

**DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY LUCKNOW**



**STUDY, EVALUATION SCHEME & SYLLABUS**

**For**

**B. Voc  
Production Technology (PT)  
Branch Code:103**

**Based on**

**AICTE Model Curriculum**

**(EFFECTIVE FROM THE SESSION: 2019-20)**

**Evaluation Scheme  
B. Voc Production Technology**

<b>NSFQ Level 5 SEMESTER- I</b>											
S. No.	Subject Code	Subject	Total Teaching/ Training Hours	Evaluation Scheme				End Semester		Total	Credit
				CT	TA	AT	Total	TE	PE		
1	BPTV511	Machine Tool Technology	30	10	5	5	20	30		50	2
2	BPTV512	General Mechanical Engineering-I	30	10	5	5	20	30		50	2
3	BPTV513	Production Technology	30	10	5	5	20	30		50	2
4	BPTV514	Metrology and Measuring Instruments	30	10	5	5	20	30		50	2
5	BPTP511	Metrology and Measuring Instruments Lab	30				20		30	50	1
6	BPTP512	Machine Tool Technology Lab	30				20		30	50	1
7	BPTP513	Language Lab	30				20		30	50	2
8	BPTT511	Metal Arc Welding (CSC/Q0204)							Any one Training 400 hrs/ 8 weeks	150	12
	BPTT512	MIG MAG or GMAW Welder (CSC/Q0209)									
	BPTT513	Assistant TIG Welder (CSC/Q0212)									
	BPTT514	CNC Setter Cum Operator (CSC/Q0120)									
	BPTT515	CNC Operator – VMC (CSC/Q0116)									
<b>Total</b>			<b>610</b>							<b>500</b>	<b>24</b>
<b>NSFQ Level 5 SEMESTER- II</b>											
S. No.	Subject Code	Subject	Total Teaching/ Training Hours	Evaluation Scheme				End Semester		Total	Credit
				CT	TA	AT	Total	TE	PE		
1	BPTV521	Industrial Management	30	10	5	5	20	30		50	2
2	BPTV522	Manufacturing Technology	30	10	5	5	20	30		50	2
3	BPTV523	Material Science and Materials	30	10	5	5	20	30		50	2
4	BPTV524	General Mechanical Engineering-II	30	10	5	5	20	30		50	2
5	BPTP521	Project	30				20		30	50	1
6	BPTP522	Basic Electricity and Electronics Lab	30				20		30	50	1
7	BPTP523	Mechanical Workshop Practice Lab	30				20		30	50	2
8	BPTT521	Metal Arc Welding (CSC/Q0204)							Any one Training (other than 1 <sup>st</sup> sem) 400 hrs/ 8 weeks	150	12
	BPTT522	MIG MAG or GMAW Welder (CSC/Q0209)									
	BPTT523	Assistant TIG Welder (CSC/Q0212)									
	BPTT524	CNC Setter Cum Operator (CSC/Q0120)									
	BPTT525	CNC Operator – VMC (CSC/Q0116)									
<b>Total</b>			<b>610</b>							<b>500</b>	<b>24</b>

V: General Vocational; P: Vocational Practical; T: On Job Training; SSC: Sector Skill Council

NSFQ Level 6 SEMESTER- III											
S. No.	Subject Code	Subject	Total Teaching/ Training Hours	Evaluation Scheme				End Semester		Total	Credit
				CT	TA	AT	Total	TE	PE		
1	BPTV631	Metal Casting Technology	30	10	5	5	20	30		50	2
2	BPTV632	Production Automation & Computer Integrated Mfg.	30	10	5	5	20	30		50	2
3	BPTV633	Fundamental of Mechatronics	30	10	5	5	20	30		50	2
4	BPTV634	Machining and Machine Tools	30	10	5	5	20	30		50	2
5	BPTH631	Uni. Human Values & ethics/Env. & Eco.	30	10	5	5	20	30		50	2
6	BPTP631	Metal Casting Technology Workshop	30				20		30	50	1
7	BPTP632	Mechatronics Lab	30				20		30	50	1
8	BPTT631	Service Engineer – Installation (CSC/Q0501)					Any one Training 400 hrs/ 8 weeks			150	12
	BPTT632	Quality Inspector – Forged, Casted or Machined Component (CSC/Q0601)									
	BPTT633	CNC Programmer (CSC/Q0401)									
	BPTT634	Maintenance Fitter – Mechanical (CSC/Q901)									
<b>Total</b>			<b>610</b>							<b>500</b>	<b>24</b>
NSFQ Level 6 SEMESTER- IV											
S. No.	Subject Code	Subject	Total Teaching/ Training Hours	Evaluation Scheme				End Semester		Total	Credit
				CT	TA	AT	Total	TE	PE		
1	BPTV641	Mass Production Devices	30	10	5	5	20	30		50	2
2	BPTV642	Agile and Lean Manufacturing	30	10	5	5	20	30		50	2
3	BPTV643	Metal Forming Processes	30	10	5	5	20	30		50	2
4	BPTV644	Non-Conventional Machining	30	10	5	5	20	30		50	2
5	BPTH641	Env. & Eco./Uni. Human Values & ethics	30	10	5	5	20	30		50	2
6	BPTP641	Tool and Die Making Lab	30				20		30	50	1
7	BPTP642	IT Tool Lab	30				20		30	50	1
8	BPTT641	Service Engineer – Installation (CSC/Q0501)					Any one Training (other than 3rd sem)400 hrs/ 8 weeks			150	12
	BPTT642	CNC Programmer (CSC/Q0401)									
	BPTT643	Quality Inspector – Forged, Casted or Machined Component (CSC/Q0601)									
	BPTT644	CNC Setter Cum Operator – VMC (CSC/Q0123)									
<b>Total</b>			<b>610</b>							<b>500</b>	<b>24</b>

