

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



STUDY, EVALUATION SCHEME & SYLLABUS

For

**B. Voc
Industrial Tool Manufacturing**

Based on

AICTE Model Curriculum

(EFFECTIVE FROM THE SESSION: 2019-20)

Evaluation Scheme
B. Voc Industrial Tool Manufacturing

NSFQ Level 5 SEMESTER- I											
S. No.	Subject Code	Subject	Total Teaching/ Training Hours	Evaluation Scheme				End Semester		Total	Credit
				CT	TA	AT	Total	TE	PE		
1	5.GV.01	Machine Tool Technology		10	5	5	20	30		50	2
2	5.GV.02	General Mechanical Engineering – I	30	10	5	5	20	30		50	2
3	5.GV.03	Manufacturing Technology -I	30	10	5	5	20	30		50	2
4	5.GV.04	Metrology and Measuring Instruments	30	10	5	5	20	30		50	2
5	5.VP.01	Metrology and Measuring Instruments Lab	30				20		30	50	1
6	5.VP.02	Machine Tool Technology Lab	30				20		30	50	1
7	5.VP.03	Language Lab	30				20		30	50	2
8	OJT 5.01	Metal Arc Welding (CSC/Q0204)						Any one Training 400 hrs/ 8 weeks	150	12	
	OJT 5.02	MIG MAG or GMAW Welder (CSC/Q0209)									
	OJT 5.03	Assistant TIG Welder (CSC/Q0212)									
	OJT 5.04	CNC Setter Cum Operator (CSC/Q0120)									
	OJT 5.05	CNC Operator – VMC (CSC/Q0116)									
Total			610							500	24

NSFQ Level 5 SEMESTER- II											
S. No.	Subject Code	Subject	Total Teaching/ Training Hours	Evaluation Scheme				End Semester		Total	Credit
				CT	TA	AT	Total	TE	PE		
1	5.GV.05	Total Quality Management	30	10	5	5	20	30		50	2
2	5.GV.06	General Mechanical Engineering – II	30	10	5	5	20	30		50	2
3	5.GV.07	Manufacturing Technology -II	30	10	5	5	20	30		50	2
4	5.GV.08	Industrial Engineering	30	10	5	5	20	30		50	2
5	5.VP.04	Project	30				20		30	50	1
6	5.VP.05	Engineering Graphics	30				20		30	50	1
7	5.VP.06	Mechanical Workshop Practice	30				20		30	50	2
8	OJT 5.06	Metal Arc Welding (CSC/Q0204)						Any one Training (other than 1 st sem) 400 hrs/ 8 weeks	150	12	
	OJT 5.07	MIG MAG or GMAW Welder (CSC/Q0209)									
	OJT 5.08	Assistant TIG Welder (CSC/Q0212)									
	OJT 5.09	CNC Setter Cum Operator (CSC/Q0120)									
	OJT 5.10	CNC Operator – VMC (CSC/Q0116)									
Total			610							500	24

GV: General Vocational; VP: Vocational Practical; OJT: 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	6.GV.01	Tool Engineering – I	30	10	5	5	20	30		50	2
2	6.GV.02	Production Automation & Computer Integrated Mfg	30	10	5	5	20	30		50	2
3	6.GV.03	Fundamentals of Mechatronics	30	10	5	5	20	30		50	2
4	6.GV.04	Machining and Machine Tools	30	10	5	5	20	30		50	2
5	6.AV.01	Uni. Human Values & ethics/Env. & Eco.	30	10	5	5	20	30		50	2
6	6.VP.01	Tool Engineering Lab	30				20		30	50	1
7	6.VP.02	Mechatronics lab – Practical	30				20		30	50	1
8	OJT 6.01	Service Engineer – Installation (CSC/Q0501)					Any one Training 400 hrs/ 8 weeks			150	12
	OJT 6.02	Quality Inspector-Forged, Casted or Machined Component (CSC/Q0601)									
	OJT 6.03	CNC Programmer (CSC/Q0401)									
	OJT 6.04	Maintenance Fitter – Mechanical (CSC/Q901)									
	OJT 6.05	CNC Setter Cum Operator – VMC (CSC/Q0123)									
Total			610							500	24

