CURRICULUM FOR ADVANCE DIPLOMA IN TOOL & DIE MAKING

MSME TECHNOLOGY CENTRE, ROHTAK

w.e.f. 2020-21

STUDY AND EVALUATION SCHEME FOR ADVANCE DIPLOMA IN TOOL AND DIE MAKING

ADVANCE DIPLOMA IN TOOL AND DIE MAKING (DURATION : 04 YEARS)

First Year

Sr. No.	Subjects	L	P	Max. Periods (45 weeks)	Internal Assessment		External Assessment				Total Marks
					Theory Max. Marks	Practical Max. Marks	Theory		Practical		
							Max. Marks	Duration (Hours)	Max. Marks	Duration (Hours)	
1.1	Communication Skill	2	-	90	50	-	100	3	-	-	150
1.2	Applied Maths	2	-	90	50	-	100	3	-	-	150
1.3	Applied Physics	2	-	90	50	-	100	3	-	-	150
1.4	Material Science	2	-	90	50	-	100	3	-	-	150
1.5	Computer Applications-I	1	1	90	25	25	50	3	-	-	100
1.6	Workshop Technology-I	4	-	180	100	-	100	3	-	-	200
1.7	Engg. Drawing	2	4	270	-	100	100	4	-	-	200
1.8	Workshop Practice –I	3	22	1125	-	200	-	-	300	6	500
	Total	18	27	2025	325	325	650		300		1600

L = Denotes Lecture per week
P = Denotes Practical per week

Second Year

Study Scheme:					Evaluation Scheme:						
Sr. No.	Subjects	L	P	Max. Periods (45 weeks)	Internal Assessment		External Assessment				Total Marks
					Theory Max. Marks	Practical Max. Marks	Theory		Practical		
							Max. Marks	Duration (Hours)	Max. Marks	Duration (Hours)	
2.1	Applied Mechanics & Strength of Materials	2	-	90	50	-	100	3	-	-	150
2.2	Heat Treatment	1	-	45	50	-	50	3	-	-	100
2.3	Engg. Metrology	1	1	90	25	25	100	3	-	-	150
2.4	Computer Aided Drawing	-	2	90	-	50	-	-	100	3	150
2.5	Workshop Technology-II	2	-	90	50	-	100	3	-	-	150
2.6	Tool Design Theory – I (Press Tools, Jigs & Fixtures)	3	-	135	50	-	100	3	-	-	150
2.7	Tool Design Practice-I(Press Tools, Jigs & Fixtures)	-	5	225	-	50	100	4	-	-	150
2.8	Tool Design Theory-II (Plastic Moulds)	2	-	90	50	-	100	3	-	-	150
2.9	Tool design practice-II (Plastic Moulds)	-	2	90	-	50	100	4	-	-	150
2.10	Workshop Practice–II	3	21	1080	-	100	-	-	200	6	300
	Total	**14**	**31**	**2025**	**275**	**275**	**750**		**300**		**1600**

Third Year

Study Scheme:					Evaluation Scheme:						
Sr. No.	Subjects	L	P	Max. Periods (45 weeks)	Internal Assessment		External Assessment				Total Marks
					Theory Max. Marks	Practical Max. Marks	Theory		Practical		
							Max. Marks	Duration (Hours)	Max. Marks	Duration (Hours)	
3.1	Hydraulics & Pneumatics	1	1	90	25	25	50	3	-	-	100
3.2	Electrical & Electronics Engineering	2	-	90	50	-	100	3	-	-	150
3.3	Computer Application-II	-	2	90	-	50	-	-	100	3	150
3.4	Computer Aided Design (CAD)	-	2	90	-	50	-	-	100	3	150
3.5	CNC Technology	1	-	45	50	-	50	3	-	-	100
3.6	Tool Design Theory-III (Plastic Moulds)	2	-	90	50	-	100	3	-	-	150
3.7	Tool Design Practice-III (Plastic Moulds)	-	2	90	-	50	100	4	-	-	150
3.8	Tool Design Theory-IV (Forging & Casting Dies)	2	-	90	50	-	100	3	-	-	150
3.9	Tool Design Practice-IV (Forging & Casting Dies)	-	4	180	-	50	100	4	-	-	150
3.10	Workshop Practice –III	3	23	1170	-	150	-	-	200	6	350
	Total	11	34	2025	225	375	600		400		1600

Fourth Year

Study Scheme:					Evaluation Scheme:						
Sr. No.	Subjects	L	P	Max. Periods (45 weeks)	Internal Assessment		External Assessment				Total Marks
					Theory Max. Marks	Practical Max. Marks	Theory		Practical		
							Max. Marks	Duration (Hours)	Max. Marks	Duration (Hours)	
4.1	Entrepreneurship Development	1	-	45	50	-	-	-	-	-	50
4.2	Industrial Management	1	-	45	50	-	50	3	-	-	100
4.3	Industrial Engg.	1	-	45	50	-	50	3	-	-	100
4.4	Production Planning & Cost Estimation	1	-	45	50	-	50	3	-	-	100
4.5	In-plant Training / OJT	27 weeks		1215	-	500	-	-	-	-	500
4.6	Project Work	14 weeks		630	-	300	-	-	450	-	750
	Total	**4**	**41**	**2025**	**200**	**800**	**150**		**450**		**1600**

Note: 1. In-plant Training / OJT will be assigned to all trainees and the working areas will consist of C & M, Design, PPC, Production and Quality Control, Maintenance & Safety etc. for duration of 1215 hrs. (27 weeks about) before starting the project work.

2. The project work has been allocated a total duration of 630 hrs. (14 weeks about) and this assignment will be started soon after completion of in-plant training.

1.1 COMMUNICATION SKILLS

Objectives

A diploma holder is supposed to write official, business and personal letters. Technical report writing forms another activity of diploma holders. Keeping in view, the above and continuing education needs of diploma holders, communication skill has been considered as essential human science subject. The emphasis of teaching should be to develop necessary competencies (knowledge and skill) in written and oral communication in English.

Units	Detailed Contents		L	P
Prose (Text book) Writing in English.	1.1	Introduction to communication skill in English language.		
	1.2	Concept, principle and procedure for prose selection.		
	1.3	Study and practice in English prose as recommended in the prescribed book		
	1.4	A book of English for polytechnics prescribed as text book by SBTE to be followed in practice.	13	-
Correspondence in English: OFFICIAL, BUSINESS AND PERSONAL LETTERS.	2.1	Introduction and understanding of writing letters in English.		
	2.2	Concept, principle and procedure in writing official letters.		
	2.3	Concept, principle and procedure in writing business letters.		
	2.4	Concept, principle and procedure in writing personal letters.		
	2.5	Classification of text of letters as Title, Body and closing procedure.	10	-
English Grammar	3.1	A review of easy form of sentences.		
	3.2	Concept, principle and procedure in conversation of direct into in-direct form of narration and vice versa.		
	3.3	Parts of speech.		
	3.4	Concept, principle and procedure of parts of speech.		
	3.5	Understanding, principle and use of punctuation in English Sentences.	08	-
Essay writing	4.1	Essay writing on scientific topics from the given outlines.		
	4.2	Concept, principle and procedure for essay writing.		
	4.3	Organization of essays (250 to 300 words) in a mythological manner to impart concept, principle and procedure in essay writing.		
	4.4	Essay writing on science, technology, general to impart adequate skill in essay writing.	10	-
Précis and comprehension	5.1	Introduction and understanding of writing precise in English.		
	5.2	Concept/ principle or procedure for précis writing.		
	5.3	Organizing and summarizing the selected paragraph to develop scheme in précis writing.		
	5.4	Text book prescribed by State Board of Technical Education to be followed.	8	-
Communication Techniques	6.1	Importance of communication.		
	6.2	One way and two way communication.		
	6.3	Essentials of good communication.		
	6.4	Methods of communication, oral, written.		
	6.5	Barriers to communication.		
	6.6	Techniques of overcoming barriers.		
	6.7	Concept of effective communication.		

Units	Detailed Contents		L	P
Communication Techniques	6.8	All forms of written communications including drafting reports, notices, agenda note, business correspondences, preparations of summaries and précis, telegrams, circulars, representations, press release and advertisements.		
	6.9	Telephone communications.	5	-
Technical Report Writing	7.1	Concept, principle and procedure in technical report.		
	7.2	Concept, principle and understanding introductory part, body and concluding part of technical report.		
	7.3	Practice in developing skill in at least two – three technical topics related to Tool Room environment.	10	-
Equivalent Terminology	8.1	150 popular and administrative and technical terms in Hindi and from Hindi to English – as per prescribed scheme of technical board.	5	-
Practice (skill) of writing personal resume and writing application for a job/ employment	9.1	Concept, principle and procedure for writing application for employment.		
	9.2	Knowledge and skill of writing contents of resume/ application.		
	9.3	Relevant statement of experience and extra curricula activities.		
	9.4	Purpose of testimonials and references.	5	-
Practicals (Oral and writing)	10.1	Participation in an informal meeting.		
	10.2	Oral presentation.		
	10.3	Interview, resume of the interview.		
	10.4	Group discussions, seminars, debates on current topics.		
	10.5	Paper reading for developing facial expressions, voices qualities etc.		
	10.6	Locate a particular book in the library.		
	10.7	Find out some words in the dictionary.		
	10.8	Pronunciation, stress and intonation.		
	10.9	Give abbreviations of particular words and vice versa.		
	10.10	Give meaning of some words.		
	10.11	Spell some words.		
	10.12	Practice of handling some communication systems like telephone and noting down and conveying messages.	10	-
		Review & Class Test	6	-
		Total No. of Hours	**90**	-

1.1 LIST OF REFERENCES FOR "COMMUNICATION SKILLS"

AUTHOR	TITLE	PUBLISHER
Krishna Mohan and Meera Bannerji	Developing Communication Skills	MacMillan, India
N.K. Aggarwal	Better English Grammar & Composition	Arnold Publication, New Delhi
Thomas Huckin and Leslie Olson	Technical Writing and Professional Communication	McGraw Hill, New Delhi
R K Bansal and J B Harrison	Spoken English for India	Orient Longman, New Delhi

1.2 APPLIED MATHEMATICS

Objectives

Applied Mathematics is a Basic Science and forms the backbone of any engineering discipline. It provides concept, principles and procedure of skill and analytical ability in analyzing the design of parts and components in Press Tool Design. It provides an essential base in CNC Programming, computer aided design and cost estimation in Tool & Die Technology application.

Units	Detailed Contents		L	P
Algebra	1.1	Application of quadratic equations simultaneous equations (one linear and other quadratic equation) in two variables to engineering problems.		
	1.2	Arithmetic progression, its nth term, sum of n terms with their applications to engineering problems. Geometrical progression, its nth term and sum of n terms and to infinity with application to engineering problems.		
	1.3	Partial fractions (excluding repeated quadratic factors) formally introduction of permutations and combinations, applications of formulae for ${}^{n}p_{r}$ ${}^{n}c_{r}$.		
	1.4	Binominal theorem for any index (expansion without proof only). First and second binomial approximation with application to engineering problems.	12	-
Trigonometry	2.1	Concept of angles, measurement of angles in degrees, grades and radians and their conversions. Trigonometrical ratios and their relations.		
	2.2	Review of ratios of some standard angles (0, 30, 45, 60, 90 degrees), T-Ratios of Allied angles (without proof), Sum, Difference formulae and their applications (without proof). Product formulae (Transformation of product to sum, difference and vice versa). T-Ratios of multiple angles, sub-multiple angles (2A, 3A, A/2).		
	2.3	Area of a triangle, Hero's formula, solution of triangles with direct applications of cosine formula, sine formula, Napier's analogy only.	16	-
Co-ordinate geometry	3.1	Cartesian coordinates (two dimensional), Distance between two points, Internal and External division formulae, Application of area formulae (without proof).		
	3.2	Area of triangle when its vertices are given, co-ordinates of centroid, incentre of a triangle when the vertices are given, using the formulae, simple problems on locus.		
	3.3	Application of equation of straight line in various standard forms, inter section of two straight lines angle between two lines. Perpendicular distance formulae.		
	3.4	General equation of a circle and its characteristics. To find the equation of a circle given (i) Centre and radius (ii) three points on it (iii) co-ordinates of end points of a diameter.		
	3.5	Definition of conic section. Standard equation of parabola, to find equations of parabola when its focus and directrix are given, given the equations of parabola, determination of its focus, vertes, axis, directrix and latus rectum.		
	3.6	Ellipse and hyperbola (standard equations without proof), given the equation in the standard form, determination of focus, directrix, latus rectum, axes, eccentricity and centre.		

Units	Detailed Contents	L	P
	3.7 Concept of polar coordinates and their conversion to Cartesian coordinates and vice versa (in two dimensions only).	16	-
Differential calculus	4.1 Concept of limits. Four standard limits $\lim_{x \to a} \frac{x^n - a^n}{x - a}$, $\lim_{x \to 0} \frac{\sin x}{x}$, $\lim_{x \to 0} \frac{a^x - 1}{x}$, $\lim_{x \to 0} (1+x)^{1/x}$ 4.2 Differentiation by definition of x^n, sin x, cos x, tan x, e^x. 4.3 Differentiation of sum, product and quotient of functions. Differentiation of function of a function. 4.4 Differentiation of trigonometric inverse functions. Logarithmic differentiation. Successive differentiation (excluding nth order). 4.5 Applications such as Rate Measures, Errors, Maxima and minima, Equation of tangent to a curve for explicit functions only and equation of normal. Newton's method of solving equation using the formula f(a)/ f' (a).	16	-
Integral calculus	5.1 Integration as inverse operation of differentiation. 5.2 Simple integration by substitutions, by parts and by partial fractions (for linear factors only). 5.3 Evaluation of definite integrals (simple problems) 5.4 Applications such as: a) Area bounded by a curve and axes. b) Volume of a solid formed by revolution of an area about axes (Simple problems). c) Centre of gravity. d) Moment of inertia. e) Average value. f) Root mean square value of a function. 5.5 Numerical integration: Applications of Simpson's rule and Trapezoidal rule (without proof)	16	-
Differential equation	6.1 Concept of formation of differential equation and solution of first order differential equation. a) Variable separation. b) Homogeneous differential equation c) Linear differential equation 6.2 Solution of linear equations having e^{ax}, Sin ax and Cos ax, x^n in the right hand side.	8	-
	Review & Class Test	6	-
	Total No. of Hours	**90**	-

1.2 LIST OF REFERENCES FOR "APPLIED MATHEMATICS"

AUTHOR	TITLE	PUBLISHER
SS Sabharwal & Others	Applied Mathematics	Eagle Prakashan, Jalandhar
K.K. Salhotra & Others	Applied Mathematics	Kaston Publishing House, New Delhi
S. Kohli & Others	Engg. Mathematics	IPH, Jalandhar
Grewal B. S.	Higher Engineering Mathematics	Khanna Publishers, New Delhi
Dass H. K.	Advanced Engineering Mathematics	S. Chand & Co., New Delhi
Loney S. R.	Plain Trigonometry	LONEY S. R.