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NSFQ Level 7 SEMESTER- V											
S. No.	Subject Code	Subject	Total Teaching/ Training Hours	Evaluation Scheme				End Semester		Total	Credit
				CT	TA	AT	Total	TE	PE		
1	BPTV751	Reliability ,Maintenance & Safety Engineering	30	10	5	5	20	30		50	2
2	BPTV752	Plant Layout and Product Handling	30	10	5	5	20	30		50	2
3	BPTV753	Product Design and Manufacturing	30	10	5	5	20	30		50	2
4	BPTV754	CAD & CAM	30	10	5	5	20	30		50	2
5	BPTH751	Indian Constitution / Essence of Indian Traditional Knowledge	30	10	5	5	20	30		50	2
6	BPTP751	CAD Lab	30				20		30	50	1
7	BPTP752	CAM Lab	30				20		30	50	1
8	BPTT751	Tool & Die Maker (CSC/Q0306)						Any one Training 400 hrs/ 8 weeks		150	12
	BPTT752	Designer – Mechanical (CSC/Q0405)									
	BPTT753	Service Engineer – Breakdown Service (CSC/Q0503)									
<b>Total</b>			<b>610</b>							<b>500</b>	<b>24</b>

NSFQ Level 7 SEMESTER- VI											
S. No.	Subject Code	Subject	Total Teaching/ Training Hours	Evaluation Scheme				End Semester		Total	Credit
				CT	TA	AT	Total	TE	PE		
1	BPTV761	Rapid Prototyping and Reverse Engineering	30	10	5	5	20	30		50	2
2	BPTV762	Production Planning and Control	30	10	5	5	20	30		50	2
3	BPTH761	Essence of Indian Traditional Knowledge / Indian Constitution	30	10	5	5	20	30		50	2
4	BPTP761	Major Project	180						150	150	6
5	BPTT761	Tool & Die Maker (CSC/Q0306)						Any one Training (other than 5 <sup>th</sup> sem) 400 hrs/ 8 weeks		200	12
	BPTT762	Designer – Mechanical (CSC/Q0405)									
	BPTT763	Service Engineer – Breakdown Service (CSC/Q0503)									
<b>Total</b>			<b>670</b>							<b>500</b>	<b>24</b>

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**Level 5 (Semester I)**  
**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 dogs, 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

## **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:**

1. Basic Mechanical Engineering, M.P. Poonia & S.C. Sharma, Khanna Publishing House
2. Strength of Materials, D.S. Bedi, Khanna Publishing House

## Production Technology

### 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

**Generation Of Forms:** Forming 'V' generating. Thread chasing. Die heads. Threadrolling. Thread milling. Thread grinding. Gear planning, Gear shaping, Gear hobbing, Straight Bevel Gear Manufacture. Spiral bevel Gear Manufacture.

### Unit 3

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

Surface Treatment Processes- Wire brushing, Belt sanding, Alkaline cleaning, Vapour degreasing, Pickling, Latest trends in Surface preparation, Ultrasonic cleaning, Solvent cleaning, Painting application by dipping, Hand spraying, Automatic spraying, Electrostatic spray finishing. Electro-coating, Hot dip coating, phosphate coating- Packerising and bonderising, Buffing, Blackening, Anodising. Electro Nickle Plating, Nickle carbide plating, Sputtering, Automation in Painting,

**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

## 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) Principle of Mechanical Measuring Instruments: Lever method, Vernier method, screw and screw nut method, compound gearing and helical spring methods.
- (ii) Principles of Optical Instruments: Reflection, Refraction, Interference, Polarisation, Optical prisms, Lenses and Optical projectors.
- (i) Principles of Electrical measuring Instruments.
- (ii) Principles of Hydraulic and Pneumatic 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, layflaws, 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 torque-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 - Dynamometers - 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

## **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- collimeter.
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.
12. Calibration of Vernier calipers/micrometers.
13. Calibration of height gauge/depth gauge.
14. Study of a tool maker's microscope.
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.

