

Model Curriculum for
B.Voc. / D. Voc.
in
Industrial Tool Manufacturing



All India Council for Technical Education
Nelson Mandela Marg, New Delhi

1. Introduction

All India Council for Technical Education (AICTE) Ministry of HRD, Government of India has introduced Entrepreneurship oriented Skill development courses of B.Voc. /D. Voc. /Skill Diploma. These courses will be run by AICTE approved institutes by using available infrastructure and facilities. In these courses the institute will conduct general education content and sector specific skills will be imparted by Skill Knowledge Providers/ Training Providers/Industries.

1.1 Key Features:

Objectives

- To provide judicious mix of skills relating to a profession and appropriate content of General Education.
- To ensure that the students have adequate knowledge and skills, so that they are work ready at each exit point of the programme.
- To provide flexibility to the students by means of pre-defined entry and multiple exit points.
- To integrate NSQF within the undergraduate level of higher education to enhance employability of the students and meet industry requirements. Such student apart from meeting the needs of local and national industry are also expected to be equipped to become part of the global workforce.
- To provide vertical mobility to students admitted in such vocational courses.
- The certification levels will lead to Diploma/Advanced Diploma/B. Voc. Degree in Industrial Tool Manufacturing and will be offered by respective affiliating University/Board of Technical Education.
- Students may be awarded Level Certificate/Diploma/Advance Diploma /Degree as out-lined in the Table below:

Award	Duration after class X	Corresponding NSQF level
Level 3 Certificate	1 Year	3
Level 4 Certificate	2 Year	4
Diploma	3 Year	5
Advance Diploma	4 Year	6
B.Voc. Degree	5 Year	7

2. Course Objectives

After successfully completing the vocational course, the student would have acquired relevant appropriate and adequate technical knowledge together with the professional skills and competencies in the field of Industrial Tool Manufacturing so that he/she is properly equipped to take up gainful employment in this Vocation. Thus he/she should have acquired:

A. Understanding of

- (a) The relevant basic concepts and principles in basic science subjects (Physics, Chemistry and Mathematics) so that he/she is able to understand the different vocational subjects.
- (b) The basic concepts in engineering drawing.
- (c) Different manufacturing processes.
- (d) Importance of Industrial Tool Manufacturing.
- (e) The concepts, principles of working different Machine tools.
- (f) The knowledge of tool design
- (g) The concepts and principles used in Tool Design.

B. Adequate Professional Skills and Competencies in

- (a) Selecting the material for the required Tool according to the end product.
- (b) Testing the performance of Industrial Tools.
- (c) Locating the fault at production level due to improper tooling and its rectification.

C. A Healthy and Professional Attitude so that He/ She has

- (a) An analytical approach while working on a job.
- (b) An open mind while locating/rectifying faults.
- (c) Respect for working with his/her own hands.
- (d) Respect for honesty, punctuality and truthfulness

D. NSQF compliant skills in Qualification developed by sector skill council in Capital Goods Sector.

3. Course Structure

The course will consist of combination of practice, theory and hands on skills in the Capital Goods Sector.

Curriculum

The curriculum in each of the years of the programme would be a suitable mix of general education and skill development components.

Skill Development Components:

- The focus of skill development components shall be to equip students with appropriate knowledge, practice and attitude, to become work ready. The skill development components will be relevant to the industry as per its requirements.
- The curriculum will necessarily embed within itself, National Occupational Standards (NOSs) of specific job roles within the industry. This would enable the students to meet the learning outcomes specified in the NOSs.
- The overall design of the skill development component along with the job roles selected will be such that it leads to a comprehensive specialization in few domains.
- The curriculum will focus on work-readiness skills in each of the year of training.
- Adequate attention will be given in curriculum design to practical work, on the job training, development of student portfolios and project work.

General Education Component:

- The general education component adheres to the normal senior secondary and university standards. It will emphasize and offer courses which provide holistic development. However, it will not exceed 40% of the total curriculum.
- Adequate emphasis is given to language and communication skills.

The curriculum is designed in a manner that at the end of year-3, year-4 and year-5, students can meet below mentioned level descriptors for level 5, 6 and 7 of NSQF, respectively:

Level	Process required	Professional Knowledge	Professional skill	Core skill	Responsibility
Level 3	Person may carry put a job which may require limited range of activities routine and predictable	Basic facts, process and principle applied in trade of employment	Recall and demonstrate practical skill, routine and repetitive in narrow range of application	Communication written and oral with minimum required clarity, skill of basic arithmetic and algebraic principles, personal banking, basic understanding of social and natural environment	Under close supervision some responsibility for own work within defined limit
Level 4	Work in familiar, predictable, routine, situation of clear choice	Factual knowledge of field of knowledge or study	Recall and demonstrate practical skill, routine and repetitive in narrow range of application, using appropriate rule and tool, using quality concepts	Language to communicate written or oral, with required clarity, skill to basic arithmetic and algebraic principles, basic understanding of social political and natural environment	Responsibility for own work and learning
Level 5	Job that requires well developed skill, with clear choice of procedures in familiar context	Knowledge of facts, principles, processes and general concepts, in a field of work or study	A range of cognitive and practical skills required to accomplish tasks and solve problems by selecting and applying basic methods, tools materials and information	Desired mathematical skill, understanding of social, political and some skill of collecting and organizing information, communication.	Responsibility for own work and learning and some responsibility for other's works and learning