1.3 APPLIED PHYSICS

Objectives

Applied physics is a basic science subject in the curriculum. It provides understanding and scientific ability for physical phenomenon and principles. It provides skill in learning of units and dimensions, force and motion, work, power and energy as applied to Tool & Die Technology course.

Units	Detailed Contents		L	P
Units and dimensions	1.1	Fundamental and derived units in SI System.		
	1.2	Dimensions of Physical Quantities.		
	1.3	Principle of homogeneity.		
	1.4	Dimensional equation.		
	1.5	Applications of dimensional analysis: Checking the correctness of Physical equations, Derivation of simple physical relations, limitation of dimensional analysis, significant figures and errors analysis.	5	-
Force and motion	2.1	Scalars and vectors.		
	2.2	Velocity and acceleration.		
	2.3	Equations of motion.		
	2.4	Newton's law of motion.		
	2.5	Force and its derivation from Newton's laws of motion.		
	2.6	Composition and resolution of forces.		
	2.7	Parabolic motion.		
	2.8	Horizontal projection and projection at an angles, time of flight.		
	2.9	Horizontal range and maximum horizontal range.		
	2.10	Simple problems.		
	2.11	Centripetal acceleration, centripetal and centrifugal forces.		
	2.12	Concept of friction and its application		
	2.13	Application to banking of roads.	7	-
Work, power and energy	3.1	Work and its units.		
	3.2	Work done on bodies moving on horizontal and inclined planes (considered frictional forces also)		
	3.3	Concept of power and its units.		
	3.4	Calculations of power (simple cases).		
	3.5	Concept of Kinetic energy and potential energy.		
	3.6	Expression of P.E. and K.E.		
	3.7	Conservation of energy in the case of freely falling bodies.		
	3.8	Principle of conservation of energy.	7	-
Rotational and simple harmonic motion	4.1	Definition of moment of inertia.		
	4.2	Moment of inertia of disc, ring and sphere.		
	4.3	Torque and angular momentum and their inter relation.		
	4.4	Principle of conservation (angular momentum and its applications)		
	4.5	Kinetic energy of rolling body.		
	4.6	S.H.M.-derivation of displacement, velocity, acceleration, time period and frequency.		
	4.7	Motion of cantilever, free, forced and resonant vibrations (No derivation).	7	-

Units	Detailed Contents	L	P
Temperature & its measurement	5.1 Concept of heat and temperature on the basis of K.E. of molecules. 5.2 Unit of heat. 5.3 Basic principles of measurement of temperature. 5.4 Thermo couple. 5.5 Bimetallic and resistance. 5.6 Pyrometers and Thermometers, Range of these thermometers. 5.7 Criteria for the selection of thermometers.	6	-
Expansion of solids	6.1 Coefficient of transfer of heat. 6.2 Surface and cubical expansions and relation amongst them. 6.3 Thermal stresses (qualitative only) and their applications.	3	-
Heat transfer	7.1 Three modes of transfer of heat. 7.2 Coefficient of thermal conductivity, its determination by Searle's method and Lee's disc method. 7.3 Conduction through compound media (Series and parallel for two materials only). 7.4 Heat radiation, characteristics of heat radiation. 7.5 Provost's theory of heat exchange. 7.6 Black body radiations. 7.7 Emissivity and absorptivity. 7.8 Kirchoff's law and Stefan's law of radiation.	7	-
Waves	8.1 Generation of waves by vibrating particles, wave motion and its parameters. Equating a wave, energy transfer by particle and wave. 8.2 Super position of waves and interference (graphical) 8.3 Sound and light as waves-frequencies, wavelength and velocities and their relationship.	7	-
Application of sound	9.1 Ultrasonics a) Production of ultrasonic waves by using magneto-striction and piezo-electric methods. b) Applications to drilling cold welding, cleaning, flaw detection, exploration (Sonar) and depth sounding. 9.2 Acoustics a) Reflection, refraction and absorption of sound waves by surfaces. b) Echo and reverberation.	5	-
Applications of Light	10.1 Refraction and refractive index. Laws of refraction. 10.2 Defects in image formation (Qualitative). Simple and compound microscope, astronomical and Galaleo telescopes and their magnifying powers.	5	-
Electrostatics	11.1 Coulomb's law, unit charge. 11.2 Electric field and electric lines of force. 11.3 Electric intensity due to charged straight conductor and plane sheet. 11.4 Capacitance and its units. Parallel plate capacitor. 11.5 Grouping of capacitors in series and parallel (simple problems) 11.6 Dielectric constant-its functions.	8	-

Units	Detailed Contents		L	P
D.C. circuits	12.1	Ohm's law. Resistivity and its variation with temperature.		
	12.2	Kirchhoff's law		
	12.3	Wheatstone bridge principle		
	12.4	Simple problems on series and parallel circuits.	5	-
Electro-Magnetism	13.1	Magnetic fields and its units.		
	13.2	Magnetic field around a current carrying straight conductor.		
	13.3	Circular loop and solenoids.		
	13.4	Force on a moving charge in a magnetic field.		
	13.5	Force on a current carrying conductor in a magnetic field.		
	13.6	Torque on a current carrying rectangular coil in a magnetic field.		
	13.7	Force between two current carrying parallel conductors.		
	13.8	Moving coil galvanometer; conversion of galvanometer into Ammeter and Voltmeter.		
	13.9	Permeability; dia, para and ferro magnetic maerials.	8	-
Modern physics	14.1	Introduction to laser, its characteristics and important applications.		
	14.2	Introduction to common modes of communication, viz fax, e-mail, internet.	4	-
		Review & Class Test	6	-
		Total No. of Hours	**90**	**-**

1.3 BOOKS OF REFERENCES FOR "APPLIED PHYSICS"

AUTHOR	TITLE	PUBLISHER
Lal H.H . & Sawhney B. K.	Applied Physics	Tata McGraw Hill
Zebrowski E.	Physics for Techinicians	Tata McGraw Hill
R.A. Banwat	Applied Physics Volume – I	Eagle Parkashan, Jalandhar
R.A. Banwat	Applied Physics Volume – II	Eagle Parkashan, Jalandhar

1.4 MATERIAL SCIENCE

Objectives

This subject is intended to teach basic materials classification, structure, physical and mechanical properties. The students are required to understand different materials for various application. It is necessary for students to know basics of metal structure, properties, usage and testing of metals. This knowledge will be used in Heat Treatment and Core technology subjects.

Units	Detailed Contents		L	P
Crystal system & imperfections	1.5	Definition of crystal (grain)		
	1.6	Solidification process. Phase rule.		
	1.7	Elements and their classification.		
	1.8	Description of metals and non-metals.		
	1.9	Structures of crystal, space lattice, unit cell (BCC, FCC, HCP)		
	1.10	Elements, compounds, alloys, solid solution and its type.		
	1.11	Classification of imperfections/ impurities in solids.	6	-
Manufacturing and application of steel and cast Iron	2.1	Iron and iron ores. Dressing and smelting of iron ores.		
	2.2	Making of iron by different processes.		
	2.3	Description of plain carbon steel. Various grades and composition of steel (Low, Medium, High Carbon)		
	2.4	Effect of carbon on structure and application.		
	2.5	Specification and designation of steel with commercial aspect (BIS Standard)		
	2.6	Various commercial forms of iron.		
	2.7	Description of cast iron and making of cast iron.		
	2.8	Carbon content and types of cast iron.		
	2.9	Commercial use of cast iron in metal working industry.		
	2.10	Special purpose cast iron such as malleable, nodular & spheroidal cast iron and application.	12	-
Mechanical properties	3.1	Concept of stress & strain and their units.		
	3.2	Study of stress-strain curve for steel and cast iron.		
	3.3	Description of mechanical properties such as strength, elasticity, plasticity, ductility and malleability, toughness, hardness, fatigue and creep.	6	-
Deformation	4.1	Principle of deformation of metals.		
	4.2	Deformation processes by slip, twining etc.		
	4.3	Description of work hardening or strain hardening.		
	4.4	Principle of stress relieving and process annealing.		
	4.5	Concept of Hot working and Cold working. Relative merits and demerits.		
	4.6	Effect of temperature on grain growth.	6	-
Alloy steel and alloying elements	5.1	Concept of alloy steel. Classification as low alloy and high alloy steel.		
	5.2	Common alloying elements.		
	5.3	Purpose of alloying elements and their effect on properties of steel.		
			6	-

Units	Detailed Contents		L	P
Destructive and non-destructive testing	6.1	Concept and procedure of mechanical testing of metals such as tensile, compression, impact (Izod and Charpy), Hardness (Rockwell, Brinell, Vickers Pyramid), Fatigue and creep test.	10	-
	6.2	Concept and procedure of non-destructive testing of metals such as Dye Penetration, Magnetic Particles, Ultrasonic rays, Laser beam.		
Non-ferrous metals and alloys	7.1	Concept of ferrous and non-ferrous metals.	10	-
	7.2	Brief description of manufacturing and application of aluminum, magnesium, zinc, lead, copper, tin and nickel.		
	7.3	Description of common non-ferrous alloys as brass, bronze, duralumin, germin silver.		
	7.4	Concept of bearing metals and alloys.		
	7.5	Common alloys used as bearing materials.		
Ceramics and refractories	8.1	Introduction and classification of ceramics (Functional)	4	-
	8.2	Common ceramics and their application.		
	8.3	Introduction and classification of refractories.		
	8.4	Main properties and application of refractories.		
Polymers and composite materials	9.1	Introduction to polymers.	6	-
	9.2	Process of polymerization.		
	9.3	Concept of plastics, fibers and elastomers as derivatives of polymers.		
	9.4	Principle and application of common thermo plastic.		
	9.5	Principle and application of common thermosetting plastics.		
Powder metallurgy	10.1	Concept of powder metallurgy.	8	-
	10.2	Process of making powder.		
	10.3	Common metals and non-metals used in powder metallurgy.		
	10.4	Procedure for making parts and components in powder metallurgy.		
	10.5	Specific application of making carbide and ceramic cutting tools or bits.		
Oxidation and corrosion	11.1	Principle and concept of oxidation and reduction.	6	-
	11.2	Principle of corrosion.		
	11.3	Specific types of corrosion based on environment.		
	11.4	Common methods and procedures to control and prevent corrosion.		
Disposal and recycling of materials	12.1	Concept and definition of pollution.	4	-
	12.2	Pollution related to industrial environment and tool room situation.		
	12.3	Procedure for disposal of material and waste causing pollution.		
	12.4	Concept and procedure for recycling of waste material.		
		Review & Class Test	6	-
		Total No. of Hours	**90**	**-**

1.4 BOOKS OF REFERENCES FOR MATERIAL SCIENCE

AUTHOR	TITLE	PUBLISHER
G. B. S. Narang	Material Science	Khanna Publications, Delhi
Hazra Choudhary & Hazra Choudhary	Material Science & Processes	Indian Book Distribution Co.
George's Brady	Material Hand Book	McGraw Hill Book Co.
Roy A. Lindberg	Materials & Manufacture	Prentice Hall of India
O.P. Khanna	Material Science & Metrology	Dhanpat Rai & Sons., New Delhi
Y. Lakhtin	Engineering Physical Metrology	Mir Publishers-Moskow
R.K. Rajput	Material Science & Engineering	Kataria & Sons., Delhi
D.S. Nat	Materials & Metallurgy	Katson Publishing House, Delhi
Albert G. Guy	Physical Metallurgy for Engineers	Addison Wesley Publishing Co.
Dr. D. Swarup & Ajay Rastogi	Elements of Metallurgy	Rastogi Publications, Meerut

1.5 COMPUTER APPLICATIONS – I

Objectives

This subject describes the facts, concepts, principles and procedures of computer applications so that this knowledge can be used in solving Engineering applications efficiently and effectively. It is useful in the application of computers in areas like CNC Technology, Tool Design and Computer aided Design, cost estimation and industrial management. This also enables to understand the Hardware and Networking concepts and provides the opportunity to learn latest technology through the use of Internet.

Units	Detailed Contents		L	P
Basics of computer	**1.1 Introduction to computer**			
	1. Introduction:	Use & Applications of the Computer system.		
	2. Definition:	Definition of computer operations, Components of computer, architecture of computer.		
	3. Principles:	Principle of Computer operations. Principle of components and its requirements, building blocks & Hardware organization.		
	4. Procedure:	Study the components of computer, architecture of computer, advantages & limitations of computer system.		
	1.2 Classification of computers			
	1. Introduction:	Use & Application of Computer system in Industry.		
	2. Definition:	Generation of computer system, Classification of computer system.		
	3. Principles:	Principle of evolution of computer system, Application of computer system in industry, dependency of hardware & software, application & use of software.		
	4. Procedure:	Study the History of computer, Generation of computer, characteristic of computer system, dependency of hardware & software, types of software.		
	1.3 Input devices			
	1. Introduction:	Use & Application of different input devices.		
	2. Definition:	Different types of data. Types of Input devices i) keyboard, ii) Mouse, iii) Joystick, iv) Light pen.		
	3. Principles:	Principle of feeding data into computers system, manipulation, feeding the data into computer.		
	4. Procedure:	Study the different methods of feeding the data into computer, Study the devices for data input, Study the method of data transfer.		
	1.4 Output devices			
	1. Introduction:	Use & Application of Output devices.		
	2. Definition:	Types of Data, Output devices.		
	3. Principles:	Principle of data transfer, output devices, use and application of output devices.		
	4. Procedure:	Study the different types of output devices and data generation, output devices and their operations, Observe the use of other output devices CRT, UPS.		

