge.

Reference Books:

2. Elements of Workshop Technology Vol. I: BS Raghuwanshi

Level 6 (SEMESTER-III)

(6.GV.01) Metal Casting Technology

Unit 1

Introduction
Design advantages of casting, Advantages of casting process, Metallurgical advantage. Technology of pattern making requirement, Pattern material, wood & wood product, plaster, Plastics and rubbers, Polyesters resins waxes, Machines and tools for pattern making machine for wood pattern making, Machines for metal pattern making, Allowance and other Technological considerations – contraction allowance, Machining allowance, Draft or taper allowance, Rapping and shake allowance, Distortion allowance, Core Prints, Core boxes, Use of loose pieces

Unit 2

Technology of moulding and core making
Moulding sands, Principal ingredients of moulding sands, Specification and testing of moulding sands, Classification of Moulding sands, Additives to moulding and Core making sands, Mould Dressings. Sand Conditioning, Sand Preparation equipment.

Unit 3

Moulding processes
Types of sand moulding, Tools for hand moulding, Characteristics of cores and core sands, Types of cores, Use of chaplets, Machine moulding, Core making machines, Processes based on organic binders.

Unit 4

Technology of metal casting processes
Permanent mould casting, Types of die casting machines, Centrifugal casting, continues casting, Electro slag casting, Gating system, Riser of casting, Economic considerations, Melting equipments for foundries, Defects in castings.

Unit 5

Modernization & Mechanization of foundries
Need, Area for mechanization, Material handling, Pollution control in foundries, Pollutants in a foundry, Plant layout for foundries, steps in planning a foundry layout.
Reference Books:
1. Evolution of Metal Casting Technologies, Khan, Muhammad Azhar Ali, Sheikh, Anwar Khalil, Al-Shaer, Bilal Suleiman
2. Foundry technology, Peter R. Beeley

(6.GV.02) Production Automation & Computer Integrating Manufacturing

UNIT 1


UNIT 2

Production Concept:
Such as Manufacturing Lead Time (MLT), Production rate, Components of Operation Time, Production Capacity (PC), Utilisation and availability, Work in Process (WIP), Time in Plant (Tip), WIP Ratio, Tip ratio, their meaning and significance. Simple numerical problems Automation Strategies and Their Effect - Specification of operation, Combined operations, Simultaneous operations, Integration operations, Increase flexibility, Improved material handling and storage, on-line inspection, process control and optimization, Plant operation control, computer integrated manufacturing. PRODUCTION ECONOMICS: Methods evaluation investment alternatives, Constraints in manufacturing, Break Even Analysis, Unit Cost of Production, Cost of manufacturing, lead time and work in process.

UNIT 3

Assembly System and Line Balancing:
The assembly process, Assembly system, Manual assembly lines, Line balancing problems, Computerised line, balancing methods, Other ways to improve the line balancing, flexible manual assembly line AUTOMATED ASSEMBLY SYSTEMS: Design for automated assembly, Types of automated assembly systems, Parts feeding devices, analysis of multi-station Assembly machines, Analysis of single station assembly machines
UNIT 4:

Numerical Control Production System
Numerical controlling, Coordinate system, and Machine motions, Types of N.C. systems, Machine tool applications, Economics of NCS

UNIT 5


Reference Books:
1. Numerical Control Machines: NK Mehta

(6.GV.03) Fundamentals of Mechatronics

Unit 1.
Introduction: Introduction to Mechatronics, systems, measurement systems, control systems, the Mechatronics approach. Introduction to Transducers: Sensors and transducers, operating characteristics of transducers, measurement of displacement, velocity, pressure, flow, and temperature.

Unit 2.
Signal conditioning: Signal conditioning- their features and various blocks, the operational amplifiers, Protection, Filtering, Wheatstone bridge, Digital signals, Multiplexers, Data acquisition, Digital signal processing. Data Presentation Systems: Displays, Data presentation elements, Magnetic recording, Displays, Data acquisition system, Telemetry- electrical, optical and pneumatic methods of telemetry.