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	6.GV.05	Tool Engineering – II	30	10	5	5	20	30		50	2
2	6.GV.06	Agile and Lean Manufacturing Systems	30	10	5	5	20	30		50	2
3	6.GV.07	Metal Forming Processes	30	10	5	5	20	30		50	2
4	6.GV.08	Mass Production Devices	30	10	5	5	20	30		50	2
5	6.AV.02	Env. & Eco./Uni. Human Values & ethics	30	10	5	5	20	30		50	2
6	6.VP.03	Tool and Die Making Lab - Practical	30				20		30	50	1
7	6.VP.04	IT Tool Lab	30				20		30	50	1
8	OJT 6.01	Service Engineer – Installation (CSC/Q0501)					Any one Training (other than 3rd sem)400 hrs/ 8 weeks			150	12
	OJT 6.02	Quality Inspector-Forged, Casted or Machined Component (CSC/Q0601)									
	OJT 6.03	CNC Programmer (CSC/Q0401)									
	OJT 6.04	Maintenance Fitter – Mechanical (CSC/Q901)									
	OJT 6.05	CNC Setter Cum Operator – VMC (CSC/Q0123)									
Total			610							500	24

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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	7.GV.01	Reliability, Maintenance & Safety Engineering	30	10	5	5	20	30		50	2
2	7.GV.02	Design Concepts in Engineering	30	10	5	5	20	30		50	2
3	7.GV.03	Product Design and Development	30	10	5	5	20	30		50	2
4	7.GV.04	CAD & CAM	30	10	5	5	20	30		50	2
5	7.AV.01	Indian Constitution / Essence of Indian Traditional Knowledge	30	10	5	5	20	30		50	2
6	7.VP.01	CAD Lab	30				20		30	50	1
7	7.VP.02	CAM Lab	30				20		30	50	1
8	OJT 7.01	Tool & Die Maker (CSC/Q0306)					Any one Training 400 hrs/ 8 weeks		150	12	
	OJT 7.02	Designer – Mechanical (CSC/Q0405)									
	OJT 7.03	Service Engineer – Breakdown Service (CSC/Q0503)									
Total			610							500	24

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	7.GV.05	Rapid Prototyping and Reverse Engineering	30	10	5	5	20	30		50	2
2	7.GV.06	Process Planning and Cost Estimation	30	10	5	5	20	30		50	2
3	7.AV.02	Essence of Indian Traditional Knowledge / Indian Constitution	30	10	5	5	20	30		50	2
4	7.VP.03	Major Project	180						150	150	6
5	OJT 7.04	Tool & Die Maker (CSC/Q0306)					Any one Training (other than 5 th sem) 400 hrs/ 8 weeks		200	12	
	OJT 7.05	Designer – Mechanical (CSC/Q0405)									
	OJT 7.06	Service Engineer – Breakdown Service (CSC/Q0503)									
Total			670							500	24

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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 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

(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:

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

(4.GV.02) Manufacturing Technology –I

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).

(B) 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

Unit 2

(A) Joining of Timber Components for Fabrications Works: Assembly of joints (Preparation steps and tools used only) Mortise, Tenon, Rivet, Groove, Tongue, Dowel, operations in assembly-simple lap and butt, Mortise, Tenon, Dovetail, Miter & bridle joints.