Units	Detailed Contents		L	P
	1.5 Storage devices			
	1. Introduction:	Use & Application of Data Storage devices.		
	2. Definition:	Data types, storage Methods, storage devices.		
	3. Principles:	Principle of data storage, data exchange, working of data storage devices.		
	4. Procedure:	Study the requirements of Data storage, method of data storage. devices of data storage, data transfer methods.		
	1.6 Microprocessor unit			
	1. Introduction:	Use & Application of semiconductor devices in computer system.		
	2. Definition:	Semiconductor devices, Microprocessor Units, Microcomputer Units.		
	3. Principles:	Principle of Microprocessor units, operation of microprocessor unit in computer system.		
	4. Procedure:	Study the concept of Microprocessor, need of Microprocessor, operation and functioning of Microprocessor.		
	1.7 Overview of the various computer systems			
	1. Introduction:	Use & applications of different computer systems.		
	2. Definition:	PII, Celeron, PIII		
	3. Principles:	Principle of application of computer systems, latest computer system used, upgrading of the system.		
	4. Procedure:	Study the different computer systems, difference between various computer systems, latest system.	8	2
Data representation & number system	**2.1 Data representation with in computer & codes**			
	1. Introduction:	Use & Application of different data types & their representation.		
	2. Definition:	Data types, Data Representation, Data Encoding, Data Interpretation.		
	3. Principles:	Study the concept of Data representation, data types, the methods of Data representation, processing methodologies of Data.		
	4. Procedure:	Principles of Data representation, Data storage, Data coding, Entry and Interpretation.		
	2.2 Number system			
	1. Introduction:	Use & Applications of Different Number system		
	2. Definition:	Concept of different Number system, data Representation, data conversion, data Interpretation.		
	3. Principles:	Principles of Number system, data representation, data conversion.		
	4. Procedure:	Study the different number system, data represented in different number system, data conversion from one number system to other.		

Units	Detailed Contents	L	P
	2.3 Algorithm & flowchart 1. Introduction: Use & Application of Algorithm & flow chart. 2. Definition: Algorithm, Decision Table, Flow chart, Pseudocde 3. Principles: Principle of Algorithm development, flow chart development, drawing effective flow charts. 4. Procedure: Study the meaning & concept of algorithm & flowchart, procedure of algorithm & flowchart developments, advantages of algorithm & flowchart.	8	2
Computer language	**3.1 Computer codes, machine code, assembly code** 1. Introduction: Use & Application of Machine Code, Assembly code. 2. Definition: Concept of Machine structure, Machine language, Assembly code, Machine code. 3. Principles: Principle of Assembly language, Machine language, Machine structure. 4. Procedure: Study the Machine structure, evolution of Assemblers, waders, Macro computer, format system, Machine language, Assembly language & Programming languages.		
	3.2 Assembler, interpreter, compiler 1. Introduction: Understand the importance of assembler, compiler & 2. Definition: interpreter. Assembler, Compiler, Interpreter. 3. Principles: Principle of General Machine structure, Assembler Design, Computer model, Interpreter. 4. Procedure: Study the Assembly language, Design of Assembler, Compiler model, Interpreter.		
	3.3 High level language, low level language 1. Introduction: Use application & importance of High level language & 2. Definition: Low level language. Concept of Programming, various languages, Assembly language, High level language, Low level language. 3. Principles: Principle of Assembly language, Machine language, High level language, Low level language. 4. Procedure: Study the application of various languages, Assembly language. Study the Machine language, High level language & Low level language.	4	2
Operating system	**4.1 Introduction to operating system** 1. Introduction: Introduction to operating system 2. Definition: Concept of operating system, computer structure, Networking. 3. Principles: Principle of operating system, computer organization, Networking. 4. Procedure: Study the need of operating system, different operating systems, importance of operating system.		

Units	Detailed Contents		L	P
	4.2 Introduction to DOS			
	1. Introduction:	Use application and importance of Disk operating system.		
	2. Definition:	Operating system., Disk operating system.		
	3. Principles:	Principle of operating system, Disk operating system.		
	4. Procedure:	Study the operating system, Disk operating system, limitation of DOS, features of DOS, MS DOS I/O system, command processor, utilities, internal & external commands, different versions of DOS, directory commands, file management commands, general commands, disk management, DOS utility, introduction to batch files, SET commands, environment variables.		
	4.3 Introduction to WindowsNT			
	1. Introduction:	Use & application of Win 95 / NT platform.		
	2. Definition:	Win95 operating system, WinNT operating system.		
	3. Principles:	Principle of Windows NT, Windows 95, Windows 2000.		
	4. Procedure:	Study the windows Basics-An overview of different versions of windows, user interface, windows accessories, start menu, miscellaneous Windows features, procedure to manage folders & files.	8	4
MS Word	**5.1 MS Word – Page Design With Columns, Tables & Using Graphics**			
	1. Introduction:	Use & application of graphics & designing page for extra		
	2. Definition:	impact. Concept of table creation & revision, creating animation, handling line breaks, page breaks.		
	3. Principles:	Principles of table creation & revision, inserting object, creating animation.		
	4. Procedure:	Study creation & modifying page numbers, creation of Headers & footers, handling of line breaks, handling of page breaks, creating & revising tables, formatting tables, objects.		
	5.2 MS Word - Mail Merge Documents & Templates			
	1. Introduction:	To create Mail merge documents, to create templates.		
	2. Definition:	Concept of Mail merge, making document easy, templates.		
	3. Principles:	Principles of Mail merge, creating templates, make documents easy to use.		
	4. Procedure:	Study the Mail merge, templates, documents easy to use.	12	5
MS Excel	**6.1 MS Excel – MS Excel 2000 Basics**			
	1. Introduction:	Use and application of Excel 2000.		
	2. Definition:	Concept of entering data, files & workbooks, Mathematical operations used in Excel sheet, printing workbook, of graphs generation.		
	3. Principles:	Principles of entering data into Excel sheet, organizing files, Mathematical operations, printing of Excel sheet, creating graphs.		
	4. Procedure:	Study the features of Excel, organization of files & workbooks, Excel Templates, printing of worksheets, use of formulae, functions & graphs.		

Units	Detailed Contents		L	P
	6.2 MS Excel - Text, Borders, Colours			
	1. Introduction:	Use and application of Text, Date, formats, color, shading.		
	2. Definition:	Concept of Text, Style, size Alignment, format Number Date & Time format, custom Date format, colour, Border, fill, shading & background.		
	3. Principles:	Principles of Text, Style, size Alignment, format, Date formats, Border, color, fill formats.		
	4. Procedure:	Study the font style, size alignments, column, number formats, dates & time formats, custom date formats, column features, border, fills, shading & background patterns.		
	6.3 MS Excel - Graphics & Objects			
	1. Introduction:	Use and application of Graphics object, clip art, word art, Multiple Graphic objects.		
	2. Definition:	Graphics object, clip art, word art, multiple graphics object		
	3. Principles:	Principles of Graphics object, clip art, word art, Multiple Graphics objects.		
	4. Procedure:	Study the Graphic object, clip art, word art, Multiple Graphic object.	12	5
MS PowerPoint	**7.1 PowerPoint - PowerPoint 2000 Basics**			
	1. Introduction:	Use and application of various powerpoint features wizard, layout, clip art, perspective, Pictures.		
	2. Definition:	Concept of powerpoint wizard, Presentation perspective, slides, Auto layout, Text objects, Clip art & Pictures.		
	3. Principles:	Principles of Auto content wizard, presentation perspective, slide, Auto layout, Text objects, clip art & Pictures.		
	4. Procedure:	Study the auto content wizard, presentation perspective, displaying slides, auto layout text object, clip art & pictures.		
	7.2 PowerPoint - PowerPoint Presentation			
	1. Introduction:	Use and application of color, slides show, Animations.		
	2. Definition:	Concept of customizing of the color scheme, customizing of the Background, speakers Notes, Masters, slide show.		
	3. Principles:	Principles of customizing presentation, customizing background, formatting the Masters, animation.		
	4. Procedure:	Study the customizing of presentation, customizing of background, formatting the masters, animations features.		
	7.3 PowerPoint – Drawing with PowerPoint			
	1. Introduction:	Use and application of text boxes, shapes, objects, shadows, 3D effects.		
	2. Definition:	Concept of formatting and text box, drawing object together, grouping and ungrouping objects, drawing special effect.		
	3. Principles:	Principle of text boxes, drawing autoshape objects, drawing object together, drawing special effect.		
	4. Procedure:	Study formatting text box, drawing of autoshapes objects, grouping and ungrouping of objects, drawing of special effects.	8	5
		Review & Class Test	5	-
		Total No. of Hours	**65**	**25**

1.5 COMPUTER APPLICATIONS - I
(PRACTICALS)

List of Practicals

Exercise No.	**Detail of exercise**	**No. of Hours (practicals)**
Exercise 1	1. Familiarization with various components and hardware configuration.	2
Exercise 2	2. Exercises on MS-DOS commands.	2
Exercise 3	3. Exercises on Windows operating system.	2
Exercise 4	4. Installing peripherals like printer, modem, scanner and plotters.	2
Exercise 5	5. a) An overview of Windows NT. b) Graphical user interface (GUI). c) Starting and quitting a program. d) Organizing files and folders. e) Move or copy a file/ folder. f) Copy a file to floppy disk. g) Recycle bin and recovery of files.	7
Exercise 6	6. Simple exercises on the basis of theory subjects on MS-Word, Excel, PowerPoint.	10
	Total No. of Hours	**25**

1.5 LIST OF REFERENCES FOR "COMPUTER APPLICATIONS – I"

AUTHOR	TITLE	PUBLISHER
Ron White ISBN-81-7635-257-8	How Computer works	Techmedia New Delhi
Peter Kent	Discover Win NT Workstation 4.0	Comdex Okhla New Delhi
Winn L. Rosch ISBN-81-87105-23-2	Hardware Basic	Techmedia New Delhi
R. K. Taxali ISBN-0-07-462467-9	PC Software made simple	Tata McGraw Hill New Delhi
Madnick Jonoran 007-463273-6	Operating system	TMH – New Delhi
Thomas C. Bartee 0-07-003899-6	Digital computer fundamentals	TMH – New Delhi
John Donovan 007-460482-1	System Programming	TMH – New Delhi
B. Ram	Fundamentals of Micro computer	Dhanpat Rai New Delhi
P. K. Sinha	Computer fundamentals	BPB / New Delhi
A. L. Steven 81- 7029-327-8	Dos Teach yourself	BPB / New Delhi
Govindraju, Haq,Narayan	Introduction to computer	Willey Eastern New Delhi
Alexandraia Haddad 81-7635-287	Ms – Powerpoint 2000	Techmedia New Delhi
Trudi Reisner 81-7635-286-1	Ms Excel 2000	Techmedia New Delhi
Stephen K. Cunningham ISBN-81-7029-247-6	Learn Microsoft Assembler in a day	BPB Publication New Delhi
Manaharhotia/Nair ISBN-81-7029-700-1	All about Motherboard	BPB Publication New Delhi
Satish Jain ISBN-81-7029-289-1	Dos Manual vol.1	BPB Publication New Delhi
Aptech	Window	Aptech Notes
Aptech	Working with Word	Aptech Notes
Aptech	PowerPoint	Aptech Notes
Ron Mansfield ISBN-81-7029-373-1	Microsoft Office	BPB Publication New Delhi

1.6 WORKSHOP TECHNOLOGY-I

Objectives

This subject describes the facts, concepts, principles and procedures of using Hand Tools, Machine Tools and related techniques efficiently effectively to plan the manufacturing of Tool & Die Parts to the specification considering safety and environment. It also useful in understanding technology and apply them in the areas such as Workshop Practice, Tool Design, Production Plan, Estimation and Supervisory Management.

It also describes the concept, principle and procedures to identify and report the maintenance requirement for corrective action. It also describes the procedures to derive the specification i.e. Hand Tools, Machine Tools for Tool and Die Making.