Unit 3.
Introduction to process control systems: Importance of process control, analog and digital processing, Supervisory digital control, direct digital control. Controller Characteristics: Process characteristics, control system parameters, Discontinuous controller modes (two position, multiple position, floating position), Continuous controller modes i.e. P, I, D, PI, PD, PID.

Unit 4.

Unit 5.
Reference Books:
1. Mechatronic Systems: Fundamentals, R. Isermann
2. Fundamentals Of Mechatronics, M. Jouaneh

(6.GV.04) Machining and Machine Tools

Unit 1
Classification of Metal Removal Process and Machines Mechanics of Metal Cutting:

Geometry of single point cutting tool and tool angles, tool nomenclature in ASA, ORS, NRS and interrelationship, introduction of mechanism of chip formation and types of chips, chip breakers, orthogonal and oblique cutting, cutting forces and power required, theories of metal cutting, thermal aspects of machining and measurement of chip tool interface, temperature, friction in metal cutting.

Unit 2
Machinability:

Concept and evaluation of machinability, tool life, mechanisms of tool failure, tool life and cutting parameters, machinability index, factors affecting machinability, Cutting fluids, types, properties, selection and application methods, General Purpose Machine Tools: tooling, attachments and operations performed, selection of cutting parameters, Simple calculation of time for machining.

Unit 3
Special Purpose Machine Tools:


Unit 4
Thread and Gear Manufacturing:
Casting, thread chasing, thread cutting on lathe, thread rolling, die threading and tapping, thread milling, thread grinding, Gear Manufacturing Processes: Hot rolling, stamping, powder metallurgy, extruding etc. gear generating processes, gear hobbling, gear shaping, gear finishing processes, shaving, grinding, lapping, shot blasting, phosphate coating, gear testing.

Unit 5
High Velocity Forming Methods:
(High-energy rate forming processes) Definition, Hydraulic forming, explosive forming, electro-hydraulic forming, magnetic pulse forming
Reference Books:

(6.VP.01) Metal Casting Technology Workshop

Minimum work in each section is indicated against that PATTERN MAKING: (a) Making Patterns (At least two) (i) Solid one-piece pattern (ii) Split tow piece pattern (iii) Split three-piece pattern (iv) Gated pattern (b) Making Core Boxes (At least one) (i) Straight Core Box (ii) Bent Core Box.


MOULDING: (a) Making at least 3 sands moulds of different forms with different types of pattern using. (i) Floor Moulding. (ii) Two Box Moulding. (iii) Three Box (or more) Moulding. (b) At least one of the following: (i) Making and setting of cores of different types. (ii) Making one shell mould apparatus

(C) MELTING AND POURING: (Each to be demonstrated at least once in the section). (a) Demonstration of Melting of cast iron in (i) Pit Furnace. (ii) Cupola. (b) Demonstration of Melting a non-Ferrous metal in (i) Pit furnace. (ii) Tilting Furnace. (c) Pouring of metals in moulds (Ferrous and Non-Ferrous).

(D) CLEANING AND INSPECTION: (a) Shaking, cleaning and fettling of casting (At least 2 Casting) (b) (i) Inspection of cast component (visual) and preparing inspection report (At least one report). (ii) Establishing cause of Defects seen (At least one cause).

(E) CASE STUDY OF: At least 2 sand castings produced from sand preparation pattern layout to final finished casting.

(6.VP.02) Mechatronics Lab

2. Study of Speed Measurement System: (a) Magnetic Pick-up (b) Stroboscope
3. Study of Load Measurement System Load Cell
4. Measurement of temperature using thermocouple, thermistor and RTD
5. Measurement of displacement using POT, LVDT & Capacitive transducer
6. Torque measurement using torque measuring devices
7. Strain Measurement using strain gauge
8. Frequency to Voltage Converter and vice versa
9. Position and velocity measurement using encoders
10. Study on the application of data acquisition system for industrial purposes
Level 6 (Semester IV)
(6.GV.05) Mass Production Devices

Unit 1
Tool holders: Tool holders for turning and milling carbide inserts-types, ISO-designation and applications, Tool holding and tool mounting systems for conventional milling and drilling machine tools.