Metal Fabrication

(B) Metal Shaping-Smithy: (i) Operations involved (concept only) (ii) Tool and equipment used (Names, size, specification for identification only) (iii) Heating and fuel handling equipment (iv) Holding and supporting tools (v) Striking Tools (vi) Cutting tools (vii) Punching & Drifting Tools (viii) Bending Tools and figures (ix) Forming & Finishing Tools (x) Defects Occurring & its remedy

Unit 3

Sheet metal Working-Tools and operation: (1) Operations involved (Names and concept only) (2) Sheet metal joints (3) Tools and equipment used (Name, size, specifications for identification only) (4) Marking tools (5) Cutting and shearing Tools (6) Straightening tool (7) Striking Tools (8) Holding Tools (9) Supporting Tools (10) Bending tools (11) Punching-Piercing and Drafting tools (12) Burring Tools-Files (13) Defects Occurring & its remedy

Unit 4

(A) Metal Joining During Fabrication-

(a) Permanent Joining: (i) Welding methods (ii) Electric welding

(b) Soldering & Brazing: (i) Its concept, comparison with welding as joining method and classification (ii) Soldering operation (iii) Materials Used (iv) Defects Occurring & its remedy

(B) Riveting- (i) Its comparison with welding as joining method. (ii) Rivets and Materials. (iii) Operation involved (iv) Tools and equipment used (Names, Size, specification and uses)), Elementary knowledge about working of pneumatic, hydraulic and electric riveter. Temporary Joining (Fasteners & their uses), General Idea about temporary fasteners & their uses

(C) Familiarity with the Use of Various Tools Used in Mechanical Engineering Workshop (a) Marking & Measuring Tools (b) Holding Tools (c) Cutting Tools (d) Files (e) Thread Cutting Tools (h) Miscellaneous Tools

They should be shown physically to each student for familiarity.

Unit 5

(A) Protection of Fabricated Structures from Weather:

(a) Painting: Its need, Introduction to methods of painting (classification only) operations involved description steps only, surface preparation materials, tools and equipment used (name, size specification for identification), Brushes-round and flat wire brush, scraper, trowel, spray gun, compressor, defects likely to occur in painting and their remedies

(b) Varnishing & Polishing: Its need, operation involved (description of steps only), surface preparation method of old and new articles, application of polishing materials, materials used for preparation of french and sprit polish, copal varnish, defects likely to occur.

Safety of Personnel, Equipment & Tools to be observed

(B) Foundry Work:

Elementary idea of patterns, green sand moulds and moulding, tools and equipment used in green sand moulding

Reference Books:

1. Workshop Technology, Vol. I: Hazra& Chaudhry
2. Workshop Technology, Vol. I: BS Raghuwanshi
3. KaryashalaTakniki: JK Kapoor

(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) 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 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 - 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

(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:** (a) Principle of Mechanical Measuring Instruments: Lever method, Vernier method, screw and screw nut method, compound gearing and helical spring methods. (b) Principles of Optical Instruments: Reflection, Refraction, Interference, Polarisation, Optical prisms, Lenses and Optical projectors. (c) Principles of Electrical measuring Instruments. (d) 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: (i) (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 (ii) 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 - 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 autocollimeter, 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.

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.

(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 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)

(5.GV.06) Total Quality Management

1. Introduction, Basic concepts of total quality management

Introduction to Quality, Dimensions of Quality, Quality Planning, Concept and definition of quality cost, Determinants of Quality, Optimum cost of performance, Principles of TQM, Pillars of TQM, Introduction to leadership and Leadership roles, Quality council and Quality statement, Strategic Planning Process, Deming philosophy

2. Continuous process improvement

Input /output process Model, Juran trilogy, PDCA Cycle, 5–‘S’ Housekeeping principle, Kaizen Seven tools of Quality (Q-7 tools), Check Sheet, Histogram, Cause and effect diagram, Pereto diagram, Stratification analysis, Scatter diagram, Control charts, Control chart for variables & process capability, Control chart for attributes

3. Management planning tools & Bench marking

Affinity diagram, Relationship diagram, Tree diagram, Matrix diagram, Matrix data analysis, Arrow Diagram, Process decision programme chart (PDPC), Concept of bench marking, Reason to bench marking, Bench marking process, Types of bench marking, Benefits of bench marking

4. Just in time (JIT)

JIT philosophy, Three elements of JIT, Principles of JIT Manufacturing, JIT Manufacturing building blocks, JIT benefits, Kanban & 2 Bin Systems

5. Total productive maintenance (TPM)

Concept of Total Productive Maintenance, Types of maintenance, OEE (Overall Equipment Efficiency), Stages in TPM implementation, Pillars of TPM, Difficulties faced in TPM implementation.