## **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 j

### **(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)**  
**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

## Manufacturing Technology

### 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.

FOUNDRY PRACTICE: Elementary idea of special casting processes-Shell mould casting, die casting, 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)

TESTING OF WELDS & RELEVANT WELDING PROCESSES: (a) Destructive methods-Tensile Test, Hardness Test, Fracture Test, Impact Test (b) Nondestructive methods-visual, Liquid Penetrant Testing, Magnetic particles Testing, Radiographic Testing.

Advanced Welding Processes: Plasma Arc Welding, Laser Beam Welding, Electron Beam welding, Atomic Hydrogen arc welding, Stud welding, Explosion welding.

### **Reference Books:**

1. Workshop Technology, Vol. I: BS Raghuvanshi
2. Production Technology, Vol. I: Hazra & Chaudhry

## 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, Ni, 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.

HEAT TREATMENT OF METALS: Elementary concept, purpose, Iron-carbon equilibrium diagram. T.T.T. and 'S' curve in steels and its significance, Hardening, Tempering, Annealing, Normalising and case hardening

#### Reference Books:

Material Science: RS Khurmi & RS Shedha

## 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:

1. Basic Mechanical Engineering, M.P. Poonia & S.C. Sharma, Khanna Publishing House
2. Strength of Materials, D.S. Bedi, Khanna Publishing House
3. General Mechanical Engineering: Jk Kapoor
4. Mechanical Engineering: Khurmi & Gupta

### 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

## 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.
3. Study of series and parallel connection of cells in 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
12. Study of Power and Energy measurement using Wattmeter and Energy meter.
13. Study of working of single layer PCB manufacturing.
14. Study of working of double 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



## 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:

1. Workshop Technology, Vol. I: Hazra & Chaudhry
2. Elements of Workshop Technology Vol. I: BS Raghuvanshi

**Level 6 (SEMESTER- III)**  
**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, continuous 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

## **Production Automation & Computer Integrating Manufacturing**

### **UNIT 1**

**General:**Automation-Definition, Scope, its types and their merits, reasons for automation, Its appreciation and criticism, Meaning of the term Computer Integrated Manufacturing (CIM CAD/CAM) Relationship between CIM and Automation **FUNDAMENTALS OF MANUFACTURING AND AUTOMATION:** Types of Industries- Manufacturing, Processing; Basic producers, Converter, Fabricators. Types of Production-Job shop production, Batch production Mass production (Quantity Production and Flow production). Manufacturing - Functions - Processing - Basic processing, Secondary processing; Operations enhancing physical properties and finishing operations, Assembly, Material handling and Storage; Inspection and test and control, their meaning with automation point of view, Automation of welding Manufacturing Process Inputs - Raw materials, Equipments (Machine Tools), Tooling and fixtures, Energy and Labour, Outputs - Finished product and Scrape/Waste. Plant Layout - Its meaning and concept of fixed position layout, Process Layout, Product layout and Group technology layout, Organisation and Information Processing Business functions, Product design, Manufacturing planning and Manufacturing control

### **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**

**N.C. Part Programming:**Tape and Tape format, Methods of N.C. part programming, Computer assisted part programming, The APT Language, Manual data inputs, N.C. part programming using CAD/CAM and Computer automated part programming. **DNC, CNC & ADAPTIVE CONTROL:** Direct Numerical Control (DNC), Computer Numerical control (CNC), Adaptive Control Machining, Current trends in N.C., introductory idea of FMS (Flexible Manufacturing System)

#### **Reference Books:**

1. Numerical Control Machines: NK Mehta
2. Production Automation & Computer Integrated Manufacturing: MP Groover

## 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.

**Introduction of Mechanical Actuation Systems:** Mechanical Actuation Systems for motion, Kinematics chains, Cams, Gear trains, Belt and chain drives, Bearings. Pneumatic and Hydraulic Systems: Actuation systems, Pneumatic and hydraulic systems, Directional control valves, Pressure control valves, Cylinders, Process control valves, rotary actuators.

### Unit 5.

**Introduction of Electrical Actuation Systems:** Electrical systems, Mechanical Switches, Solid-state switches, Solenoids, DC motors, AC motors, Stepper motors.