Level 6	Demands wide range of specialized technical skill, clarity of knowledge and practice in broad range of activity involving standard/ non-standard practices	Factual and theoretical knowledge in broad contexts within a field of work or study	A range of cognitive and practical skills required to generate solutions to specific problems in a field of work or study	Reasonably good in mathematical calculation, understanding of social, political and reasonably good in data collecting organizing information, and logical communication	Responsibility for own work and learning and full responsibility for other's works and learning
Level 7	Requires a command of wide ranging specialized theoretical and practical skill, involving variable routine and non-routine context	Wide ranging, factual and theoretical knowledge in broad contexts within a field of work or study	Wide range of cognitive and practical skills required to generate solutions to specific problems in a field of work or study	Good logical and mathematical skill understanding of social political and natural environment good in collecting and organizing information, communication and presentation skill	Full responsibility for output of group and development

Curriculum

Level	Code	Educational Component	Credit	Marks	
3 Semester I	Theory				
	3.GE.01	Language - I	3	50	
	3.GE.02	Applied Chemistry	3	50	
	3.GE.03	Applied Physics	3	50	
	3.GE.04	Applied Mathematics-I	3	50	
	Lab/Practical				
	3.GP.01	Applied Chemistry Lab	1.5	50	
	3.GP.02	Applied Physics Lab	1.5	50	
	On-Job-Training (OJT)/Qualification Packs				
	Operator – Conventional Training (CSC/Q0110)		(Any one)	15	200
	Fitter – Fabrication (CSC/Q0303)				
Operator – Conventional Milling (CSC/Q0108)					
Assistant MMAW SMAW Welder (CSC/ Q 0202)					
3 Semester II	Theory				
	3.GV.01	General Foundation Course – I	3	50	
	3.GV.02	Basic Electricity	3	50	
	3.GV.03	Basic Electronics	3	50	
	3.GV.04	Applied Mathematics – II	3	50	
	Lab/Practical				
	3.VP.01	Basic Electricity – Lab	1.5	50	
	3.VP.02	Basic Electronics – Lab	1.5	50	
	On-Job-Training (OJT)/Qualification Packs				
	One more QP to be opted from the QPs mentioned in Level 3 first semester		(Any one)	15	200
4 Semester I	Theory				
	4.GV.01	Engineering Science	3	50	
	4.GV.02	Manufacturing Technology – I	3	50	
	4.GV.03	IT Tools	3	50	
	4.GE.05	Language – II	3	50	
	Lab/Practical				
	4.VP.01	Workshop Practice – I	1.5	50	
	4.VP.02	IT Tools (Practical)	1.5	50	
	On-Job-Training (OJT)/Qualification Packs				
	CNC Operator – Turning (CSC/Q0115)		(Any one)	15	200
	Operator – Surface Grinding machines (CSC/Q0109)				
Fitter – Mechanical Assembly (CSC/Q0304)					
Draftsman – Mechanical					
4 Semester II	Theory				
	4.GV.04	General Foundation Course – II	3	50	
	4.GV.05	Material Science & Materials	3	50	

Level	Code	Educational Component	Credit	Marks	
	4.GV.06	Manufacturing Technology – II	3	50	
	4.GV.07	General Mechanical Engineering –I	3	50	
	Lab/Practical				
	4.VP.03	Material Science Lab.	1.5	50	
	4.VP.04	Workshop Practice – II	1.5	50	
	On-Job-Training (OJT)/Qualification Packs				
	One more QP to be opted from the QPs mentioned in the Level 4 first semester		(Any one)	15	200
5 Semester I	Theory				
	5.GV.01	Machine Tool Technology	3	50	
	5.GV.02	General Mechanical Engineering – II	3	50	
	5.GV.03	Industrial Engineering	3	50	
	5.GV.04	Metrology and Measuring Instruments	3	50	
	Lab/Practical				
	5.VP.01	Metrology and Measuring Instruments Lab	1.5	50	
	5.VP.02	Machine Tool Technology Lab.	1.5	50	
	On-Job-Training (OJT)/Qualification Packs				
	Metal Arc Welding (CSC/Q0204)		(Any one)	15	200
	MIG MAG or GMAW Welder (CSC/Q0209)				
Assistant TIG Welder (CSC/Q0212)					
CNC Setter Cum Operator (CSC/Q0120)					
CNC Operator – VMC (CSC/Q0116)					
5 Semester II	Theory				
	5.GV.05	Industrial Management	3	50	
	5.GV.06	Total Quality Management	3	50	
	5.GV.07	Entrepreneurship	3	50	
	Lab/Practical				
	5.VP.03	Project	6	150	
	On-Job-Training (OJT)/Qualification Packs				
One more QP to be opted from the QPs mentioned in the Level 5 first semester		(Any one)	15	200	
6 Semester I	Theory				
	6.GV.01	Tool Engineering – I	3	50	
	6.GV.02	Production Automation & Computer Integrated Mfg.	3	50	
	6.GV.03	Fundamentals of Mechatronics	3	50	
	6.GV.04	Machining and Machine Tools	3	50	
	Lab/Practical				
	6.VP.01	Tool Engineering Lab	1.5	50	
	6.VP.02	Mechatronics lab – Practical	1.5	50	
On-Job-Training (OJT)/Qualification Packs					