Reference Books:

1. Total Quality Management, S.C. Sharma, M.P. Poonia, Khanna Publishing House

(5.GV.06) 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

(5.GV.07) Manufacturing Technology – II

UNIT I

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, Elementary idea of machines used for the above processes.

WELDING: (a) Weld edge preparation, Introduction to various welding processes with procedure equipment and applications such as (i) Electric arc welding. (ii) Resistance welding. (iii) Thermit welding (iv) Carbon arc gauging. (v) Metal-Inert-Gas welding (MIG)

(vi) Tungsten Inert Gas welding (TIG) (vii) Atomic Hydrogen arc welding. (viii) Stud welding. (ix) Laser Beam, Electron Beam welding, Explosion welding (b) 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.

UNIT 2

WELDING OF SPECIAL MATERIALS: (a) Welding of plastics, equipment, filler rods, weldability, procedures and precautions. (b) Welding of Grey Cast Iron, shielded metal arc gas welding procedures. (c) Welding of Aluminium, Argon arc and gas welding procedures.

(d) Welding of copper, Brass and Bronze, Gas shielded metallic arc welding, TIG, Oxy-acetylene method.

TESTING OF WELDS & RELEVANT WELDING CODES: (a) Destructive methods (b) Non-destructive methods-visual, X-ray, Y-ray, Magnetic particles, fluorescent, penetrant and ultrasonic testing.

UNIT 3 & UNIT 4:

FOUNDRY PRACTICE PATTERN & MOULDING: The pattern materials used, Types of pattern allowances and pattern layout, Colour scheme patterns defects, Types of cores and their utility.

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.

UNIT 5

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 mechanisation of foundries

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:

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

(5.GV.08) Industrial Engineering

UNIT 1

INSPECTION: Inspection and its objective, Types of inspection, Inspection standards, Duties of inspection foreman **QUALITY CONTROL:** Concept of quality control, Elements of quality control, quality control groups, objectives of quality control. Statistical quality control, objectives of S.Q.C. Inspection by variables & attributes, Frequency distribution, mean, median & mode, standard deviation, X-R charts, P-Charts, C-Charts and acceptance sampling (i) I.S.O. 9000 (ii) KAIZEN (iii) Six Sigma (iv) 5S (v) TQM system, concept & brief idea only .

UNIT 2:

WORK STUDY Method study-Process chart, Flow process chart, Flow diagram, Man and Machine chart, gang process chart, Work Measurement-Time study, Tools used in time study, Performance rating, Allowance and use of time standard, Time and Motion Study. Principles of human motion economy, Micro-motion study, Memo motion study, Therbligs, left hand and right hand chart.

UNIT 3:

CPM & PERT Introduction to CPM, language of CPM network, Diagram map for CPM chart, arrow diagram method of CPM, Programme Evaluation & Review Technique (PERT) Activity event network (simple manual cases only). Project scheduling with CPM & PERT

UNIT 4:

PLANT LAYOUT General Plant location factors, Influence of location on plant layout, selection of plant site, Product layout, Process layout. Advantages and disadvantages of process layout and product layout, **GENERAL:** Standardization, sources of standard, value of standardization. Production Planning & Control-Introduction, concept of planning, scheduling routing & dispatching and follow up functions, Need for Production, Planning and Control.

UNIT 5:

MATERIAL HANDLING Material Handling & material handling equipment, factors in material handling problems, cost reduction through improved material handling, Reduction in time of material handling, Material handling equipment-Idea about lifting lowering devices, Transportation devices, combination devices, Maintenance of material handling equipment.