Units	Detailed Contents	L	P
Unit 1	**1.1 Introduction to workshop technology** 1. Introduction: Classification of industrial materials and processing methods. 2. Definition: This defines the major of industrial materials and description of major processing methods. 3. Principles: Materials and processing techniques used in an industrial, especially a tool room situation and it's impact of efficiency, effectiveness and safety. 4. Procedure: Identification, classification of major industrial material processing. **1.2 Safety precautions** 1. Introduction: Use and application of safety precautions. (safety rules, prevention of accidents) 2. Definition: Concept of accidents, Classification of accidents, rules and safety precautions. 3. Principles: Source of accident, Rules for prevention of accidents, safety precautions. 4. Procedure: Study causes of accidents, Select safety rules and precautions.	8	-
Unit 2	**2.1 Basic metal working technique** 1. Introduction: Selection and use of Hand Tools. 2. Definition: Classification: This defines the description, design features, classification, description and design and construction of various hand tools. 3. Principles: Design features, Working features 4. Procedure: Identification, description of hand tools. **2.2 Metal working techniques-joining** 1. Introduction: Introduction to metal joining techniques. 2. Definition: Classification of welding, Soldering, Brazing 3. Principles: Basic working principles of welding, soldering and brazing equipment tools. 4. Procedure: Identification of purpose, Selection of technique, equipment and tools, Maintenance storage of equipment and tools		

Units	Detailed Contents	L	P
	2.3 Metal working techniques – Hot Forming 1. Introduction: Introduction to Hot metal working. 2. Definition: Casting, forging 3. Principles: Plastic deformation, solidification of metals and alloys. 4. Procedure: Identification of castings and forgings. **2.4 Measuring instruments** 1. Introduction: Use and application of basic measuring instruments. (Bench work related measuring instruments) 2. Definition: Concept of basic measuring instruments. Classification of basic measuring instruments. 3. Principles: Working principle of basic measuring instruments. 4. Procedure: Study basic measuring instruments, define measuring instruments, Select proper measuring instruments, proper handling and maintenance of basic measuring instruments.	26	-
Unit 3	**3.1 Drilling Operations and Drilling Machines (Level I)** 1. Introduction: Classification, selection and use of Drilling operations and Drilling Machines: Pillar Drill, Portable Drill 2. Definition: Description of main parts and functions. 2.1 Machines (Bench drill, pillar, portable) 2.2 Work holding devices: Vice, Angle plate, V block, C-Clamp 2.3 Cutting Tools: Center Drill, Drills up to Dia 20 mm straight and taper shank, Counter sinks, Counter bores piloted or non-piloted reamers 2.4 Cutting tool holders for drilling machines: Drill Chucks, Reduction sleeves, Drifts, Tapping Attachments 2.5 Cutting Parameters: Calculation of Speed, Feed, Depth of cut., Cutting fluids 2.6 Operations: Drilling, Tapping, Reaming, Counter sinking, Counter boring 3. Principles: Cutting and material removal Calculation of machine parameter and tool geometry selection, Safety and maintenance of m/c., work piece and cutting tools & accessories. 4. Procedure: Identify the drilling machines, work holding device and cutting tool for operation by applying the standard practice and norms with respect to safety and maintenance.		

Units	Detailed Contents	L	P
	3.2 Drilling Operations and Drilling Machines (Level II) 1. Introduction: Classification, selection and use of drilling operation of machines and functions. 2. Definition: Description of main parts of machine. 2.1 Machines: Column drilling machines, Radial drilling m/c 2.2 Work holding devices: Step blocks, T bolts and clamps, Co-ordinate tables, Sine vice and sine table 2.3 Cutting Tools: Large size drills, Boring tools, Special reamers 2.4 Cutting tool attachments: Boring attachments, 2.5 Cutting Parameters: Machine calculation, setting up, speed, feed, depth of cut. 2.6 Operations: Drilling, Counter boring, Reaming, Step drilling, Spot facing 3. Principles: Cutting and material removal, calculation of machine parameter and tool geometry selection, safety and maintenance of m/c., work piece and cutting tools and accessories. 4. Procedure: Identify the drilling machines, work holding device and cutting tool for operation by applying the standard practice and norms with respect to safety and maintenance.		
	3.3 Drilling Operations and Drilling Machines (Level III) 1. Introduction: Classification, Selection and use of Drilling operations and Drilling Machines 2. Definition: 2.1 Description of main parts and function of machines: Gang drilling machines, Multi spindle machines, Drilling machines for batch and mass production. 2.2 Work holding devices: Jigs and fixtures 2.3 Cutting tool holders: Quick Change Chucks. 2.4 Operations: setting up the machine tools for batch and mass production. 3. Principles: Operational principles of Machine and accessories. Cutting and material removal Calculation of machine parameter and tool geometry selection. Safety and maintenance of machine, work piece and cutting tools and accessories. 4. Procedure: Identify the setting up of machine for production of components.	18	-

Units	Detailed Contents		L	P
Unit 4	**4.1 Hand Grinding Operation and Pedestal Grinder**			
	1. Introduction:	Use and selection of Hand grinding operation and pedestal grinder.		
	2. Definition:	Classification, Design, Construction, Description.		
	3. Principles:	Factors of cutting tool, work material, machine		
	4. Procedure:	Identify the use and select the Hand grinding operation and pedestal grinder by applying the standard practice and norms.	6	-
Unit 5	**5.1 Sawing Operation and Power Hack Saw**			
	1. Introduction:	Use and selection of Sawing operations & power hack saw.		
	2. Definition:	Classification, Design, Construction, Description.		
	3. Principles:	Factors of cutting tool, work material, machine		
	4. Procedure:	Identify the use and select the sawing operations & power hack saw by applying the standard practice and norms with respect to safety and maintenance.		
	5.2 Sawing Operation and Band Saw			
	1. Introduction:	Use and selection of Sawing operation and Band Saw.		
	2. Definition:	Classification, Design, Construction, Description.		
	3. Principles:	Factors of cutting tool, work material, machine		
	4. Procedure:	Identify the use and select the Sawing operation and Band Saw by applying the standard practice and norms with respect to safety and maintenance.	8	-
Unit 6	**6.1 Shaping Operations and Shaper**			
	1. Introduction:	Use and selection of Shaping operation and shaper.		
	2. Definition:	Classification, Design, Construction, Description.		
	3. Principles:	Factors of cutting tool, work material, machine		
	4. Procedure:	Identify the use and select the shaping operation and shaper by applying the standard practice and norms with respect to safety and maintenance.		
	6.2 Planning Operations and Planer			
	1. Introduction:	Use and selection of Planning operations and Planer.		
	2. Definition:	Classification, Design, Construction, Description.		
	3. Principles:	Factors of cutting tool, work material, machine		
	4. Procedure:	Identify the use and select the Planning operations and Planer by applying the standard practice and norms with respect to safety and maintenance.		
	6.3 Slotting Operations and Slotting Machine			
	1. Introduction:	Use and selection of Slotting operation & Slotting machine.		
	2. Definition:	Classification, Design, Construction, Description.		
	3. Principles:	Factors of cutting tool, work material, machine		
	4. Procedure:	Identify the use and select the Slotting operation & Slotting machine by applying the standard practice and norms with respect to safety and maintenance.	16	-

Units	Detailed Contents	L	P
Unit 7	**7.1 Turning Operations and Lathe (Level I)** 1. Introduction: Classification, selection and use of turning operation and lathe. 2. Definition: Description of main parts and functions of 2.1 Machines :Center Lathe 2.2 Work Holding Devices: 3 Jaw Chuck, 4 - Jaw Chuck, Dead Center, Revolving center, Face plate, Dog carrier 2.3 Cutting Tools: Nomenclature and types of, Center Drills, H S S Tools (single point) for roughing and finishing, Knurling tools, Grooving, left hand, right hand tools. 2.4 Cutting tool holders: Drill chuck, Tool post, Multiple or indexing tool post, Quick change tool holder 2.5 Cutting Parameters: Speed, Feed, Depth of cut, Tool geometry, Time calculations, Cutting fluids 2.6 Operations: Plain Turning, Shoulder turning, Grooving, Facing, Knurling, Eccentric Turning, Drilling, Chamfering 3. Principles: The operational principles of machines, parts and accessories. Cutting and material removal, Calculation of machine parameters and tool geometry selection, Safety and maintenance of machines and cutting tools. 4. Procedure: Identify the lathe machine, work holding device, cutting tool and holder for Operations by applying the standard practice and norms with respect to safety and maintenance.		
	7.2 Turning Operation and Lathe (Level II) 1. Introduction: Classification, selection and use of turning operations and lathe 2. Definition: Description of main parts and functions of 2.1 Machines: Tool room lathe, Capstan lathe, Turret lathe 2.2 Work holding Devices: Collets, steady rest, follow rest, Taper Turning attachments, Thread Chaser 2.3 Cutting Tools: Boring, Threading form tools, Counter Boring tools, Parting tools, ISO nomenclature for brazed carbide tips, Taps and Dies 2.4 Cutting Tool holders: Boring tool holders, Die holders, Special tool holders for capstan and turret lathe 2.5 Cutting parameters: Tool geometry with respect to operations, Time calculation for carbide tools. 2.6 Operations: Boring, Threading- internal, external, Counter boring, Taper turning, Form Generation e.g.: External grooves for 'o' rings, circlips fillets, Reaming, Tapping, Use of die sets for external threads.		

Units	Detailed Contents		L	P
	3. Principle:	The operational principles of machines and parts, Cutting and material removal, Calculation of machine parameters and cutting tool selection, Operational principle of work holders and cutting tool holders, Use coolants, Safety and maintenance of machine and cutting tools etc.		
	4. Procedure:	Identify the machine, work holding devices, tools and tool holders for operations by applying the standard practice and norms with respect to safety and maintenance.		
	7.3 Turning Operation and Lathe (Level III)			
	1. Introduction:	Classification, selection and use of turning operation and lathe		
	2. Definition:	Description of main parts and functions of		
		2.1 Machines: Special Purpose Machines e.g. Automats Large size lathes		
		2.2 Work holding devices and attachments: Soft jaws, Special fixtures, Radius turning attachments, Copy turning attachments, Milling attachments, Grinding attachments.		
		2.3 Cutting tools: Modular tooling system, Holders and Inserts.		
		2.4 Cutting the holders: Special purpose holders		
		2.5 Cutting parameters: Tool geometry of inserts, Special tool geometries, Coolants and cutting fluids		
		2.6 Operations: Form turning, Milling, Grinding, Polishing		
	3. Principles:	Operational principles of machines and parts, work holders and cutting tool holders, Safety and maintenance		
	4. Procedure:	Identify the machine, work holding device, tool and tool holders for operation by applying standard practice and norms with respect to safety and maintenance.	44	-
Unit 8	**8.1 Milling Operations and Milling Machines (Level I)**			
	1. Introduction:	Classification, selection, use of Milling Operations & Milling M/c.		
	2. Definition:	Description of main parts and functions of:		
		2.1 Machine: Vertical Milling Machine, Horizontal Milling Machine, Safety and maintenance of the machine.		
		2.2 Work holders and attachments: Vice, Parallel Bars, Clamps, Angle plates, Jacks, V-blocks		
		2.3 Cutting Tools : End mills, Shell and Mills, Slide face cutters, Angular cutters, Drills, Reamers etc.		
		2.4 Cutting Tool Holders: Collets, Arbours, Adapters, Edge finder, Dial indicator		
		2.5 Cutting Parameters: Speed , Feed, Depth of cut, Tool Geometry, Cutting Fluids, Time calculations		
		2.6 Operations: Plane Milling, Face Milling, Side Milling, Straddle Milling, Angular Milling, Slot Milling		

Units	Detailed Contents		L	P
	3. Principles:	Operational principles of Machine and accessories, Cutting and material removal, Calculation of machine parameter and tool geometry selection, Safety and maintenance of machine, work piece and cutting tools and accessories.		
	4. Procedure:	Identify the milling machine, work holding device, cutting tool holder for operations by applying the standard practice and norms with respect to safety and maintenance.		
	8.2 Milling Operations and Milling Machine (Level II)			
	1. Introduction:	Classification, selection and use of Milling Operations and Milling Machines.		
	2. Definition:	2.1 Machines: Universal Milling Machine 2.2 Work Holders and attachments: Universal vice, Sine vice, Rotary table 2.3 Cutting tools: Concave and Convex form cutters, T slot Cutters, Saws, Single point boring cutter, Introduction of carbide inserts and holders , Solid carbide Cutters. 2.4 Cutting Tool Holders: Spring Collet, Long Arbor, Boring Head 2.5 Cutting Parameters: Machining Time, Calculation of number of teeth, Tool Geometry, Speed, feed, depth of cut, cutting fluids as per tables and charts, 2.6 Operations: Profile Milling, Key ways, Sawing Slits and openings, T – slots.		
	3. Principles:	Operational Principles of machine parts and accessories, Cutting and material removal, Calculation of machine parameters and tool geometry selection, Safety and maintenance of machine, work piece, cutting tools and accessories.		
	4. Procedure:	Identify the Milling Machine, work holding devices, cutting tool and holder for operations by applying the standard practice and norms with respect to safety and maintenance.		

Units	Detailed Contents	L	P
	8.3 Milling Operation and Milling Machine (Level III) 1. Introduction: Classification, selection and use of milling operations and milling machines. 2. Definition: 2.1 Machines: Tool Room Milling Machines e.g. M1TR, Special Purpose Machines. 2.2 Work Holding Devices: Dividing Head, Slotting Attachment, Indexing Attachment 2.3 Cutting tools: Ball nose cutters, Indexable carbide Inserts and holders. 2.4 Cutting Tool Holders: Indexable tool holders and spares. 2.5 Cutting Parameters: Indexing, Slotting, Cavity opening 2.6 Operations : Cavity Milling, Die opening, Precision boring and reaming, Grooving slots on plane surfaces and cylindrical surfaces 3. Principles: Operational Principles of machine parts and accessories, Cutting and material removal, Calculation of parameters for machines and accessories settings, Safety and maintenance of machine, work piece, cutting tools. 4. Procedure: Identify the Milling Machine, work Holding devices, cutting tool and holder for operations by applying the standard practice and norms with respect to safety and maintenance.	44	-
	Review & Class Test	10	-
	Total No. of Hours	**180**	**-**

1.6 LIST OF REFERENCES FOR "WORKSHOP TECHNOLOGY"

AUTHOR	TITLE	PUBLISHER
Chapman A. J.	Workshop Technology (Vol I, II & III)	New Delhi : Amol Publication
Hazra S.K. & Choudhary S.K.	Elements of Workshop Technology	Metropolitan Publishers, Bombay
Raghuwanshi B.S. & Others	Workshop Technology	New Heights, New Delhi
Gupta K.N. & Kaushish J.P.	Workshop Technology Vol.I to II	New Heights, New Delhi
Atherton W.H.	Workshop Practice Vol I to V	New Era Publishers, London
Gerling	All About Machine Tools	WILEY EASTERN, Delhi
B. Kishore	Tool & Die Maker	Saurabh & Co., Delhi
Hermann Jutz Edward Scharkus	Westermann Tables	WILEY EASTERN, Delhi

1.7 ENGINEERING DRAWING

Objectives

Understand the scientific facts, concepts, principles & procedures of Engineering Drawing used in Tool Design, Manufacturing, Process Planning, Estimation, Inspection & QC including Supervisory Management to express the ideas, conveying instructions for carrying out jobs in Tool & Die Technology. It is also useful in understanding Technology subject such as Tool Design, Workshop Practice, Production Planning & Estimation, Supervisory Management, CAD by achieving basic drawing skills, utilization & interpreting drawings. It also describes the concepts, principles and procedures of drawing of machine elements to understand machine maintenance & service manuals and related technical catalogue.