Level	Code	Educational Component	Credit	Marks	
	Service Engineer – Installation (CSC/Q0501)	(Any one)	10	200	
	Quality Inspector – Forged, Casted or Machined Component (CSC/Q0601)				
	CNC Programmer (CSC/Q0401)				
	Maintenance Fitter – Mechanical (CSC/Q901)				
	CNC Setter Cum Operator – VMC (CSC/Q0123)				
6 Semester II	Theory				
	6.GV.05	Tool Engineering – II	3	50	
	6.GV.06	Agile and Lean Manufacturing Systems	3	50	
	6.GV.07	Metal Forming Processes	3	50	
	6.GV.08	Mass Production Devices	3	50	
	Lab/Practical				
	6.VP.03	Tool and Die Making Lab - Practical	3	100	
	On-Job-Training (OJT)/Qualification Packs				
One more QP to be opted from the QPs mentioned in the Level 6 first semester		(Any one)	15	200	
7 Semester I	Theory				
	7.GV.01	Reliability, Maintenance & Safety Engineering	3	50	
	7.GV.02	Design Concepts in Engineering	3	50	
	7.GV.03	Product Design and Development	3	50	
	7.GV.04	CAD & CAM	3	50	
	Lab/Practical				
	7.VP.01	CAD & CAM Lab – Practical	3	100	
	On-Job-Training (OJT)/Qualification Packs				
	Tool & Die Maker (CSC/Q0306)		(Any one)	15	200
	Designer – Mechanical (CSC/Q0405)				
Service Engineer – Breakdown Service (CSC/Q0503)					
7 Semester II	Theory				
	7.GV.05	Rapid Prototyping and Reverse Engineering	3	50	
	7.GV.06	Process Planning and Cost Estimation	3	50	
	Lab/Practical				
	7.VP.02	Project Work	9	200	
	On-Job-Training (OJT)/Qualification Packs				
One more QP to be opted from the QPs mentioned in the Level 7 first semester		(Any one)	15	200	

Detailed Curriculum

Level 3 (Semester I)

(3.GE.01) Language - I

Module 1: Reading comprehension (prescribed texts) and functional grammar

A variety of genres – short stories, expository pieces, biographies, poems, plays, newspaper and magazine excerpts have been included. Teaching of grammar has been integrated with the reading texts. The emphasis is on functional grammar.

The following ten prose texts and five poems have been selected for development of different reading skills.

Prose texts (Prescribed)

1. A warmer or a colder earth (popular science) Arthur – C. Clark
2. The tiger in the tunnel (narrative) – Ruskin Bond.
3. First two or four pages from Sunny Days (autobiographical) – By Sunil Gavaskar
4. Case of suspension (narrative)
5. Big brother (narrative) Shekhar Joshi
6. Father, dear father (news paper article form the Hindu)
7. Face to face (autobiographical) Ved Mehta
8. I must know the truth (narrative) SigrunSrivastva
9. If I were you (play) Douglas James
10. India, her past and her future (speech) Jawahar Lal Nehru

Poems

1. Leisure – W H Davis
2. The road not taken – Robert Frost
3. Where the mind is without fear- Tagore
4. My grandmother's house – Kamla Das
5. The night of the scorpion – Nissi, Ezekiel

Non prescribed

In this section learners will be exposed to newspaper, articles, tables, diagrams, advertisements etc. which they have to read carefully and interpret. In the examination similar pieces will be used.

Grammar and usage:

The following points of grammar and usage have been selected from the reading passages.

1. agreement/concord: number – gender etc.
2. Tenses: simple past (negatives/interrogatives) present perfect, past perfect continuous, past perfect, expressing future time (will and going to)
3. Passive voice (perfect tenses and modals)
4. Modals (must, should ought to, would)
5. Linking words (to like because although, instead of, if, as, since, who, which that, when however, inspite of)
6. Reported speech, statements, questions (yes/no)

Module 2: Functional writing and study skills

This module helps the learner to write descriptive and narrative paragraph, letters, reports notices etc. and also practice skills of note making

1. Paragraph writing
 - Describing objects
 - Describing people
 - Narrating events, stories
2. Letter writing
 - Application for leave
 - Application for jobs
 - Asking for information from various agencies (e.g. Last date for getting prospects; price of items before placing orders etc.)
3. Note making
4. Ending (punctuation, spelling, appropriate vocabulary, structures)

Reference Books:

1. [Effective Communication Skills, Kulbhushan Kumar, Khanna Publishing House](#)
2. [Business Communications, Varinder Bhatia, Khanna Publishing House](#)

(3.GE.02) Applied Chemistry**1. Structure of Atom:**

Rutherford model of the structure of atom, Bohr's theory of electrons, quantum numbers and their significance, de-Broglie equation and uncertainty principle, electronic configuration of 1 to 30 elements

2. Periodic Properties of Elements:

Periodic law, periodic table, periodicity in properties like atomic radii and volume, ionic radii, ionization energy and electron affinity, Division of elements into s, p, d and f blocks

3. Chemical Bonds:

Electrovalent, covalent and coordinate bond and their properties, Metallic bonding (electron cloud model) and properties (like texture, conductance, luster, ductility and malleability).

4. Fuel and their Classification:

Definition, characteristics, classification into solid, liquid and gaseous fuel, Petroleum and brief idea of refining into various fractions and their characteristics and uses, Calorific value of fuel, Gaseous fuels- preparation, properties, composition and use of producer gas, water and oil gas.

5. Water:

Impurities in water, methods of their removal, hardness of water, its types, causes and removal, disadvantages of hard water in boilers, pH value and its determination by calorimetric method.

6. Corrosion:

Its meaning, theory of corrosion, prevention of corrosion by various methods using metallic and non-metallic coatings.

7. Plastic and Polymers:

Plastic-thermo-plastic and thermo-setting, Introduction of Polythene. P.V.C. Nylon, synthetic rubber and phenol-formal-dehyde resin, their application in industry.