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

(5.VP.04) Project

On the basis of learning in the vocational diploma, a project to be taken up by the student strengthening his/ her vocational skills

(5.VP.05) Engineering Graphics

1. Introduction

Drawing Instruments and their uses, BIS conventions, Lettering, Dimensioning line conventions and free hand practicing, AUTO CAD, layout of the software, standard tool bar/menus and description of most commonly used toolbars, navigational tools. Co-ordinate system and reference planes. Definitions of HP, VP, RPP & LPP. Creation of 2D/3D environment. Selection of drawing size and scale. Commands and creation of Lines, Co-ordinate points, axes, poly-lines, square, rectangle, polygons, splines, circles, ellipse, text, move, copy, off-set, mirror, rotate, trim, extend, break, chamfer, fillet, curves, constraints.

2. Orthographic Projections

Introduction, Definitions - Planes of projection, reference line and conventions employed, Projections of points in all the four quadrants, Projections of straight lines (located in First quadrant/first angle only), True and apparent lengths, True and apparent inclinations to reference planes

3. Orthographic Projections of Plane Surfaces (First Angle Projection Only)

Introduction, Definitions—projections of plane surfaces—triangle, square, rectangle, rhombus, pentagon, hexagon and circle, planes in different positions by change of position method only.

4. Projections of Solids (First Angle Projection Only)

Introduction, Definitions – Projections of right regular tetrahedron, hexahedron (cube), prisms, pyramids, cylinders and cones in different positions.

5. Sections and Development of Lateral Surfaces of Solids

Introduction, Section planes, Sections, Section views, Sectional views, Apparent shapes and True shapes of Sections of right regular prisms, pyramids, cylinders and cones resting with base on HP.

6. Isometric Projection (Using Isometric Scale Only)

Introduction, Isometric scale, Isometric projection of simple plane figures, Isometric projection of Tetrahedron, hexahedron (cube), right regular prisms, pyramids, cylinders, cones, spheres, cut Spheres.

Reference Books:

1. Engineering Drawing - N.D. Bhatt & V.M. Panchal, 48th edition, 2005-Charotar Publishing House, Gujarat.
2. Computer Aided Engineering Drawing - S. Trymbaka Murthy, -I.K. International Publishing House Pvt. Ltd., New Delhi, 3rd revised edition- 2006.
3. Engineering Graphics - K.R. Gopalakrishna, 32nd edition, 2005- Subash Publishers Bangalore.
4. Fundamentals of Engineering Drawing with an Introduction to Interactive Computer Graphics for Design and Production-Luzadder Warren J., Duff John M., Eastern Economy Edition, 2005-Prentice-Hall of India Pvt. Ltd., New Delhi.

(5.VP.06) 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 Raghuwanshi

Level 6 (Semester III)

(6.GV.01) Tool Engineering - I

Unit 1

Introduction:

Concept, meaning and definitions of tool, tool design and tool engineering, Tools-types, classification, features & applications, Tool engineering- functions and importance to enhance productivity and quality, Importance of process planning in tool engineering, Economy-concept, meaning, importance and principles in tool engineering.

Unit 2

Cutting tools: Cutting tool materials-types, composition, properties and applications, Carbide inserts-types, ISO-designation and applications, Re-sharpening methods of following cutting tools: i. Drill. ii. Side and face milling cutter. iii. End mill. iv. Centre drill etc.

Unit 3

Press tools: Press working processes-types, sketches and applications, Press tools: types, working, components and their functions, Concept, meaning, definitions and calculations of press tonnage and shut height of press tool, Shear action in die cutting operation, Centre of pressure: Concept, meaning, definition, methods of finding and importance, Die clearance: Concept, meaning, definition, reasons, effects and methods of application, Scrap strip layout: - Concept, importance, method to prepare, and determining percentage stock utilization, Types, working, and applications of stock stop, pilots, strippers and knockouts, Cutting dies-types and applications.