Units	Detailed Contents		L	P
Unit 1 Introduction	**1.1 Introduction to Engineering Drawing**			
	1. Introduction:	Introduction and observation of engineering drawing practices in the Tool Room environment and manufacturing industry.		
	2. Definition:	Definition of sketches, mechanical and computer generated drawings. Classification of drawing set and related information.		
	3. Principles:	Industrial drafting process from product conception to production.		
	4. Procedure:	Read link diagram and subject objective. Integrate the flow of engineering drawing Tool Room. Select reference material and ISO norms. Sketch flow charts of engineering drawing process of Tool Room.		
	1.2 Media used for engineering drawing			
	1. Introduction:	Introduction to drawing instruments, machines, complete conventional and latest working stations.		
	2. Definition:	Concept of standard drawing sheets, conventional drawing instruments accessories and aids, reproduction, storage, retrieval.		
	3. Principles:	Principle of standard drawing sheets, conventional drawing instruments accessories and aids, reproduction, storage, retrieval.		
	4. Procedure:	Procedure of standard drawing sheets, conventional drawing instruments accessories and aids, reproduction, storage, retrieval.	2	5
Unit 2 Basics of drawing	**2.1 Scales, Lines & Lettering**			
	1. Introduction:	Introduction to scales, lines and lettering.		
	2. Definition:	Classification of scales, full, reduce and large scale. Classification of lines and lettering.		
	3. Principles:	Choice and use of BIS norms for scale, lines & lettering.		
	4. Procedure:	Factors for selection of various scales, lines & lettering.		
	2.2 Geometric constructions			
	1. Introduction:	Introduction to examples of simple and advanced geometrical construction		
	2. Definition:	Straight lines, Angles, Polygons, Circle/ Arcs		

Units	Detailed Contents		L	P
	3. Principles:	Definition, principles, procedures, exercise of advance geometrical construction Conic Section: Ellipse, Parabola, Hyperbola Other curves: Helix, Cycloid, Involute		
	4. Procedure:	Procedure for drawing, state line, angles, polygons, circle.		
	2.3 Orthographic projections			
	1. Introduction:	Introduction to orthographic projections		
	2. Definition:	Definition of orthographic projections - Points, Lines, Planes, Solids		
	3. Principles:	Principles of quadrants and planes - Principles of different views		
	4. Procedure:	Procedure for drawing different views of points, lines, and solids planes (in 1st and 3rd quadrants)		
	2.4 Orthographic projections of objects using is code of practice			
	1. Introduction:	Introduction to 1st angle and 3rd angle projections.		
	2. Definition:	Definition of orthographic projections, 1st angle and 3 angles.		
	3. Principles:	Principles of 1st angle and 3rd angle projections according to BIS norms.		
	4. Procedure:	Procedure for drawing different views of an object in 1st angle and 3rd angle.		
	2.5 Dimensioning			
	1. Introduction:	Introduction to dimension		
	2. Definition:	Functional dimension, Nonfunctional dimension, Auxiliary dimension		
	3. Principles:	Rules of dimensioning, Method of dimensioning, Indication of dimensioning, BIS norms.		
	4. Procedure:	Procedure of dimensioning	20	60
Unit 3 Basics of isometric projection	**3.1 Isometric projections**			
	1. Introduction:	Introduction to isometric projection.		
	2. Definition:	Definition of isometric projections (axes, lines, planes)		
	3. Principles:	Principles of co-ordinates (x, y, z) Principles of isometric projections of planes, prisms, pyramids, cylinders, cones, irregular objects. Principles of dimensioning isometric projections		
	4. Procedure:	Procedure for drawing isometric views of regular solids and irregular objects.		
	3.2 Conversion of isometric views to orthographic projections & visa-versa			
	1. Introduction:	Introduction to conversion of orthographic projections to isometric view and visa versa.		
	2. Definition:	Recall the concepts of orthographic projections and isometric view.		
	3. Principles:	Principles of conversion of orthographic views to isometric and visa versa.		
	4. Procedure:	Procedure of drawing orthographic views from isometric view and isometric view from orthographic views.	8	24

Units	Detailed Contents		L	P
Unit 4 Surface texture, limits, fits and tolerances, geometrical tolerances	**4.1 Tolerances, limits, fits**			
	1. Introduction:	Introduction to tolerances, limits, fits.		
	2. Definition:	Definition of single and related features. Form tolerances, orientation tolerances, location tolerances and run-out.		
	3. Principles:	Rules of geometrical tolerencing procedure of drafting and symbol, tolerancing and various characteristics.		
	4. Procedure:	Procedure for drafting symbols, indicating tolerances and their interpretation.		
	4.2 Surface Texture			
	1. Introduction:	Introduction to surface texture symbols.		
	2. Definition:	Classification of surface texture symbols.		
	3. Principles:	Surface texture value and location.		
	4. Procedure:	Procedure for drafting of symbols & location of symbol.		
	4.3 Geometric tolerancing symbols and characteristics			
	1. Introduction:	Introduction to geometrical tolerance symbols and characteristics.		
	2. Definition:	Definition of single and related features. Form tolerance (Straightness, flatness, circularity, cylindricity, profile of line and profile of surface), Orientation tolerances (Parallelism, Perpendiculasiting and angularity), Location tolerances (Position, coaxiality, symmetry), Run-out tolerances (Circular run-out, total run-out)		
	3. Principles:	Rules of geometrical tolerancing, Relationship of individual features from its ideal feature form.		
	4. Procedure:	Procedure of drafting symbols, indicating tolerances and characteristics, interpreting symbols and indications	4	12
Unit 5 Development of surfaces	**5.1 Sectional views**			
	1. Introduction:	Introduction to section views.		
	2. Definition:	Types of sections, Sectional lines, Assembly sectioning.		
	3. Principles:	Principles of sectioning & BIS norms.		
	4. Procedure:	Procedure for selecting and drawing of section views.		
	5.2 Development of surfaces			
	1. Introduction:	Introduction to development of surfaces.		
	2. Definition:	Ruled surfaces. - Plane surfaces, Single curved surfaces, Warped surfaces. Double curved surfaces.		
	3. Principles:	Parallel line development, Radial line development, Triangular development, Approximate development.		
	4. Procedure:	Rectangular truncated prism, Cylinder with inclined, Pyramid and truncated pyramid, Cone and truncated cone.		
	5.3 Interpenetration of solids			
	1. Introduction:	Introduction to interpenetration of solids.		
	2. Definition:	Intersection of two plane surfaces, intersection of two curved surfaces, intersection of plane surface and curved surface.		

Units	Detailed Contents		L	P
	3. Principles:	Principles of generating curves of intersection by line method and cutting planemethod.		
	4. Procedure:	Prism and prism, Cylinder and cylinder, Cone and cylinder, Cylinder and prism.	15	45
Unit 6 Drawings of elements	**6.1 Elements of assembly**			
	1. Introduction:	Introduction to Elements of assembly.		
	2. Definition:	Temporary joints - Screw threads, Bolts, Nuts, Dowels, Washers, Springs Permanent joints		
	3. Principles:	Representation norms as per BIS to represent the elements being used for assembly.		
	4. Procedure:	Selection and representation of different elements in engineering drawing used in assembly.		
	6.2 Elements of joints			
	1. Introduction:	Introduction to rivet joints, welded joints and pipe joints.		
	2. Definition:	Temporary joints, Permanent joints - Rivet joints and types, Welded joints and types, Pipe joints and types.		
	3. Principles:	Principles of representation of different types of joints as per BIS norms.		
	4. Procedure:	Drawing and dimensioning of different joints.	4	14
Unit 7 Drawing of sub-assembly and assembly	**7.1 Assembly and detail drawings**			
	1. Introduction:	Introduction to assembly drawing and detail drawings.		
	2. Definition:	Detail Drawing, Title block, Bill of material block, Modification block.		
	3. Principles:	Relationship of assembly drawing, detail drawing and bill of material.		
	4. Procedure:	Procedures for drawing of assembly drawing and detail drawing and with bill of material etc. for the following simple jobs - Jig, Fixture, Press tool (Single operation), Injection mould (Single cavity)		
	7.2 Machine elements			
	1. Introduction:	Introduction to machine elements		
	2. Definition:	Gears and types, Bearings and types, Cotter joints and types, Shaft couplings and types, Keys and types, Circlips, Pins, O-rings		
	3. Principles:	Principles of representation of different machine elements stated as above as per BIS norms.		
	4. Procedure:	Procedures for representation of different machine elements and dimensioning.	7	20
		Review & Class Test	-	30
		Total No. of Hours	**60**	**210**

1.7 LIST OF REFERENCES FOR "ENGINEERING DRAWING"

AUTHOR	TITLE	PUBLISHER
Bhatt N. D.	Elementary Engineering Drawing	Charotar Book Stall, Anand
Bhatt N. D.	Geometrical & Machine Drawing	Charotar Book Stall, Anand
Gupta, Mahanjan & Sharma	A First Year Engineering Drawing	Satya Parkashan, New Delhi
Gupta, Mahanjan & Sharma	A Second Year Engineering Drawing	Satya Parkashan, New Delhi
AC Parkinson	Engineering Workshop Drawing	Pitman Publishers
PS Gill	Engineering Drawing	SK Kataria & Sons., New Delhi
RK Dhawan	Engineering Drawing	S Chand & Co., New Delhi
NS Kumar	Engineering Drawing	Tata Publication, New Delhi
D.N. Arora	Fundamentals of Engineering Drawing	India Publishing House, Delhi
Cecil Jensen, Jay Helsel	Engineering Drawing & Design	McGraw Hill Book Co.

1.8 WORKSHOP PRACTICE-I

Objectives

At the end of 1st year the trainees will be able to produce useful items by acquiring hand skill and selected machining skill in basic metal working and machine tool operations and by combining them with the knowledge of organization and safety regulations. The trainees also manufacture machine accessories and standard parts by integrating hand skill and machine tool operation skill.

Units	Detailed Contents	Time allotted	
		Weeks	Hours
Unit 1	1.1 **Introduction** Introduction to MSME TC Rohtak mandate, mission, organization and policies. Explain safety and environment, protection and guidelines. Identify and take charge of work place, tools, time table etc.		
	1.2 **Bench work** To make utility items such as parallel plates and bow for v block using the bench tools and covering the skills such as filing, sawing, punching, marking, center drilling, drilling, counter boring, counter sinking, reaming and taping. Shearing, realigning and curving.		
	1.3 **Basic fitting and assembly** Sharing and realigning.	6	270
Unit 2	2.1 **Turning** To make the exercise jobs and the parts of press tools such as bushes, pillars and utility items like central punch, studs, nuts to cover the skills like plane turning, facing, step turning, parting, recessing, undercutting, thread cutting, taper turning and eccentric turning.		
	2.2 **Milling** Making v block covering the following skills of face milling, step milling, profile milling, sawing on horizontal milling machines. Making step clamps to cover the skills of face milling, slot milling, step milling, groove milling and polygon milling on vertical milling machine.		
	2.3 **Surface grinding** Grinding of exercises and utility items such as parallel plates, v blocks and step clamps already made on bench and milling m/cs.	6	270
Unit 3	3.1 **Heat treatment & hardness testing** Heat treatment of items made on the bench, lathe and milling machine and hardness testing.		
	3.2 **Sheet metal working** Making of sheet metal tray which covers the skill of manual bending, machine bending and forming, joining by riveting, soldering & tack welding.		

Units	Detailed Contents	Time allotted	
		Weeks	Hours
	3.3 **Basic tool & cutter grinding** Grinding and test single point tools, twist drills and milling cutters.		
	3.4 **Fundamentals of dimensional metrology** Metric & inch system. Measuring with steel rule, vernier caliper, outside calipers, micrometer external internal and depth angular measurements using universal bevel protector. Measuring errors, remedies and prevention.		
	3.5 **Store management & material preparation** Central store system, receipt and issue of material, store records, filling of forms, store handing equipment. Min.-max. Level, re-order, preparation of material and tools for issuing, stock taking, inspect returning items for damage and correction.	4	180
Unit 4	4.1 **Make jigs & fixtures and parts of jigs & fixtures** Produce low/ batch production drilling/ milling jigs & fixtures to location accuracy of $\pm$ 0.1mm and fine finish using hand skill and conventional machine tools.		
	4.2 **Make non-guided press tools and parts of press tools** Produce single function press tools to cut and form ferrous and non-ferrous sheet metal components to an overall accuracy of $\pm$ 0.05/ 0.1mm using hand skill and conventional machine tools. Making the parts of press tools and the punch passing exercises to cover the basic skills of press tool making.		
	4.3 **Make small moulds and parts of mould** Produce single function hand mould to mould different materials to an overall accuracy of $\pm$0.05/ 0.1mm using hand skill and conventional machine tools.	9	405
	Total Nos.	**25**	**1125**

Note: Shoptalk @ 3 periods per week is included in the total number of hours.

2.1 APPLIED MECHANICS & STRENGTH OF MATERIALS

Objectives

This subject is from Engineering Science group which deals with laws and principles of mechanics along with their applications in general engineering and tool & die technology problems. The knowledge of engineering mechanics & strength of materials enables students to analyze problems encountered in core technology subjects like design, heat treatment, planning, workshop technology, workshop practice.