Reference Books:

1. [Chemistry, Satyaprakash, Khanna Publishing House](#)
2. [Engineering Chemistry, Saiful Islam, Khanna Publishing House](#)

(3.GE.03) Applied Physics

1. **Units & Dimensions:** M.K.S. fundamentals & derived units, S.I. base units supplementary units and derived units, Dimensions of various physical quantities, uses of dimensional analysis.
2. **Surface Tension and Viscosity:** molecular forces, molecular theory of surface tension, surface energy, capillary action, concept of viscosity, coefficient of viscosity, principle and construction of viscometers.
3. **Vibrations:** Vibration as simple spring mass system, elementary and qualitative concept of free and forced vibrations, resonance. Effects of vibrations on building bridges and machines members.
4. **Heat:** Temperature and its measurement, thermoelectric, platinum resistance thermometers and pyrometers. Conduction through compound media and laws of radiations.
5. **Ultrasonics:** Productions of ultrasonic waves by magnetostriction and piezo-electric effect, application of ultrasonics in industry.
6. **Optics:** Nature of light, reflection and refraction of a wave from a plane surface. Overhead projector and Epidiascope.

(3.GE.04) Applied Mathematics - I**Sets, Relations and Functions**

1. Sets
2. Relations and Functions-I
3. Trigonometric Functions-I
4. Trigonometric Functions-II
5. Relation between Sides and Angles of A triangle

Sequences and Series

1. Sequences and Series
2. Some Special Sequences

Algebra-I

1. Complex Numbers
2. Quadratic Equations and Linear inequalities
3. Principle of Mathematical Induction
4. Permutations and Combinations
5. Binomial Theorem

Co-ordinate Geometry

1. Cartesian System of Rectangular Co-ordinates
2. Straight Lines
3. Circles
4. Conic Sections

Statistics and Probability

1. Measures of Dispersion
2. Random Experiments and Events
3. Probability

Reference Books:

1. [Applied Mathematics-I, J.K. Tyagi, Khanna Publishing House](#)
2. [Engineering Mathematics, Reena Garg, Khanna Publishing House](#)

(3.GP.01) Applied Chemistry – Lab

1. Proximate analysis of solid fuel.
2. Experiments based on Bomb Calorimeter.
3. Determination of turbidity in a given sample.
4. To determine the flash and fire point of a given lubricating oil.
5. To determine the viscosity of a given lubricating oil by Redwood viscometer.
6. To determine cloud and pour point of a given oil.

(3.GP.02) Applied Physics – Lab

1. To determine the surface tension of a liquid by rise in capillary.
2. To determine the viscosity of a given liquid.
3. To determine the frequency of tuning fork using a sonometer.
4. To determine the frequency of AC main using sonometer.
5. Time period of a cantilever.

Level 3 (Semester II)**(3.GV.01) General Foundation Course – I****A. Business Management and Entrepreneurship****(a) Entrepreneurship Orientation**

Importance and relevance in real life: Emphasis on self-employment.

(b) Entrepreneurship Values and Attitudes

Innovativeness, Independence, Risk Taking, Analytical ability.

(c) Entrepreneurial Motivation

Achievement Planning, personal efficacy, entrepreneurial goal setting.

(d) Launching of a Business Venture

Identification of project, steps in setting up a business, information about various institutions providing assistance, project formulation.

B. Computational Skills

- a. Percentage, ratio & proportion, profit & loss, discount, simple and compound interest, population growth and depreciation of value of articles using logarithm.
- b. Area and volume: rectangle, parallelogram, circle, cube, cone, cylinder & sphere.

C. Environmental Education

- a. Environment and the society.
- b. Environment properties risks in different economic enterprises, in use of raw materials, in processing / manufacturing and designing.
- (c) Poverty and environment.

D. Rural Development

- a. Agriculture, the back bone of Indian Economy.
- b. Rural development projects in India including integrated rural development programme.
- c. Agro based rural industries.
- d. Community approach to rural development.

Reference Books:

1. [Environmental Studies, M.P. Poonia & S.C. Sharma, Khanna Publishing House](#)
2. [A Textbook of Environmental Sciences, Rimpi Mehani Ne' Chopra, Khanna Publishing House](#)

(3.GV.02) Basic Electricity**1. Current Electricity**

Definition of Resistance, Voltage, Current, Power, Energy and their units, Relation between electrical, mechanical and thermal units, Temperature variation of resistance, Difference between AC and DC voltage and current

2. D.C. Circuits

Ohm's Law, Series – parallel resistance circuits, calculation of equivalent resistance, Kirchhoff's Laws and their applications.

3. Electric Cells

Primary cell, wet cell, dry cell, battery, Li-ion battery, series and parallel connections of cells,

Secondary cells, Lead Acid Cell, Discharging and recharging of cells, preparation of electrolyte, care and maintenance of secondary cells.

4. **Lighting Effects of Current**

Lighting effect of electric current, filaments used in lamps, and Tube-light, LED, their working and applications.

5. **Capacitors**

Capacitor and its capacity, Concept of charging and Discharging of capacitors, Types of Capacitors and their use in circuits, Series and parallel connection of capacitors, Energy stored in a capacitor.

6. **Electromagnetic Effects**

Permanent magnets and Electromagnets, their construction and use, Polarities of an electromagnet and rules for finding them.

Faraday's Laws of Electromagnetic Induction, dynamically induced e.m.f., its magnitude and induction, inductance and its unit. Mutually induced e.m.f., its magnitude and direction, Energy stored in an inductance.

Force acting on a current carrying conductor in magnetic field, its magnitude and direction, Principles and construction of dynamo.

7. **A.C Circuits**

Generation of A.C. voltage, its generation and wave shape. Cycle, frequency, peak value R.M.S. value, form factor, crest factor, Phase difference, power and power factor, A.C. Series Circuits with (i) resistance and inductance (ii) resistance and capacitance and (iii) resistance inductance and capacitance, Q factor of R.L.C. series circuits.