Unit 4

Dies and moulds: Bending: Types, Parts and functions of bending die, Definition, calculations and factors affecting bend radii, bend allowance and spring back, Method to compute bending pressure, Types, sketch, working and applications of bending dies. Drawing dies-types and method to determine blank size for drawing operation, Types, sketch, working and applications of drawing dies (embossing, curling, bulging, coining, swaging and hole flanging), Forging dies- terminology, types, sketch, working and applications, Dies / Mould: Sketch, working and applications of following i. Extrusion. ii. Plastic injection. iii. Blow moulding

Reference Books:

1. Tool Engineering ,Albert A Dowd

(6.GV.02) 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

(6.GV.03) Fundamentals of Mechatronics

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.

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.

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.

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.

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

Reference Books:

1. Mechatronics: A Multidisciplinary Approach, by William Bolton
2. Mechatronic Systems: Fundamentals, by R. Isermann

(6.GV.04) Machining and Machine Tools

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.

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.

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.

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.

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

(6.VP.01) Tool Engineering Lab

1. Study of the influence of tool geometry on surface integrity
 - a. With positive rake angle
 - b. With negative rake angle
2. Effect of speed, feed, depth of cut and nose radius on surface topography of the components machined using tool inserts
3. Cutting force measurement and construction of Merchant circle diagram as a function of rake angle
4. Study of different type of chips
5. Tool tip temperature measurement during turning of heat treated and cast products
6. Machinability studies on different materials (for different conditions)
7. Machining of the heat treated samples
8. Machining of as-cast product
9. Measurement of tool wear of inserts due to machining

(6.VP.02) 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)

(6.GV.05) Tool Engineering – II

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. Tool Engineering BY Albert A Dowd

(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:

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

(6.GV.08) Mass Production Devices

Unit 1.

Introduction- Properties of tool material, types of tool material, 5 basic requirements of tool material and general considerations in tool design, Tools-types, classification, features & applications

Unit 2.

Design of Cutting Tools- Geometry and features of Single point tool, Boring tool, Twist Drill, Milling cutter, Broaches. Carbide inserts-types, ISO-designation and applications.

Unit 3.

Press Tools- Introduction to Press tools, Elements of press tools - punches, punch holder, knockouts, pilots stock, Types of punches, Standard die sets, Element of blanking die, Element of drawing die, Element of bending die, Working of progressive and compound dies

Unit 4.

Jig & Fixtures-I- Usefulness, Principles of Jig & Fixtures design, Principle of location, Locating and clamping devices
Jig & Fixtures-II- Type of jigs, Element of a fixture, Milling fixtures, Lathe fixture, Economics of jigs and fixtures

Reference Books:

1. Mass Production, Phaidon

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

1. Manufacture of Box Jig and Angle plate jig
2. Manufacture of "V" Block angle grinding Fixtures and profile milling fixture
3. Manufacture of simple Blanking & piercing Tool
4. Manufacture of Progressive tool for producing a Cycle chain link
5. Manufacture of Press tools like Combination tool & Compound tool
6. Manufacture of Draw tool
7. Trial out On Fly press and power press the Produced components such as V, U, Cycle link, Cup, Washer and Cycle bell cup
8. Manufacture of simple V and U bending tool
9. Maintenance of Jig& fixture and press tool

(5.VP.06) IT Tools Lab.

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

Level 7 (Semester I)

(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 lessens, 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

(7.GV.02) Design Concepts in Engineering

1. Design Fundamentals: Importance of design- The design process-Considerations of Good Design – Morphology of Design –Organization for design– Computer Aided Engineering – Designing to codes and standards – Concurrent Engineering – Product and process cycles – Technological Forecasting – Market Identification – Competition Bench marking.

2. Customer Oriented Design & Societal Considerations: Identification of customer needs- customer requirements- Quality Function Deployment- Product Design Specifications- Human Factors in Design – Ergonomics and Aesthetics. Societal consideration - Contracts – Product liability – Protecting intellectual property – Legal and ethical domains – Codes of ethics - Ethical conflicts – Environment responsible design-future trends in interaction of engineering with society.