Unit 2
Locating and clamping devices: Concept, meaning and definitions of location and clamping, Use of locating and clamping principles in day-to-day supervision on shop floor, Degree of freedom-concept and importance, 3-2-1 principle of location, Locators-Types, Sketches with nomenclature, Working, Applications, Fool proofing and ejecting

Unit 3
Clamping devices: Types, Sketches with nomenclature, Working, Applications

Unit 4
Jigs and fixtures: Concept, meaning, differences and benefits of jigs and fixtures, Types, sketches with nomenclature, working and applications of jigs, Types, sketches with nomenclature, working and applications of fixtures

Unit 5
Design of Jigs and Fixtures: Steps in designing jigs and fixture for given simple component

Reference Books:
1. Mass Production, phaidon

(6.GV.06) Lean and Agile Manufacturing

Unit 1
Introduction-
Introduction to Just in time production, Toyota production system, Introduction to lean manufacturing (LM), history of LM, advantages of LM over mass production

Unit 2
Waste Identification-
Types of wastes, lean manufacturing principles; Value, value stream, flow, pull and perfection

Unit 3
Value stream mapping-
Introduction to value stream mapping, types of value stream mapping, value added activities, necessary non value added activities, non-value added activities
Unit 4
Lean manufacturing tools-
Introduction to 5S, Kanban, kaizen, work standardization, Statistical process control, automation and other lean tools

Unit 5
Agile manufacturing-
Introduction to agile manufacturing, advantages of agile manufacturing, differences with lean manufacturing.

Reference Books:
1. Lean and Agile Manufacturing: Theoretical, Practical and Research Futurities, Devadasan S.R
2. Learning Agile: Understanding Scrum, XP, Lean, and Kanban, Andrew Stellman, Jennifer Greene

(6.GV.07) Metal Forming Processes

Unit 1
Rolling
Introduction, Types of rolling, Hot rolling, Two high reversing mill, Three high mill, Continuous mill, Roll bending

Unit 2
Forging
Introduction, Advantages of Forging, Application of Forging, Limitations of Forging, Upsetting, Hollow Forging, Impression die or closed, Methods of Forging, Drop Forging, Press Forging, Hammer and press Forging, Hot bar Forging, Upset Forging

Unit 3
Extrusion
Direct and forward, Sleeve method of direct, Indirect or backward, Impact Extrusion, Tube Extrusion, Stepped Extrusion, Combined forging and Extrusion

Unit 4
Drawing
Wire Drawing, Cupping and Bending, Tube Drawing, Spinning, Hot and cold Spinning Advantages of Metal Spinning

Unit 5
Pipe and Tube Production-
Manufacturing of seamless pipe- Butt welded pipe- Lap welded pipe

Reference Books:
2. Metal Forming Processes, G. R. Nagpal
Unit-I
Introduction:
Limitations of conventional manufacturing processes need of unconventional manufacturing processes and its classification.

Unit-II
Un-Conventional Machining Processes:
Principle and working and applications of unconventional machining processes such as Electric Discharge machining (EDM), Electro- Chemical machining (ECM), Ultrasonic Machining (USM), and Abrasive Jet machining (AJM)

Unit-III
Un-Conventional Welding Processes:
Principle and working and applications of unconventional welding processes such as Laser Beam Welding, Electron Beam Welding, Ultrasonic Welding, Plasma Arc Welding processes.