Reference Books:

1. [Basic Electrical Engineering, Ritu Sahdev, Khanna Publishing House](#)
2. [Basic Electrical Engineering, Pradeep Kumar, Khanna Publishing House](#)

(3.GV.03)Basic Electronics

i) Overview of Atom, Sub-Atomic Particles and CRO

- Brief History of Electronics.
- Atom and its elements,
- Electron, Force, Field intensity, Potential, Energy, current
- Electric field, Magnetic field, Motion of charged particles in electric and magnetic field.
- Overview of CRO, Electronic and Magnetic deflection in CRO, Applications.

ii) Voltage and Current

- Resistance, Ohm's law, V-I Characteristics, Resistors, Capacitors, Inductors.
- Voltage and Current sources, Symbols and Graphical representation
- Overview of AC, DC, Cells and Batteries, Energy and Power.

iii) Basics of Semiconductor

- Semiconductor materials, Metals and Semiconductors and Photo-electric emission.
- N-type and P-type semiconductor, Effects of temperature on Conductivity of semiconductor.
- PN junction diode, depletion layer, Forward & Reverse bias, V-I Characteristic, Effects of temperature, Zener diode, Photo diode, LED, Types and applications of diode.
- Diode as a rectifier, Half wave and full wave rectification, Zener diode Regulator.

- Introduction to Filters, Clippers, Clampers

iv) Bipolar Junction Transistor

- Operation of NPN and PNP transistors, Biasing of BJT.

- CB, CE and CC configuration

- Introduction to FET, JFET, MOSFET, CMOS and VMOS

v) Transistor Amplifier and Applications

- Introduction, Single and Multi-stage amplifiers
- Introduction to Oscillators
- Introduction to Thyristors, PNP diode, SCR, LASCR, DIAC, TRIAC

Reference Books:

1. [Basic Electronics, S. Biswas, Khanna Publishing House](#)
2. [All in One Electronics Simplifies, A.K. Maini, Khanna Publishing House](#)

(3.GV.04) Applied Mathematics – II**Algebra-II**

1. Matrices
2. Determinants
3. Inverse of a Matrix and its Applications

Relations and Functions

1. Relations and Functions-II
2. Inverse Trigonometric Functions

Calculus

1. Limits and Continuity
2. Differentiation
3. Differentiation of Trigonometric functions
4. Differentiation of Exponential and Logarithmic functions
5. Application of Derivatives
6. Integration
7. Definite Integrals
8. Differential Equations

Vectors and Three Dimensional Geometry

1. Introduction to Three Dimensional Geometry
2. Vectors
3. Plane
4. Straight Line

Linear Programming and Mathematical Reasoning

1. Linear Programming
2. Mathematical Reasoning

Reference Books:

1. [Applied Mathematics-II, J.K. Tyagi, Khanna Publishing House](#)
2. [Elements of Mathematical Analysis, R. Agor, Khanna Publishing House](#)

(3.VP.01) Basic Electricity Lab

1. Verify that resistance of conductor is directly proportional to resistivity and length and inversely proportional to cross-sectional area of the conductor.
2. Verification of Ohm's Law.
3. Verification of temperature co-efficient of resistance:
 - (i) Positive for Tungsten and Nichrome and
 - (ii) Negative for carbon.

4. Study of series resistive circuits.
5. Study of parallel resistive circuits.
6. Study of series and parallel connection of cells in circuits.
7. Preparation of Electrolyte for lead acid battery and its charging and measurement of Specific gravity with the help of hydrometer.
8. To find heat efficiency of an electric kettle.
9. Charging and Discharging of a capacitor.
10. Verification of magnetic field of a Solenoid with:
 - (i) Iron core and
 - (ii) Air core.
11. Verification of Faraday's Laws of electromagnetic induction.
12. Verification of Torque development in a current carrying coil in magnetic field.
13. Study of R.L. series circuit and measurement of power and power factor.
14. Study of R.C. series circuit and measurement of power and power factor.
15. Study of R.L.C. series circuit and measurement of power and power factor.
16. Study of R.L.C. series circuit for calculation of inductive reactance, capacitive reactance, impedance and Q- Factor.

Instruments Required

- Trainer kit for verifying ohm's law,
- Trainer kit for measuring TCR
- Lead acid battery,
- Hydrometer,
- Electric kettle,
- Trainer kit for measuring power and power factor in RLC circuits

(3.VP.02) Basic Electronics – Lab

1. Study of current and voltage measurement using Ammeter and Voltmeter.
2. Study of current and voltage measurement using Galvanometer.
3. Study of current, voltage and resistance measurement using of Multi-meter
4. Study of Power and Energy measurement using Wattmeter and Energy meter.
5. Study of working principle of Signal Generator and measurement of amplitude, time period and frequency of signal using Oscilloscope.
6. Study of V-I Characteristic of Diode.
7. Study of V-I Characteristic of Zener Diode. And use of Zener Diode as voltage regulator.
8. Study of Half wave rectifier with and without filter circuit.
9. Study of Full wave rectifier with and without filter circuit.
10. Study CE configuration for NPN and PNP transistors and measurement of voltage and current gain.
11. Study CB configuration for NPN and PNP transistors and measurement of voltage and current gain.
12. Study CC configuration for NPN and PNP transistors and measurement of voltage and current gain.
13. Study of working of single layer PCB manufacturing
14. Study of working of double layer PCB manufacturing.