3. Design Methods: Creativity and Problem Solving –Creativity methods-Theory of Inventive Problem Solving (TRIZ)–Conceptual decomposition-Generating design concepts-Axiomatic Design – Evaluation methods-Embodiment Design-Product Architecture-Configuration Design- Parametric Design. Role of models in design-Mathematical Modelling – Simulation – Geometric Modelling –Rapid prototyping- Finite Element Analysis– Optimization – Search Methods

4. Material Selection Processing and Design: Material Selection Process – Economics – Cost Vs Performance – Weighted property Index – Value Analysis – Role of Processing in Design – Classification of Manufacturing Process – Design for Manufacture – Design for Assembly –Designing for castings, Forging, Metal Forming, Machining and Welding – Residual Stresses – Fatigue, Fracture and Failure.

Reference Books:

1. Design concepts for engineers, Mark N. Horenstein
2. Concepts in Engineering Design, Sumesh Krishnan, Dr. Mukul Shukla

(7.GV.03) Product Design and Development

Unit 1.

Importance of New Product: Definition-importance-Development Process, Importance of new product for growth of enterprise, Definition of product and new product, Responsibility for new product development, Demands on product development team, Classification of products from new product development point of view. New product development process and organization, Generic product development process for Market Pull Products, Modification of this process for other types of products.

Unit 2.

Need Analysis: Problem formulation establishing economic existence of need, need identification and analysis, engineering statement of problem, establishing target specification

Unit 3.

Generation of Alternatives and Concept Selection: Concept generation- a creative process, Creativity, Road Elects to creative thinking Fear of criticism and Psychological set, Tools of creativity like brain storming, Analogy, Inversion etc., Creative thinking Process, Concept feasibility and Concept Selection, Establishing Engineering Specification of Products.

Unit 4.

Preliminary and Detailed Design: Design Review Preliminary design- Identification of subsystems, Subsystem specifications, Compatibility, Detailed design of subsystems, component design, Preparation of assembly drawings, Review of product design from point of view of Manufacturing, Ergonomics and aesthetics.

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:

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

(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.
8. Sheet Metal Operations.
9. Surface Modeling.

(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

Level 7 (Semester VI)

(7.GV.05) 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, Kimura Fumihiko

(7.GV.06) Process Planning and Cost Estimation

Unit 1. Introduction to Process Planning: Process Planning—Definition, Purpose of Process Planning, Concept of Process Planning, Objectives of Process Planning, Scope of Process Planning, and Information required to do Process Planning, Preparing Operation Planning Sheet

Unit 2. Process Planning activities: Process Planning Procedure, Approaches of Process Planning, Manual Process Planning, Computer Aided Process Planning, Factors Affecting Selection Process, Machine Capacity, Determination of Man, Machine and Material Requirements, Factors Influencing Choice of Machinery

Unit 3. Introduction to Cost Estimation: Reasons for doing Estimates, Importance of Estimating, Objectives or Purpose of Estimating, Functions of Estimating, Cost Accounting of Costing, Importance of Costing, Aims of Cost Accounting, Difference between Cost Estimating and Cost Accounting, Cost of Product (Ladder of Cost) Production Cost Estimation, Determination of Material Cost, Mensuration in Estimating

Unit 4. Machining Time Calculation: Selection of Cutting Speed, Feed and Depth of Cut for Turning: Machining Time Calculation for Turning Operation. Selection of Cutting Speed, Feed and Depth of Cut for Milling Operation: Machining Time Calculation for Milling Operation. Selection of Cutting Speed, Feed Depth of Cut for Drilling Operation: Machining Time Calculation for Drilling Operation

Reference Books:

1. Process Planning And Cost Estimation, Panneerselvam R., Sivasankaran P.
2. Process Planning and Cost Estimation, B. Vijayaramanath, C. Elanchezhian, R. Kesavan

(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.