#### Reference Books:

1. Mechatronic Systems: Fundamentals, R. Isermann
2. Fundamentals Of Mechatronics, M. Jouaneh

## **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:**

Automatic lathes, capstan and turret lathe machines, tracer attachment in machine tools, mechanical-copying machines, Hydraulic tracing Devices, Electric tracing systems, Automatic tracing, Abrasive Processes: Abrasives, natural and synthetic, manufacturing, nomenclature, selection of grinding wheels, wheel mounting and dressing, characteristic terms used in grinding, machines for surface and cylindrical grinding, their constructional details and processes, surface finishing, honing, lapping, super finishing, polishing and buffing processes.

### **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:**

1. Machine Design, Sadhu Singh, Khanna Publishing House
2. Machine Design Data Book, Sadhu Singh, Khanna Publishing House

## **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 two 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 SAND PREPARATION AND TESTING: (a) Sand Testing (At least one Experiments) (i) Grading (Grain Size). (ii) Determination of Moisture content (iii) Determination of Clay content. (iv) Determination of Permeability for gases (b) Preparation of: (i) Green Sand Composition. (ii) Dry sand Composition. (iii) Loam Sand composition (iv) Oil Sand for Cores.

MOULDING: (a) Making at least 3 sand 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.

## **Mechatronics Lab**

1. Displacement Measurement using Capacitive & inductive Pick –ups.
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)**  
**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

## 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



## **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:**

1. Sheet Metal Forming Processes: Constitutive Modelling and Numerical Simulation, D. Banabic
2. Metal Forming Processes, G. R. Nagpal

## Non-conventional Machining

### 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

## 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

## IT Tools Lab.

1. Spreadsheets, Word, Presentation
2. Multimedia Design
3. Troubleshooting
4. Project / Practical File
5. Viva Voce

## Level 7 (Semester V) 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:

1. Reliability Engineering, S.C. Sharma, Khanna Publishing House
2. Reliability, Maintenance and Safety Engineering, A.K. Gupta

## 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

## 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

## CAD & CAM

### Unit 1

#### **Introduction CIM and CAD & Analysis:**

CIM: Introduction of CIM– concept of CIM - evolution of CIM – CIM wheel –Benefits – integrated CAD/CAM. CAD: Introduction– CAD definition – Shigley’s design process – CAD activities – benefits of CAD. Types of CAD systems, CAD software packages, 2D & 3D transformations, Geometric modeling: Techniques: Wire frame modeling – surface modeling – solid modeling

### Unit 2

#### **Computer aided Manufacturing CAM:**

Definition, functions, benefits. Group technology – Part families - Parts classification and coding - coding structure – Optiz system, MICLASS system and CODE System - process planning – CAPP – Types of CAPP: Variant type, Generative type – advantages of CAPP – production planning and control – computer integrated production management system – Master Production Schedule (MPS) – Capacity planning – Materials Requirement Planning (MRP) –Manufacturing Resources Planning (MRP-II)

### Unit 3

#### **CNC Machine and Components:**

CNC Machines: Numerical control – definition – components of NC systems – development of NC – DNC – Adaptive control systems – working principle of a CNC system – Features of CNC machines - advantage of CNC machines – difference between NC and CNC – Construction and working principle of turning centre – Construction and working principle of machining centers – machine axes conventions turning centre and machining centre – design considerations of NC machine tools.

### Unit 4

#### **Part Programming**

NC part programming – methods – manual programming – conversational programming – APT programming - Format: sequential and word address formats - sequence number – coordinate system – types of motion control: point-to-point, paraxial and contouring – Datum points: machine zero, work zero, tool zero NC dimensioning – reference points – tool material – tool inserts - tool offsets and compensation - NC dimensioning – preparatory functions and G codes, miscellaneous functions and M codes – interpolation: linear interpolation and circular interpolation.

### 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 Retrieval Systems (ASRS). ROBOT – definition – robot configurations – basic robot motion – robot 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
2. Engineering Graphics and Design, Pradeep Jain & A.P. Gautam, Khanna Publishing House

### **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.
8. Sheet Metal Operations.
9. Surface Modeling.

### **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

**Level 7 (Semester VI)**  
**Rapid Prototyping and Reverse Engineering**

**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**

Photo-polymerization process, Powder Bed Fusion process, Applications of Powder Bed Fusion Processes. Extrusion - Based RP Systems, 3D Printing process modelling, Applications of Printing Processes. Sheet Lamination process /Laminated Object Manufacturing (LOM), Beam Deposition: Laser Engineered Net Shaping (LENS), Direct Metal Deposition (DMD), Processing - structure-properties, relationships, Benefits and drawbacks.

**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 Fumihiko)



# Production Planning and Control

## 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

### 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.