15. Design of 7 segment display using LED and bread board.

Instruments Required

- Ammeter
- Voltmeter,
- Multi-meter,
- Galvanometer,
- Energy Meter,
- CRO,
- Diode Trainer kit
- Zener diode Trainer kit
- Rectifier trainer kit
- Transistor characteristics trainer kit,
- PCB manufacturing Lab
- Bread board trainer kit to design 7 segment displays.

Level 4 (Semester I)**(4.GV.01) Engineering Science****i) Soldering and Brazing**

General characteristics of soldering, brazing joints, processes and their characteristics, brief description of soldering and brazing tools equipment, types of solders and fluxes and their uses, soldering defects and their remedies, brazing materials, advantages and disadvantages of soldering and brazing. Introduction to PCB, PCB designing, wet etching, dry etching, track correction, wiring, single sided and double sided PCB.

ii) Measuring Instruments

Construction and working principles of moving iron and moving coil voltmeters and ammeters, dynamometer type wattmeter, ohm meter, megger and induction type energy meter- their circuit connection and application for measurement of electrical quantities.

iii) Electrical Engineering Drawing

Schematic and wiring diagram for domestic simple wiring, symbols used for different electrical devices and equipments.

iv) Electrical wiring

Types of wiring – cleat wiring, casing and capping, C.T.S./T.R.S. wiring, metal sheath wiring, conduit wiring and concealed wiring – their procedure. Factors of selection of a particular wiring system, importance of switch, fuse

v) Earthing

Earthing of wiring system, types of faults, their causes and remedies, Types of earthing- plate earthing and Pipe earthing, their procedure and application. Methods of finding numbers of circuits and circuit distribution by distribution board system loop in system of wiring connections IE rules related to wiring.

Reference Books:

1. [Environmental Studies, M.P. Poonia & S.C. Sharma, Khanna Publishing House](#)
2. [A Textbook of Environmental Sciences, Rimpi Mehani Ne' Chopra, 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 Raghuvanshi
3. Karyashala Takniki: JK Kapoor

(4.GV.03) IT Tools

- I. Computer Organization & OS: User perspective.
 - Understanding of Hardware.
 - Basics of Operating System.
- II. Networking and Internet.
 - Network Safety concerns.
 - Network Security tools and services.
 - Cyber Security.
 - Safe practices on Social networking.
- III. Office automation tools:
 - Spreadsheet.
 - Word processing.
 - Presentation.
- IV. Multi Media Design: (Open Source Design Tools).
 - Interface and Drawing Tools in GIMP.
 - Applying Filters.
 - Creating and handling multiple layers.
 - Using Stamping and Smudging tools.
 - Importing pictures.
- V. Troubleshooting: Hardware, Software and Networking.
 - Commonly encountered problems.
 - (Monitor: No display, KB/Mouse not responding, monitor giving beeps, printer not responding, check for virus, delete temporary files if system is slow, adjust mouse speed).

Work Integrated Learning IT – ISM

 - Identification of Work Areas.
 - Work Experience.

Reference Books:

1. [IT Tools, R.K. Jain, Khanna Publishing House](#)
2. [Information Security & Cyber Laws, Sarika Gupta, Khanna Publishing House](#)
3. [Mastering PC Hardware & Networking, Ajit Mittal, Khanna Publishing House](#)

(4.GE.05) Language - II**Module – 3: Listening and speaking skills**

In this module the learners will be exposed to a variety of listening activities recorded on audiotapes. These will be samples of good spoken English, which the learners can use as models. Work sheets will accompany the listening material.

This module will include the following:

1. Introducing yourself/friends in formal and informal situations.
2. Inviting people (over the phone and face to face) giving details of occasion, time place and date. Acceptance and refusal of invitation – formal and informal.
3. Seeking and supplying information (example opening an account in a bank, applying for loans etc.)
4. Talking and conveying messages (over the phone and face to face).
5. Giving directions / instruction.
6. Discussing contemporary issues related to environment, child labour, gender bias etc.
7. Listening to excerpts form television and radio.
8. Listening to poems/plays (prescribed).
9. Listening to speeches / talks.
10. Listening to songs like “We shall overcome”.

Module – 4 to 6 (English for specific purposes) (opt any one)

There modules are being offered. A learner has to opt for any one. The first is for academic purposes and the next two are for vocational purposes. The focus is not on the teaching of the subject matter like science and literature but on the way in which language is used in the deferent subjects.

Module 4: English for Science

This course will introduce learners to some interesting pieces of popular science

1. Health and hygiene
2. Conservation of (nearly extinct) animals.
3. Plant life.
4. Bio gas / solar energy.

These pieces illustrate the use of English in scientific writing: giving information factually, logically and objectively.

Module 5: English for Receptionist

This module will introduce the learners to a variety of exercises, tasks and meaningful activities related to the receptionist’s use of English. The printed course materials will be supported by tapes.

The following competencies be developed:

1. Receiving messages, making request etc.
2. Supplying information
3. Giving advice and making suggestions
4. Dealing with complaints
5. Making entries in an appointment book, register etc.

Module 6: English for Office Use

This course will help the learner to use English effectively and appropriately in the office environment. The competencies will be developed.

1. Using the telephone taking and passing messages.
2. Receiving messages
3. Marking noting on files and circular.
4. Writing office notes, memos, notices, agendas for meetings.
5. Telegrams and fax messages.
6. Writing business letters, application enquires, complaints.
7. Filling in forms, cheques, pay in slips etc.