Unit-IV
Explosive Welding:
Cladding etc. Under water welding, Metalizing Theory, Process and applications

Unit-V
Un-conventional forming processes:
Principle and working and applications of high energy forming processes such as Explosive forming, Electromagnetic forming. Electro discharge forming Water hammer forming, Explosive Compaction

Reference Books:
1. Modern Machining Process, P.C. Pandey
2. Un-conventional machining, V.K. Jain

(6.VP.03) Tool & Die Making Lab

- Manufacture of Box Jig and Angle plate jig
- Manufacture of DzVdz Block angle grinding Fixtures and profile milling fixture
- Manufacture of simple Blanking & piercing Tool
- Manufacture of Progressive tool for producing a Cycle chain link
- Manufacture of Press tools like Combination tool & Compound tool
- Manufacture of Draw tool
- Trial out On Fly press and power press the Produced components such as V, U, Cycle link, Cup Washer and Cycle bell cup
- Manufacture of simple V and U bending tool
- Maintenance of Jig & fixture and press tool
Level 7 (Semester V)

(7.GV.01) Reliability, Maintenance and Safety Engineering

Unit 1
Reliability
Definition, reliability function, Mean failure rate, mean time to failure (MTTF), mean time between failures (MTBF), hazard rate curve. Bathtub curve, Conditional Reliability

Unit 2
Constant Failure rate model
Exponential Reliability function, Failure Modes, CFR model, memory lessness, System reliability: Series, parallel, mixed & complex configuration; Reliability improvement.

Unit 3
Design for reliability
Reliability specifications and system measurements, System Effectiveness, redundancy, Classification of Redundancy, Introduction of failure mode and effect analysis (FMEA)

Unit 4
Maintainability
Analysis of Downtime, repair time distribution, stochastic point processes.

Unit 5
Safety engineering
Fundamentals of industrial safety, Safety policy and safety terminology, Different types of safety systems and equipments, Safety targets, standards, objectives

Reference Books:
2. Reliability, Maintenance and Safety Engineering, A.K. Gupta

(7.GV.02) Plant Layout & Product Handling

Objective of Facility Design: Types of layout problems, the layout function, organization of layout. Analysis and Design of Material Flow: Systems approach to flow cycle, process charts, flow process charts, Quantitative analysis of material flow; optimal material flow configuration. Space and Area Allocation for Production and Physical Plant Services;
Computerized handling of layout algorithms; Algorithms for computerized Layout Planning, Construction and Development type of computerized Layout Planning Techniques i.e. CRAFT, ALDEP, CORELAP etc.;

Product handling; Design of system configurations conforming to various kinds of product features and layout characteristics; Design concepts of common handling and transfer equipment; Different types of conveyors, elevators, fork lifters;

Design concept of warehouse facilities commensurate with adopted kind of handling and transfer devices; Automated Handling of materials, Automated Transfer lines, AGVS, Use of Robots in Product handling, automated packaging devices.

Application of pneumatic and hydraulic system in transportation and handling of products, Design of integrated plant layout for product handling systems

Reference Books:
1. Plant Layout and Materials Handling, S. C. Sharma
2. Plant Layout and Materials Handling, R. B. Choudhary and G. R. N. Tagore

(7.GV.03) Product Design for Manufacturing

Unit 1
Importance of New Product
Importance of new product for growth of enterprise, Definition of product and new product, Classification of products from new product development point of view- Need based/Market pull products, Tech. push, Platform based, Process based and customized products

Unit 2
New product development process and organization
Generic product development process for Market Pull and Market Push Products, Need Identification and Analysis, Problem Formulation, establishing economic existence of need, Engineering Statement of Problem, Establishing Target Specification

Unit 3
Generation of Alternatives and Concept Selection
Introduction to Concept generation, Tools of creativity like brain storming, Analogy, Inversion, introduction to Concept feasibility and Concept Selection, Establishing Engineering Specification of Products

Unit 4
Preliminary and Detailed Design
Preliminary design, Identification of subsystems, Subsystem specifications, detailed design of subsystems, component design
Unit 5
Assembly drawing and review
Preparation of assembly drawings, Review of product design from point of view of Manufacturing, Ergonomics and aesthetics
Reference Books:
1. Manufacturing Processes for Design Professionals, Rob Thompson
2. Product design for manufacture and assembly, Geoffrey Boothroyd