Units	Detailed Contents		L	P
1. Introduction	**1.1 Scalar and Vector Quantities**			
	1. Introduction:	Scalar and vector quantity and application.		
	2. Definition:	Concept of scalar quantity, vector quantity.		
	3. Principles:	Principles of system of units, scalar quantities, vector quantities.		
	4. Procedure:	Related problems on scalar and vector quantities.		
	1.2 System of Units			
	1. Introduction:	System of units, standard quantity and derived quantity.		
	2. Definition:	Units of C.G.S. system, systems of international (S.I.). Rules for writing abbreviations, standard quantity, derived quantity.		
	3. Principles:	Principle of abbreviation, symbols, units of quantities.		
	4. Procedure:	Related problems on units and standard quantities.	2	-
2. Coplanar concurrent forces	**2.1 Principle of Statics**			
	1. Introduction:	System of forces and its application.		
	2. Definition:	Concept of force, type of forces, resultant of force, composition of force, resolution of force. Concept of Bow's notation.		
	3. Principles:	Principle of force, type of forces, resultant of force, composition of force, resolution of force. Bow's notation.		
	4. Procedure:	Related problems of system of forces of finding resultant force.		
	2.2 Equilibrium of coplanar concurrent forces			
	1. Introduction:	Equilibrium of coplanar forces and its applications.		
	2. Definition:	Concept of condition of equilibrium, parallelogram law of forces, triangle law of forces, free body diagram. Lami's theorem. Resolution and resultant, graphical methods. Newton's third law.		
	3. Principles:	Principle of condition of equilibrium, parallelogram law of forces, triangle law of forces, free body diagram. Lami's theorem. Resolution and resultant, graphical methods. Newton's third law.		
	4. Procedure:	Related problems on equilibrium of coplanar concurrent forces.	10	-

3.Coplanar, parallel & non-concurrent forces	**3.1 Coplanar, parallel and non-concurrent force** 1. Introduction: Coplanar, parallel and non-concurrent force and application. 2. Definition: Concept of parallel forces, unlike parallel forces, non-concurrent forces, couple, resultant force, condition of equilibrium. Lami's theory.		

Units	Detailed Contents		L	P
	3. Principles:	Principle of parallel forces, unlike parallel forces, non-concurrent forces, couple, resultant force, condition of equilibrium. Lami's theory.		
	4. Procedure:	Related problems on parallel and unlike parallel forces, non-concurrent force.		
	3.2 Moments			
	1. Introduction:	Moments in engineering field and application.		
	2. Definition:	Concept of moment, types of moments, law of moments. Resultant force. Condition of equilibrium. Varignon's principle.		
	3. Principles:	Principles of moment, types of moments, law of moments. Resultant force. Condition of equilibrium. Varignon's' principle.		
	4. Procedure:	Related problem and application of moments.	10	-
4.Centre of gravity	**4.1 Centre of gravity**			
	1. Introduction:	Center of gravity and centroid for basic shapes and solids.		
	2. Definition:	Concept of center of gravity, centroid, symmetry consideration, theorem of moments, axes of symmetry.		
	3. Principles:	Principle of center of gravity, centroid, symmetry consideration, theorem of moments, axes of symmetry.		
	4. Procedure:	Related problems on center of gravity or centroid of basic shapes or solids.		
	4.2 State of equilibrium			
	1. Introduction:	State of equilibrium and application.		
	2. Definition:	Concept of stability, equilibrium, types of equilibrium, magnitude of force.		
	3. Principles:	Principle of stability, equilibrium, types of equilibrium, magnitude of force.		
	4. Procedure:	Related problems in equilibrium and stability.	6	-
5.Friction	**5.1 Friction**			
	1. Introduction:	Friction in engineering field.		
	2. Definition:	Concept of friction, limiting friction, co-efficient of friction, angle of friction, laws of friction.		
	3. Principles:	Principle of friction, limiting friction, co-efficient of friction, angle of friction, laws of friction.		
	4. Procedure:	Study problem, identify and categories problem, select laws of friction, describe solution.	6	-
6.Rectilinear motion	**6.1 Terms related to motion**			
	1. Introduction:	Motion, uniform velocity, variable velocity, acceleration.		
	2. Definition:	Concept of motion, speed, velocity, acceleration, distance traversed.		
	3. Principles:	Principle of motion, speed, velocity, acceleration, distance traversed.		
	4. Procedure:	Related problems on uniform velocity, acceleration and terms related to motion.		

Units	Detailed Contents	L	P
	6.2 Laws of motion 1. Introduction: Laws of motion and its application. 2. Definition: Concept of momentum, Newton's laws, force equation from second law of motion, piles, lift, bodies tied with string. 3. Principles: Principle of momentum, Newton's laws, force equation from second law of motion, piles, lift, bodies tied with string. 4. Procedure: Related problem on application of laws of motion.	6	-
7.Simple machine	**7.1 Mechanical advantage and velocity ratio** 1. Introduction: Mechanical advantage and velocity ratio in simple machine. 2. Definition: Concept of mechanical advantages and velocity ratio, work done by machine, simple pulleys, lever, wheel and axle, screw jack, crab winch (single & double). 3. Principles: Principle of mechanical advantages and velocity ratio, work done by machine, simple pulleys, lever, wheel and axle, screw jack, crab winch (single & double). 4. Procedure: Related problems on simple machine for finding out mechanical advantages and velocity ratio.	6	-
8.Stresses & strains	**8.1 Simple stress & strain** 1. Introduction: Simple stress and strain. 2. Definition: Concept of classification of load, stresses, strains, types of stress and strains. Hooke's Law, Young modulus of elasticity, nominal stress, yield point, plastic stage. 3. Principles: Principle of elasticity, stresses, strains, types of stress and strains. Hooke's Law, Young modulus of elasticity, nominal stress, yield point, plastic stage. 4. Procedure: Describe stresses and strains, deformation of body due to load, relationship of stress and strain. Related problems on stresses and strain.		
	8.2 Tensile & compressive stresses & strains 1. Introduction: Tensile & compressive stresses & strains. 2. Definition: Concept of ultimate strength and breaking stress, percentage elongation. Proof stress, working stress, factor of safety. Bars of varying cross section. 3. Principles: Principle of ultimate strength and breaking stress, percentage elongation. Proof stress, working stress, factor of safety. Principle of super position. 4. Procedure: Related problems on shear stress and strain, modulus of elasticity and rigidity.		
	8.3 Principle of shear stress and strain 1. Introduction: Principle of shear stress and strain. 2. Definition: Concept of shear stress, strain. Modulus of rigidity, Poisson's ratio. Relationship between modulus of elasticity and rigidity.		

Units	Detailed Contents		L	P
	3. Principles:	Principle of shear stress, strain. Modulus of rigidity, Poisson's ratio. Relationship between modulus of elasticity and rigidity.		
	4. Procedure:	Related problems on shear stress and strain, modulus of elasticity and rigidity.		
	8.4 Strain energy due to direct stresses			
	1. Introduction:	Strain energy due to direct stresses.		
	2. Definition:	Concept of strain energy. Resilience, proof resilience, modulus of resilience. Types of loading.		
	3. Principles:	Principle of strain energy. Resilience, proof resilience, modulus of resilience. Types of loading..		
	4. Procedure:	Related problems on strain energy under direct stresses due to gradual. Sudden and falling load.	12	-
9.Shear force and bending moment	**9.1 Shear force and bending moment diagram (beam)**			
	1. Introduction:	Shear force and bending moment.		
	2. Definition:	Concept of beam, form of loading, end supports-roller, hinged and fixed. Bending moment and shear force.		
	3. Principles:	Principle of beam, form of loading, end supports-roller, hinged and fixed. Bending moment and shear force.		
	4. Procedure:	Related problem on bending moment and shear force diagram for cantilever and simple supported beams subjected to concentrated and uniformly distributed load (UDL).	6	-
10. Simple bending	**10.1 Theory of simple bending (bending stresses)**			
	1. Introduction:	Theory of simple bending.		
	2. Definition:	Concept of simple bending, bending stresses, moment of resistance, bending equation, bending stress diagram.		
	3. Principles:	Principle of simple bending, bending stresses, moment of resistance, bending equation, bending stress diagram.		
	4. Procedure:	Related problems on maximum bending stress in beams of rectangular, circular, I and T sections.	4	-
11.Moment of inertia	**11.1 Moment of inertia**			
	1. Introduction:	Moment of inertia and its application.		
	2. Definition:	Concept of moment of inertia, second moment, radius of gyration, section modulus.		
	3. Principles:	Principle of moment of inertia, second moment, parallel axis theorem, perpendicular axis theorem, modulus of section.		
	4. Procedure:	Describe application of moment of inertia, second moment of area of common geometrical sections.	4	1
12.Column & strut	**12.1 Column & strut**			
	1. Introduction:	Column & strut.		
	2. Definition:	Concept and classification of column and strut, short and long column, effective length, slenderness ratio, buckling load, crushing load. Euler formula.		

Units	Detailed Contents		L	P
	3. Principles:	Principle of column and strut, short and long column, effective length, slenderness ratio, buckling load, crushing load. Euler formula.		
	4. Procedure:	Apply Euler theory of column, Rankin formula for solution of problems on column and strut.	4	-
13.Torsion	**13.1 Torsion**			
	1. Introduction:	Torsion, torsion equation and torsional rigidity.		
	2. Definition:	Concept of torque and torsion, torsion equation, torsional rigidity, angle of twist, hollow and solid shaft.		
	3. Principles:	Principle of torque and torsion, torsion equation, torsional rigidity, angle of twist, hollow and solid shaft.		
	4. Procedure:	Apply formula to solve problem on torsion and torsional rigidity.		
	13.2 Shaft (power transmission)			
	1. Introduction:	Power, torque and size of shaft.		
	2. Definition:	Concept of torque, power transmitted, angular displacement, shaft size, shear stress.		
	3. Principles:	Principle of torque, power transmitted, angular displacement, shaft size, shear stress.		
	4. Procedure:	Determine size of shaft, shear stress to solve related problems.	4	-
14.Spring	**14.1 Leaf Spring**			
	1. Introduction:	Leaf spring and calculation of stresses.		
	2. Definition:	Concept of leaf spring, deflection, stiffness, strain energy stored in leaf spring.		
	3. Principles:	Principle of leaf spring, deflection, stiffness, strain energy stored in leaf spring.		
	4. Procedure:	Describe stresses in leaf spring, length of spring. Apply formula for calculating deflection, strain energy stored in leaf spring.		
	14.2 Helical Spring			
	1. Introduction:	Helical spring and calculation of stresses.		
	2. Definition:	Concept of helical spring, types of helical spring, deflection, stiffness, strain energy and shear stress developed in helical spring.		
	3. Principles:	Principle of helical spring, types of helical spring, deflection, stiffness, strain energy and shear stress developed in helical spring.		
	4. Procedure:	Describe shear stress, deflection using appropriate formula. Describe stiffness and energy stored in helical spring.	4	-
		Review & Class Test	6	-
		Total No. of Hours	**90**	-

2.1 LIST OF REFERENCES FOR APPLIED MECHANICS & STRENGTH OF MATERIALS

AUTHOR	TITLE	PUBLISHER
R.S. Khurmi	A text book of Engineering method- (S.I.) units	S. Chand & Co. Ltd. Delhi
Ramamrutham & Narayan R.	A text book of Engineering mechanics - (S.I.) units	Dhanpat Rai & Son's Delhi
Junarkar	Applied Mechanics	--
R.S. Khurmi & J.K. Gupta	Engineering Mechanics & Strength of Material	S. Chand & Co. Ltd. Delhi
Harry Parker & James Ambrose	Simple Mechanics & Strength of Material	John Willey & Sons, Inc.
J. Hannah & M.J. Hillier	Applied Mechanics	CLBS with Layman ESSEX, England
Learning resources development Centre	Engineering Mechanics	Continuing Education Board, D.T.E. Gujarat
J.B. Prasad	A text book of Applied Mechanics	Khanna Publisher, Delhi
J.B. Prasad	Applied Mechanics & Strength of Material	Khanna Publisher, Delhi
Dr. S.K. Aggarwal & Dr. P.K. Gupta	Strength of Materials	Metropolitan Book Co., New Delhi

2.2 HEAT TREATMENT

Objectives

The subject is indented to know the facts, concepts, principles & procedures of Heat-treatment of ferrous metals, so that this knowledge can be applied in Heat-treatment of components of Tools & Dies effectively & efficiently. This knowledge and skills are also useful in selection of proper metals for different elements of Tools & Dies. The knowledge and skills is also useful in designing of Tools, Workshop Practice and Production Planning.

Units	Detailed Contents	L	P
1. Introduction	**1.1 Overview of heat treatment** 1. Introduction: Heat Treatment and its application. 2. Definition: Concept of heating & cooling of metals. 3. Principles: Principle of Heat Treatment. 4. Procedure: Study & identify elements of Heat Treatment.	1	-
2. Phase diagram with special references to iron & steel	**2.1 Iron-Carbon phase diagram** 1. Introduction: Iron-carbon phase diagram and its application. 2. Definition: Concept of Iron-carbon phase diagram. Classification of phases. Concept of allotropy of iron. 3. Principles: Principles of Iron – Carbon phase diagram. Transformation of phases. Allotropy of iron. 4. Procedure: Draw and explain Iron–Carbon phase diagram, phase constituents. Allotropy of iron. **2.2 Micro constituents of iron and carbon system** 1. Introduction: Understand Micro constituents of Iron & carbon system. 2. Definition: Concept of micro constituents of various phases. 3. Principles: Principle of micro constituents of various phases. 4. Procedure: Describe micro constituents of Iron & carbon system and phase structure. **2.3 Transformation of Hypo, Hyper & eutectoid steel** 1. Introduction: Hypo eutectoid, Hyper eutectoid and eutectoid steel. 2. Definition: Concept of Hypo eutectoid, Hyper eutectoid & eutectoid steel. 3. Principles: Principle of Hypo eutectoid, Hyper eutectoid & eutectoid steel. 4. Procedure: Describe constituents of Hypo eutectoid, Hyper eutectoid & eutectoid steel.	8	-
3. Isothermal transformation (T-T-T curve)	**3.1 Transformation of Austenite, Pearlite, Bainite, Martensite & cementite** 1. Introduction: Time-temperature-transformation (TTT) curve in Heat Treatment of Steel. 2. Definition: Concept of transformation at constant temperature into various phases. 3. Principles: Principles of transformation at isothermal temperature 4. Procedure: Describe transformation into various phases of steel with help of TTT curve.	4	-

4. Heat treatment process for steel	**4.1 Heat treatment process of steel** 1. Introduction: Different processes of Heat Treatment of Steel. 2. Definition: Concept of Annealing, Normalizing, Hardening, Tempering. 3. Principles: Principles of Annealing, Normalizing, Hardening, Tempering.		