Reference Books:

1. [Effective Communication Skills, Kulbhushan Kumar, Khanna Publishing House](#)
2. [Business Communications, Varinder Bhatia, Khanna Publishing House](#)

(4.VP.01) Workshop Practice - I**1. CARPENTRY SHOP WORK:**

- (EX-1) Planing and sawing practice
- (EX-2) Making of lap joint
- (EX-3) Making of mortise and tanon joint

2. PAINTING AND POLISHING:

(EX-1) To prepare a wooden surface for painting apply primer on one side and to paint the same side. To prepare french polish for wooden surface and Polish the other side.

(EX-2) To prepare metal surface for painting, apply primer and paint the same.

(EX-3) To prepare a metal surface for spray painting, first spray primer and paint the same by spray painting gun and compressor system.

The sequence of polishing will be as below- (i) Abrasive cutting by leather wheel. (ii) Polishing with hard cotton wheel and with polishing material. (iii) Buffing with cotton wheel or buff wheel.

3. SHEET METAL WORKING AND SOLDERING:

(EX-1) Cutting, shearing and bending of sheet.

(EX-2) To prepare a soap case by the metal sheet

(EX-3) To make a funnel with thin sheet and to solder the seam of the same

(EX-4) To make a cylinder and to solder the same

4. FITTING SHOP WORK:

(EX-1) Hack sawing and chipping of M.S. flat

(EX-2) Filing and squaring of chipped M.S. job

(EX-3) Filing on square of rectangular M.S. Plate

5. PLUMBING SHOP WORK:

(EX-1) Cutting and threading practice for using socket, elbow and tee etc and to fit it on wooden practice board.

6. SMITHY SHOP WORK:

(EX-1) To prepare square angular piece by M.S. rod

(EX-2) To Braze M.S. flat/Tipped tool on M.S. shank

(EX-3) To make a screw driver with metallic handle

7. WELDING SHOP WORK:

(EX-1) Welding practice gas & electric

(EX-2) Welding for lap joint after preparing the edge

(EX-3) Welding Butt joint after preparing the edge

Reference Books:

1. Workshop Technology, Vol. I: Hazra & Chaudhry

(4.VP.02) IT Tools Lab.

- Spreadsheets, Word, Presentation
- Multimedia Design
- Troubleshooting
- Project / Practical File
- Viva Voce

Level 4 (Semester II)**(4.GV.04) General Foundation Course – II****A. Business Management and Entrepreneurship**

Management of Business, Elementary treatment/exposure to basic conceptual frame work of the topic listed below:

(a) Basic Function (b) Marketing Management(c) Financial Management (d) Production Management (e) Personnel Management

B. Computational Skills

1. (a) Solution of linear equations and their application to problem of commercial mathematics.

(b) System of linear equations and in equation in two variables. Applications in formation of simple linear programming problems

2. Statistics: Raw data, bar charts and Histogram; Frequency Tables; Frequency Polygon; Ogive; Mean, Median and Mode of ungrouped and grouped data; Standard Deviation; Introduction to Mortality tables; Price Index etc. Introduction to Computers

C. Environmental Education & Rural Development

Environmental Education:

- a. Modernization of agriculture and environment, irrigation, water logging, use of fertilizers, pesticides, soil erosion, land degradation (desertification and deforestation), silting and drying of water resources.
- b. Rational utilization, conservation and regeneration of environmental resources (soil, air, water, plant, energy, minerals).

2. Rural Development

Principles and goals of rural development, major problems/constraints in rural development in India.

Reference Books:

1. [Environmental Studies, M.P. Poonia & S.C. Sharma, Khanna Publishing House](#)
2. [A Textbook of Environmental Sciences, Rimpi Mehani Ne' Chopra, Khanna Publishing House](#)
3. [Elements of Mathematical Analysis, R. Agor, Khanna Publishing House](#)

(4.GV.05) Material Science & Materials**UNIT I**

GENERAL: Brief introduction to the subject metallurgy 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-crystallisation 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

(a) 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-METALIC MATERIALS

(a) 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
(b) Paints, Enamels, Varnishes and Lacquers: Paints and Enamels-types, its purpose, essential ingredients and their role, characteristics of a good paints and enamel, trade names of some important types of products. Varnishes-types purpose of varnish, essential ingredients and their role, characteristics, preparation, trade names storage of varnish, Lacquer- characteristics, preparation and uses

UNIT 4: NON-METALIC MATERIALS

(c) 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.
(d) 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 5

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:

1. MATERIAL SCIENCE: RS Khurmi & RS Shedha

(4.GV.06) 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 casing, 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

(4.GV.07) 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.VP.03) Material Science Lab

1. (a) Study of various crystals structures through models BCC, FCC, HCP, tetrahedral and octahedral voids.
(b) Material identification of, say, 50 common items kept in a box.
2. Specimen preparation for metallographic examination /micro structural examination- cutting, grinding, polishing, etching.
3. Comparative study of microstructures of different given specimens (mild steel, gray C.I., brass, copper etc.)
4. Heat treatment experiments such as annealing, normalizing, quenching, case hardening and comparison of hardness before and after.
5. Study of Microstructure and hardness of steel at different rates of cooling, Microstructure examination of white cast iron.

(4.VP.04) Workshop Practice - II

1. WELDING SHOP WORK
Exp-1: Welding practice-gas and electric
Exp-2: Welding for lap joint after preparing the edge
Exp-3: Welding for Butt joint after preparation of the edge
Exp-4: 'T' joint welding after preparation of edge.

2. CARPENTRY

(i) Bridle joint (ii) Dovetail joint (iii) Utility article like picture frame, larger peg, Name plate etc.

3. FITTING

(i) Drill a hole in MS Block & tapping the same (ii) Making a Bolt & Nut by Tap & Die set.
(iii) Utility article-screw driver, Paper weight.