(7.GV.04) CAD & CAM

Unit 1
Introduction CIM and CAD & Analysis:

Unit 2
Computer aided Manufacturing CAM:

Unit 3
CNC Machine and Components:

Unit 4
Part Programming
Unit 5
FMS, Integrated Material Handling and Robot:
Types of manufacturing - introduction to FMS – FMS components – FMS layouts – Types of FMS: 
flexible manufacturing cell – flexible turning cell – flexible transfer line – flexible machining systems – 
benefits of FMS - introduction to intelligent manufacturing system – virtual machining. Computer 
Integrated material handling – AGV: working principle – types, benefits – Automatic Storage and 
programming method – robotic sensors - industrial applications: characteristics, material transfer, 
machine loading, welding, spray coating, assembly and inspection.

Reference Books:
1. Engineering AutoCAD, Pradeep Jain & A.P. Gautam, Khanna Publishing House

(7.VP.02) CAD Lab

1. Introduction and different features of the CAD Software.
2. 2-D Drafting.
3. 3-D Modeling.
4. 3-D Advanced Modeling.
5. Assembly modeling.
6. Feature Modification and Manipulation
7. Detailing.

(7.VP.02) CAM Lab

1. To prepare part programming for plain turning operation.
2. To prepare part programming for turning operation in absolute mode.
3. To prepare part program in inch mode for plain turning operation.
4. To prepare part program for taper turning operation.
5. To prepare part program for turning operations using turning cycle.
6. To prepare part program for threading operation.
7. To prepare part program for slot milling operation.
8. To prepare part program for gear cutting operation.
9. To prepare part program for gear cutting using mill cycle.
10. To prepare part program for drilling operation
Unit 1
Introduction
Introduction to Prototyping, Traditional Prototyping Vs. Rapid Prototyping (RP), Need for time compression in product development, Usage of RP parts, Generic RP process, Distinction between RP and CNC, other related technologies, Classification of RP.

Unit 2
CAD Modelling and Data Processing for RP
CAD model preparation, Data Requirements, different types of Data formats, Data interfacing, Part orientation and support generation, Support structure design, Model Slicing and contour data organization, direct and adaptive slicing, Tool path generation.

Unit 3
RP Systems

Unit 4
Rapid Tooling:
Conventional Tooling Vs. Rapid Tooling, Classification of Rapid Tooling, Direct and Indirect Tooling Methods, Soft and Hard Tooling methods.

Unit 5
RP Applications:
Design, Engineering Analysis and planning applications, Rapid Tooling, Reverse Engineering, Medical Applications of RP

Reference Books:
1. Rapid Product Development (English, Paperback, Kimura Fumihiroko
Unit 1
Demand Forecasting
Introduction, components of forecasting demand, Approaches to forecasting: forecasts based on judgment and opinion, Selection of forecasting technique.

Unit 2
Capacity Planning
Defining and measuring capacity, determinants of effective capacity, capacity strategy, steps in capacity planning process, determining capacity requirements, Capacity alternatives, Evaluation of alternatives; Cost-Volume analysis.

Unit 3
Facility Location
Need for location decisions, factors affecting location, qualitative and quantitative techniques of location. Facilities layout: Product, Process, fixed position, combination and cellular layouts; Designing product and process layout, line balancing.

Unit 4
Production Control
Capacity control and priority control, production control functions; Routing, scheduling, Dispatching, expediting and follow up, Techniques of production control in job shop production, batch production and mass production systems

Unit 5
Sequencing
Priority rules, sequencing methods, sequencing jobs through two work centers, scheduling services, application of CPM and PERT techniques.

Reference Books:
1. Production Planning and Control, W. Bolton
2. Production Planning and Control with SAP, Jörg Thomas Dickersbach and K. Weihrauch

(7.VP.03) Project

On the basis of learning in the B.Voc. Programme, i.e. Level 5 to Level 7, a project to be taken up by the student strengthening his/her vocational skills.