Units	Detailed Contents		L	P
	4. Procedure:	Describe Annealing, Normalizing, Hardening, tempering for different types of steel.		
	4.2 Quenching & Quenching medium			
	1. Introduction:	Quenching medium and application.		
	2. Definition:	Concept of Quenching and classification of quenching medium.		
	3. Principles:	Principles of Quenching and types of quenching medium.		
	4. Procedure:	Describe quenching, selection of quenching medium.		
	4.3 Hardenability			
	1. Introduction:	Hardenability and its application.		
	2. Definition:	Concept of Hardenability, Jominy Test.		
	3. Principles:	Principle of Hardenability, Jominy Test.		
	4. Procedure:	Describe Hardenability, determination of Hardenability and Jominy Test.	6	-
5. Case hardening of steel	**5.1 Thermo chemical Treatment**			
	1. Introduction:	Thermo chemical treatment and its application.		
	2. Definition:	Concept of different processes of Thermo chemical Treatment such as Nitriding, Carbonitriding, Nitro carbonizing, carbonizing, cyaniding.		
	3. Principles:	Principle of Nitriding, Carbonitriding, Nitro carbonizing, Carbonizing, Cyaniding.		
	4. Procedure:	Describe various steps in Nitriding, Carbonitriding, Nitro corborising, Carbonizing, Cyaniding.		
	5.2 Surface hardening			
	1. Introduction:	Surface hardening and its application.		
	2. Definition:	Concept of flame hardening & induction hardening.		
	3. Principles:	Principles of Local Area hardening.		
	4. Procedure:	Various steps in process of flame hardening and induction hardening.	6	-
6. Heat treatment of Tool steel	**6.1 Types of Tool steel**			
	1. Introduction:	Tool steels in Tool & Die Making and its types.		
	2. Definition:	Concept and classification of tool steel, effect of alloying elements in tool steel. DIN and BIS standards.		
	3. Principles:	Principle and classification of tool steel. DIN and BIS standards.		
	4. Procedure:	Study chemical composition of different type of tool steel and effects f alloying elements. DIN and BIS standards.		
	6.2 Heat Treatment of Tool steel & alloy steel			
	1. Introduction:	Heat treatment process for tool steel.		
	2. Definition:	Concept of heat treatment for tool steel and alloy steel.		
	3. Principles:	Principle of heat treatment for tool steel & alloy steel.		
	4. Procedure:	Describe process of hardening tool steels and alloy steels.	4	-
7. Heat treatment of cast iron	**7.1 Classification of cast Iron**			
	1. Introduction:	Different types of cast Iron.		
	2. Definition:	Classification of cast Iron such as Grey cast Iron, White cast Iron, Malleable cast Iron, Spheroidal cast Iron.		

Units	Detailed Contents		L	P
	3. Principles:	Principles of Grey cast Iron, White cast Iron, Malleable cast Iron, Spheroidal cast Iron.		
	4. Procedure:	Study classification and application of cast iron.		
	7.2 Heat Treatment of cast Iron			
	1. Introduction:	Need of heat treatment for cast iron.		
	2. Definition:	Concept of heat treatment for malleable and spheroidal cast iron.		
	3. Principles:	Principle of heat treatment for cast iron, for malleable and spheroidal cast iron.		
	4. Procedure:	Describe various steps in heat treatment of various types of cast iron.	3	-
8. Furnaces & equipment	**8.1Type of furnaces**			
	1. Introduction:	Furnaces in heat treatment and their use.		
	2. Definition:	Concept of different type of furnaces such as Induction furnace, salt bath furnaces.		
	3. Principles:	Principles of working of furnaces, selection of furnaces.		
	4. Procedure:	Study constructional features & function of different furnaces in heat treatment.		
	8.2 Furnace Atmosphere			
	1. Introduction:	Furnace atmosphere and application.		
	2. Definition:	Concept of Neutral atmosphere, gaseous atmosphere.		
	3. Principles:	Principle of Neutral atmosphere, gaseous atmosphere.		
	4. Procedure:	Study neutral atmosphere, different gaseous atmosphere.	4	-
9. Defects, causes & prevention during heat treatment	**9.1 Defects, causes and their prevention.**			
	1. Introduction: Defects, causes and their prevention.			
	2. Definition:	Concept of defects such as decarburisation , quenching cracks , Excessive hardness , less hardness , soft spots. Concept of prevention and remedies.		
	3. Principles:	Principle of causes of defects, prevention and remedies.		
	4. Procedure:	Describe main cause of defects and remedial measures to control defects.		
	9.2 Disposal of consumables in Heat Treatment &Health hazards			
	1. Introduction:	Overview of consumables used in Heat Treatment process & its effects on health.		
	2. Definition:	Concept of disposal of consumables. Concept of health hazards and precautions.		
	3. Principles:	Principle of disposal of consumables. Principle of health hazards and precautions.		
	4. Procedure:	Describe methods for disposal of consumables. Health hazards and precautions.	4	-
		Review & Class Test	5	-
		Total No. of Hours	**45**	-

2.2 LIST OF REFERENCES FOR "HEAT TREATMENT"

AUTHOR	TITLE	PUBLISHER
G.B.S. Narang	Material Science	Khanna Publication Delhi – 6
B.K. Agrawal	Introduction to Engineering Material	Tata McGraw Hill Publishing Co. Ltd., New Delhi
G.K. Narula K.S. Narula V.K. Gupta	Material Science	Tata McGraw Hill Publishing Co. Ltd., New Delhi
O.P. Khanna	A test book of Materials & metallurgy	Dhanpat Rai Publications Pvt. Ltd. New Delhi

2.3 ENGINEERING METROLOGY

Objectives

This subject is intended to teach concepts, principles and procedure of Engineering Metrology to acquire skills in handling and maintaining the measuring instruments for effective use, maintaining standards of inspection and quality control. These skills are used in core technology subjects like work shop practice, manufacturing tools and dies, tool design practice, production planning and cost estimation.

Note: Related practical exercises will be conducted for Internal Assessment only.

Units	Detailed Contents		L	P
1. Introduction	**1.1 Scope and need of metrology**			
	1. Introduction:	Scope and need of metrology.		
	2. Definition:	Concept of metrology, units, sensitivity & repeatability, measurement, accuracy & precision.		
	3. Principles:	Principles of physical measurement and inspection, sensitivity & repeatability, accuracy & precision.		
	4. Procedure:	Study metrology as science, need and scope of inspection.	2	-
2. Basic measuring instruments	**2.1 Basic linear measurements**			
	1. Introduction:	Basic linear measurement instruments.		
	2. Definition:	Concept of least count. Concept of each measuring instrument (Steel rule, caliper, surface plate, angle plate, 'V' block, try square, straight edge, radius gauge, feeler gauge, vernier caliper, micrometer.) Classification of each type of measuring instrument. Concept of linear parameters, alignment, deflection and environmental parameters.		
	3. Principles:	Principle of least count, working of each type of measuring instruments.		
	4. Procedure:	Study various steps, select appropriate instruments, verify instrument, method of handling and maintaining instrument.		
	2.2 Basic angular measurements			
	1. Introduction:	Basic angular measuring instruments.		
	2. Definition:	Concept of least count, angular measuring instrument. (Bevel protector, combination set and screw pitch gauge), angular parameters, classification of each type of instrument.		
	3. Principles:	Principle of least count, working of each type of instrument.		
	4. Procedure:	Study measuring parameter and select appropriate instrument, handling and maintaining instrument.	8	4
3. Manufacturing Errors	**3.1 Source of errors**			
	1. Introduction:	Errors and their effect on quality.		
	2. Definition:	Concept of errors, classification of errors, comparison/ measurement, precision and accuracy.		
	3. Principles:	Principles of least count, parallax, alignment, environment.		
	4. Procedure:	Study source of errors, effect of errors on accuracy, precautions to be taken in measurement.		

Units	Detailed Contents		L	P
	3.2 Geometrical parameters and errors			
	1. Introduction:	Checking of geometrical parameters.		
	2. Definition:	Concept of each geometric parameter, measurement of each geometric parameter (straightness, flatness, parallelism, circularity, cylindericity, concentricity, co-axiality, ovality, lobbing, angularity), concept of profile, representation of symbols.		
	3. Principles:	Principle and measurement of each geometrical parameter.		
	4. Procedure:	Study various steps, method specification and their symbols, geometric parameters to be checked, checking above parameters.	6	4
4. Limits, fits & gauges	**4.1 Limits and Fits**			
	1. Introduction:	Limits and fits and application.		
	2. Definition:	Concept of interchangeability, tolerances and allowances, classification of tolerances, limits and fits, assembly/ selective assembly.		
	3. Principles:	Interchangeability, tolerances and allowances, limits and fits, BIS standards, selection of limits, fits and tolerances.		
	4. Procedure:	Study different kinds of limits, fits, tolerances and allowances, different classes and grades of tolerance, standards (BIS) of limits and fits.		
	4.2 Gauges			
	1. Introduction: Plain limit gauges and application.			
	2. Definition:	Concept of gauges, classification of gauges (plug gauge, snap gauge and ring gauge), material selection, design of gauge.		
	3. Principles:	Principle of Tayler's for designing of Plain limit gauges.		
	4. Procedure:	Select component to be checked, use appropriate gauge to check dimension, select type of gauge, calculate design parameters, derive gauge dimension with Tolerances.	8	4
5. Screw thread & gear metrology	**5.1 Screw thread terminology & testing**			
	1. Introduction:	Screw thread measurement.		
	2. Definition:	Concept of screw thread, thread parameters, errors of pitch, angle errors, Various thread types e.g. Metric & B.S.W., concept of measurement.		
	3. Principles:	Screw thread and their measurement.		
	4. Procedure:	Study screw thread metrology, identify and apply different methods for checking, procedure for measurement by thread micrometer, 2 & 3 wire method and comparison with profile projector.		
	5.2 Gear tooth terminology and testing			
	1. Introduction:	Spur gear profile testing.		
	2. Definition:	Concept of gear terminology, optical instruments, master profile, gear tooth vernier, gear parameters measurement.		
	3. Principles:	Principle of spur gear terminology, master profile, gear tooth vernier, measurement of gear parameters.	4	2

Units	Detailed Contents		L	P
	4. Procedure:	Study terminology of gears, checking parameters of spur gear, compare actual size with drawing or master template.		
6. Quality control and standardization	**6.1 Quality control and quality assurance**			
	1. Introduction:	Quality for effectiveness of organization.		
	2. Definition:	Concept of inspection, quality management (Quality control and quality assurance)		
	3. Principles:	Principle of quality and quality characteristics.		
	4. Procedure:	Study different terminology used in quality system, quality control methods and quality control programs.		
	6.2 Standardization			
	1. Introduction:	Standardization and its application.		
	2. Definition:	Concept of standardization, calibration.		
	3. Principles:	Principle of standardization, calibration.		
	4. Procedure:	Procedure for standardization, calibration.	5	-
7. Advance engg. Measurement	**7.1 Advance linear measuring instruments**			
	1. Introduction:	Dial gauge, slip gauge and bore gauge.		
	2. Definition:	Concept of dial gauge and classification, slip gauge and classification, bore gauge and classification, zero error.		
	3. Principles:	Principle of dial gauge, slip gauge, bore gauge, zero error.		
	4. Procedure:	Procedure for using above instruments for measurement.		
	7.2 Advance angular and profile measurement			
	1. Introduction:	Angular and taper measurements.		
	2. Definition:	Concept of angular measurement, taper measurement, sine bar, sine setting devices, angular gauge.		
	3. Principles:	Sine principle, working principle of sine bar, angle gauge and roller principle.		
	4. Procedure:	Procedure for sine bar and slip gauges and roller set-up for taper measurement.		
	7.3 Calibration of instruments			
	1. Introduction:	Calibration and its application.		
	2. Definition:	Concept of calibration, precision, references, national and international standards, maintainability of accuracy.		
	3. Principles:	Principle of calibration, accuracy, standards.		
	4. Procedure:	Step for calibration, environmental conditions required for calibration, related clause of ISO standards.	10	5
8. Surface finish	**8.1 Surface texture and related methods of measurement.**			
	1. Introduction:	Surface texture measurement.		
	2. Definition:	Concept of surface roughness and classification, electronic moduling, Roughness, waviness, measurement, stylus.		
	3. Principles:	Principle of electronic moduling, measurement, tracer type profilogram, surface irregularities.		
	4. Procedure:	Select sample, analyze methods to be used, surface finish, symbols used in surface roughness.	2	2

Units	Detailed Contents		L	P
9. Comparators	**9.1 Comparators**			
	1. Introduction: Comparators and its application.			
	2. Definition:	Concept of mechanical comparators, other types of comparators, cam & gear, rack & pinion, leverage, displacement, measuring contact, parallax.		
	3. Principles:	Working principle of mechanical comparators, sensitivity and amplification.		
	4. Procedure:	Procedure of using comparators.	2	2
10. Advance measuring equipments	**10.1 Introduction to tool makers microscope, profile projector, linear height master and 3D- quardinate measuring machine.**			
	1. Introduction:	Tool maker's microscope, profile projector, linear height master, 3D- quardinate measuring machine.		
	2. Definition:	Concept of tool maker's microscope, profile projector, linear height master, C.M.M, main parts of above measuring equipment.		
	3. Principles:	Working principles of tool maker's microscope, profile projector, linear height master, C.M.M. amplification and magnification.		
	4. Procedure:	Procedure for using tool maker's microscope, profile projector, linear height master & 3D-C.M.M.	8	7
		Review & Class Test	5	-
		Total No. of Hours	**60**	**30**

2.3 LIST OF REFERENCES FOR "ENGG. METROLOGY"

AUTHOR	TITLE	PUBLISHER
R. K. Jain	Engineering Metrology	Khanna Publishers
Welliam Winchel	Inspection & Measurement in Manufacturing	--
ASM International	ASM Hand Book Vol. 17	ASM International
S. N. Mahajan S. C. Shilwant N. M. Ambedkar	Metrology & Quality control	Nirali Prakashan Budwar Peth Pune.
Surender K. B. G. Rao Madhukar Puri	Engineering Measurement	Satya Prakashan New Delhi
M. Mahajan	Statistical Quality Control	--

2.4 COMPUTER AIDED DRAWING
(PRACTICE-ORIENTED EXERCISES)

Objectives

This practice-oriented subject describes the facts, concepts, principles and procedures of computer aided drafting and design used in tool design practice, manufacturing and quality control to express the ideas, convey instructions through drafting and design for carrying out jobs in tool and die technology. It is also useful in understanding technology subjects such as tool design practice, workshop practice, CNC technology. It also describes the concepts, principles and procedure of developing models and designs using CAD softwares.