4. SMITHY

(i) To make square or hexagonal head bolt (ii) To make ring with hook (iii) Utility article-to prepare a fan hook.

5. TIN SMITHY, SOLDERING, BRAZING

(i) To prepare different types of joint such as lap joint single seam, double seam & cap joint- hem & wired edge. (ii) Utility article-waste paper basket or paper tray (iii) Study & sketch stakes/ anvils.

Reference Books:

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

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, 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.

(5.GV.02) 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.03) 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 & despatching 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): Hemendra Dutt

(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, zeiss optotest, 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 auto collimeter, checking of straightness, flatness, squareness and parallelism, circularity (By dial gauge and telerod).

MAINTENANCE OF MEASURING INSTRUMENTS: Defects likely to occur in measuring instruments and their remedies. General maintenance of measuring instruments

Reference Books:

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

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

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 job

(B) FITTING SHOP

1. To make a cut and cup tool - 1 job
2. To make blank and pierce tool - 1 job
3. To make a male and female fitting jobs - 1 job
4. To grind a shaper/planer tool - 1 job

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

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.

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.

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.

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): Hemendra Dutt

(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.07) Entrepreneurship

1. Entrepreneurship and entrepreneur:

Need of Employment and Opportunities, Essential Characteristics of a good Entrepreneur, Industrial Policy, Classification of industries- Micro, small scale, Medium scale, Large scale, Type of industries- Production, Job based & Service

2. Entrepreneurial Development:

Product identification/ selection, Site selection, Plant layout, Institutional support needed, Pre- market survey.

3. Entrepreneurship Support System and Start-ups:

Introduction to start-up's, Role of District Industries Centre in setting up industry, Function of NSIC, SISI, NISIET, NRDC, SSIC, SIDO, NMTC, KVIC, RSMML, Role of state finance corporation, state electricity corporations, pollution control board, BIS, I.S.O. etc.

4. Introduction to Tax System, Insurance and Acts:

Idea of income tax, sales tax, excise duty and custom duty, Industrial and fire insurance, procedure for industrial insurance, Introduction to Industrial acts, factory act, Workmen's compensation act 1923, Apprentices act 1961, Environmental protection act 1986

5. Project Report Preparation:

Procedure of preparing a project report, Format of project report, Preparation of project report, Introduction to ISO: 9000 Series of Quality System

(5.VP.03) Project

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

Level 6 (Semester I)**(6.GV.01) Tool Engineering - I****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.

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.

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.

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

(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.

(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
 - With positive rake angle
 - 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)
 - Machining of the heat treated samples
 - Machining of as-cast product
7. 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 II)**(6.GV.05) Tool Engineering – II****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.

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

3. Clamping devices:

Types, Sketches with nomenclature, Working, Applications

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.

5. Design of Jigs and Fixtures:

Steps in designing jigs and fixture for given simple component

(6.GV.06) Lean and Agile Manufacturing**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

2. Waste Identification-

Types of wastes, lean manufacturing principles; Value, value stream, flow, pull and perfection

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

4. Lean manufacturing tools-

Introduction to 5S, Kanban, kaizen, work standardization, Statistical process control, automation and other lean tools

5. Agile manufacturing-

Introduction to agile manufacturing, advantages of agile manufacturing, differences with lean manufacturing.

(6.GV.07) Metal Forming Processes**1. Rolling-**

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

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

3. Extrusion-

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

4. Drawing-

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

5. Pipe and Tube Production-

Manufacturing of seamless pipe- Butt welded pipe- Lap welded pipe

(6.GV.08) Mass Production Devices**1. Introduction-**

Properties of tool material, types of tool material, 5 basic requirement of tool material and general consideration in tool design, Tools-types, classification, features & applications

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.

3. Press Tools-

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

4. Jig & Fixtures-I-

Usefulness, Principles of Jig & Fixtures design, Principle of location, Locating and Clamping devices

5. Jig & Fixtures-II-

Type of jigs, Element of a fixture, Milling fixtures, Lathe fixture, Economics of jigs and fixtures

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

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

Level 7 (Semester I)**(7.GV.01) Reliability, Maintenance and Safety Engineering****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

2. Constant Failure rate model-

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

3. Design for reliability-

Reliability specifications and system Measurements, System Effectiveness, redundancy, Classification of Redundancy. Introduction of failure mode and effect analysis (FMEA)

4. Maintainability-

Analysis of Downtime, repair time distribution, stochastic point processes.

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](#)

(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.

(7.GV.03) Product Design and Development

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.

2. Need Analysis:

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

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.

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.

(7.GV.04) CAD & CAM

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

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)

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.

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.

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.01) CAD & CAM Lab

- Introduction and different features of the CAD Software
- 2-D Drafting.
- 3-D Modeling.
- 3-D Advanced Modeling.
- Assembly modeling.
- Feature Modification and Manipulation
- Detailing.
- Sheet Metal Operations.
- Surface Modeling
- To prepare part programming for plain turning operation.
- To prepare part programming for turning operation in absolute mode.
- To prepare part program in inch mode for plain turning operation.
- To prepare part program for taper turning operation.
- To prepare part program for turning operations using turning cycle.
- To prepare part program for threading operation.
- To prepare part program for slot milling operation.
- To prepare part program for gear cutting operation.
- To prepare part program for gear cutting using mill cycle.
- To prepare part program for drilling operation.

Level 7 (Semester II)**(7.GV.05) Rapid Prototyping and Reverse Engineering****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.

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.

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.

4. Rapid Tooling:

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

5. RP Applications:

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

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

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

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

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

(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.