Note: 1. The related theory will be imparted to students in practical class. Only practical and viva-vice will be conducted for practical examination.

2. Rel.-14 for AutoCAD will be used as reference.

Units	Detailed Contents		L	P
1. Introduction	**1.1 Review of computer fundamentals (lab talk)**			
	1. Introduction:	Review of computer fundamentals and functions in CAD section.		
	2. Definition:	Review of computer fundamentals, instructions with respect to computer lab, file handling in WindowsNT.		
	3. Principles:	Principles of computer fundamentals related to hardware and software, handling computers and peripherals, handling hardware and software in the lab.		
	4. Procedure:	Computer fundamentals, observe starting WindowsNT, practice mouse, key board navigation and house keeping.		
	1.2 Application of CAD in drawing and design of tools and dies			
	1. Introduction:	Understand use of computer and CAD software in area of design and drawing.		
	2. Definition:	Concept of convention design process, computer operation and control, CAD software in tool room.		
	3. Principles:	Conventional design process, CAD setup in tool room.		
	4. Procedure:	Observe CAD setup in tool room, practice of handling of software available in CAD lab.	2	4
2. Introduction to AutoCAD equipment	**2.1 Quick tour**			
	1. Introduction:	Quick tour and application.		
	2. Definition:	Concept of AutoCAD Rel.14, quick tour, tool bars in AutoCAD		
	3. Principles:	Operation of AutoCAD Rel.14, quick tour.		
	4. Procedure:	Open help in AutoCAD, open quick tour, run quick tour.		
	2.2 Tutorials 1 to 10			
	1. Introduction:	Tutorials 1 to 10 and application.		
	2. Definition:	Concept of AutoCAD Release-14, tutorials 1 to 10, tool bars, different command in AutoCAD, creating objects in AutoCAD		
	3. Principles:	Operation of AutoCAD R-14., tutorials 1 to 10.		
	4. Procedure:	Open help in Auto CAD Rel.14, open lesson 1 to10, start from lesson 1, also load lesson 1 from template, play demo for lesson 1, draw object by following instructions, complete lessons 2 to 10 also in same way.		

Units	Detailed Contents	L	P
	2.3 Introduction to learning assistance (lab talk) 1. Introduction: Understand learning assistance. 2. Definition: Concepts of AutoCAD 14 under windows, tutorials in learning assistance, creating and editing objects, dimensioning and using text, plotting in AutoCAD. 3. Principles: Operation of AutoCAD 14, learning assistance. 4. Procedure: Open help in AutoCAD and learning assistance, load CD for learning assistance and run concepts, after viewing concepts run the tutorials in learning assistance, observe demonstration of tutorial and try exercises one by one.		
	2.4 Co-ordinate systems 1. Introduction: Understand co-ordinate systems in AutoCAD Rel.14. 2. Definition: Using co-ordinate system to specify points, using direct distance entry, shifting and rotating the coordinate system, drawing objects in different co-ordinate systems. 3. Principles: Principles of using co-ordinate systems, using direct distance entry, shifting and rotating the co-ordinate system. 4. Procedure: Demonstration by using a co-ordinate system to specify point using direct distance entry, shifting ad rotating the co-ordinate system.	2	40
3. Creation/ editing of lines	**3.1 Types of lines** 1. Introduction: Understand and use line commands for line types of geometric construction. 2. Definition: Different line commands/ buttons, lines used in AutoCAD, line command, P Line, M Line, X Line, Ray, Hidden, Centre line, dash dot, zig zag line etc. 3. Principles: Co-ordinates commands line types, drawing geometric construction using AutoCAD. 4. Procedure: Purpose of drawing and area required for drawing as per software, scale, units and select object drawing as per software, drawing on AutoCAD screen by using different line command.		
	3.2 Modifying lines 1. Introduction: Understand and use editing command as required for construction. 2. Definition: Types of different editing commands. 1. Scale, erase, copy, stretch, lengthen, and explode. 3. Principles: Principle of editing, geometric construction using AutoCAD. 4. Procedure: Purposes of lines, line type, edit line command and location on the screen.		

Units	Detailed Contents	L	P
	3.3 Drawing with precision 1. Introduction: Understand and draw with precision. 2. Definition: Types of object snap setting options (Ortho mode, snap, grid, geometric snap mode), application of auto snap, O snap & grid properties. 3. Principles: Principle of drawing with precision, object snap settings, ortho ode, snap, grid and auto snap. 4. Procedure: Drawing with snap and grid, auto snap, grid and ortho mode.	2	10
4. Creation/ editing of curves	**4.1 Types of curves** 1. Introduction: Drawing curved objects. 2. Definition: Drawing curved objects, creating point objects, changing drawing order of objects, creating solid filled areas and regions. 3. Principles: Principle of drawing curved objects, create point objects, changing drawing order of objects, creating solid filled areas and regions. 4. Procedure: Study and observe drawing curved objects, draw different types of curved objects; create point objects; create solid filled areas and regions.		
	4.2 Modifying of curves 1. Introduction: Modifying of curved objects. 2. Definition: Editing methods of different types of curved objects. 3. Principles: Editing methods of different types of curved objects. 4. Procedure: Study and observed editing methods of curved objects.		
	4.3 Precision construction of curved objects. 1. Introduction: Precision construction of curved objects. 2. Definition: Concept of precision construction of curved objects. Different types of curved objects with precision. 3. Principles: Principle of precision construction of curved objects. 4. Procedure: Draw different types of curved objects with precision.	2	10
5. Creation/ editing of subjects	**5.1 Orthographic view of objects** 1. Introduction: Understand orthographic projection using AutoCAD 2. Definition: Definition of orthographic views of objects: Front, top, left side, right side. 3. Principles: Principle of orthographic views, lines, osnap, grid, drawing and drafting. 4. Procedure: Draw orthographic view of an object using commands.		
	5.2 Scale, dimension, text 1. Introduction: Understand command to make drawing in CAD for scales. 2. Definition: Concept of drawing to scale, dimensioning and text, tolerancing, modifying dimension and tolerancing. 3. Principles: Principles of scales, dimensioning and tolerancing, placing text in drawing area. 4. Procedure: Draw component to scale, dimension it by AutoCAD command, place tolerance parameter into drawing.		

Units	Detailed Contents		L	P
	5.3 Sectioning and hatching			
	1. Introduction:	Understand commands for sectioning and hatching.		
	2. Definition:	Definition of sectional views: types of sections, section planes, assembly sectioning, and hatching.		
	3. Principles:	Principle of sectioning and hatching.		
	4. Procedure:	Drawing to section and hatch, sectioning plane, hatch pattern/ style, hatching sectioned drawing.	2	10
		Review & Class Test	-	6
		Total No. of Hours	**10**	**80**

2.5 WORKSHOP TECHNOLOGY – II

Objectives

Understand the facts, concepts, principles and procedures of using machine tools and related techniques efficiently effectively to plan manufacturing of Tool & Die Parts to specification considering safety and environment. It is also useful in understanding technology and apply in areas such as Workshop Practice, Tool Design, Production Planning, Estimation and Industrial Management. It also describes concept, principle and procedures to identify and report maintenance requirement for corrective action.

Units	Detailed Contents		L	P
Unit 1	**1.1 Grinding Operations and Grinding Machines – Level I (surface Grinder)**			
	1. Introduction:	Grinding operations and grinding machines.		
	2. Definition:	Concept of main parts and functions of surface grinding machines. Work holding attachments: Vices, sine table, Angle plate, V-block. Cutting tools: Grinding wheel nomenclature, Common grinding wheels (abrasive), Dressers for grinding wheels. Cutting Parameters: Speed, Feed, Depth of cut.		
	3. Principles:	Operational principles of machines and parts, calculation of machine parameters and grinding wheel selection, Safety and maintenance of machine.		
	4. Procedure:	Description & selection of grinding machine, work holding devices and grinding wheel, various steps performed in surface grinding operations.		
	1.2 Grinding Operation and Grinding Machine – Level II (Cylindrical Grinder-External & Internal)			
	1. Introduction:	Grinding operations and machines.		
	2. Definition:	Concept of main parts and function of Cylindrical Grinding-internal & external. Work holding devices: Collets, Chucks and centers Cutting tools: Mounted points, Profiled wheels, Dressing attachments for generation of profiles. Cutting tool holders: Standard mounting as per machine. Cutting parameters: machining time calculation, coolant selection and use.		
	3. Principles:	Functional parts of grinding machines and working principles, Principles of grinding wheel selection and dressing tool, Working principles of attachments and accessories.		
	4. Procedure:	Description & selection of grinding machine and operations, work holding devices and grinding wheels, various steps performed in cylindrical grinding operations.		
	1.3 Grinding Operation and Grinding Machine – Level III (Tool & Cutter Grinder)			
	1. Introduction:	Grinding operations and grinding machines		

Units	Detailed Contents		L	P
	2. Definition:	Concept of main parts and functions of Tool cutter Grinder Work holding devices: Chucks and universal vice. Cutting Tools: Grinding Wheels, Dressers Cutting parameters: Machine time calculation, Tool and cutter grinder, wheel selection and dressing.		
	3. Principles:	Operational principles, cutting and material removal.		
	4. Procedure:	Describe various steps performed in tool & cutter grinding operations.		
	1.4 Special purpose grinding m/c. & operations (Gear grinding, valve grinding, slot grinding)			
	1. Introduction:	Special purpose grinding machines and operations.		
	2. Definition:	Concept of main parts and functions of gear grinding, valve grinding, slot grinding machines. Work holding attachments		
	3. Principles:	Operational principles, cutting and material removal, wheel selection.		
	4. Procedure:	Various steps performed in gear grinding, valve grinding, slot grinding operations.		
	1.5 Gear and Gear Cutting Techniques			
	1. Introduction:	Gear cutting techniques.		
	2. Definition:	Concept of major gear manufacturing techniques: Spur gear, Rack and pinion, Helical, Bevel		
	3. Principles:	Principle of cutters and setting up machine and accessories.		
	4. Procedure:	Identify operational sequence, cutting tools and accessories by applying standard practice and norms with respect to safety and maintenance.	25	-
Unit 2	**2.1 Jig Boring Operation and Jig Boring Machine**			
	1. Introduction:	Jig Boring Operation and machine.		
	2. Definition:	Concept of main parts and functions of Machine (e.g. Hauser), Work holding attachments, Cutting tools, Cutting tool holders, Operations		
	3. Principles:	Operational principles of machine and parts, Setting up machine for operation.		
	4. Procedure:	Describe various steps performed in jig boring operations.		
	2.2 Jig Grinding and Jig Grinder			
	1. Introduction:	Jig Grinding and Jig Grinder machine.		
	2. Definition:	Concept of main parts and functions of Machine (e.g. Hauser), Work holding attachments, Cutting tools, Cutting tool holders, Operations		
	3. Principles:	Operational principles of machine and parts, Setting up machine for grinding operations.		
	4. Procedure:	Describe various steps performed in jig grinding operations.		
	2.3 Profile Grinding and Profile Grinder			
	1. Introduction:	Profile Grinding and Profile Grinder.		
	2. Definition:	Concept of main parts and functions of: Machine (e.g. Hauser), Work holding attachments, Cutting tools, Cutting tool holders, Operations		

Units	Detailed Contents		L	P
	3. Principles:	Operational principles of machine and parts, Setting up machine for grinding operations.		
	4. Procedure:	Describe various steps performed in profile grinding operations.		
	2.4 Pantograph			
	1. Introduction:	Pantograph machine and operations.		
	2. Definition:	Concept of main parts and functions of Machine (e.g. Hauser), Work holding attachments, Cutting tools, Cutting tool holders, Operations		
	3. Principles:	Operational principles of machine and parts, Setting up machine for machining operation.		
	4. Procedure:	Describe various steps performed in pantograph, profile machining operations.		
	2.5 Copy Milling and Copy Milling Machine			
	1. Introduction:	Copy Milling and Copy Milling machine.		
	2. Definition:	Concept of main parts and functions of Machine (e.g. Hauser), Work holding attachments, Cutting tools, Cutting tool holders, Operations		
	3. Principles:	Operational principles of machine and parts, Setting up machine for machining operation.		
	4. Procedure:	Describe steps performed in copy milling and milling machine operations.		
	2.6 Single Lip Grinder			
	1. Introduction:	Single Lip Grinder operations and machine.		
	2. Definition:	Concept of main parts and functions of machine, work holding attachments, operations.		
	3. Principles:	Operational principles of machine and parts, setting up machine for lip grinding operation.		
	4. Procedure:	Describe various steps performed in Single Lip Grinder operations.		
	2.7 EDM process and Machine			
	1. Introduction:	EDM (Spark erosion), EDM Wirecut processes and Machines.		
	2. Definition:	Concept of main parts and functions of EDM spark erosion, EDM wire cut. Work holding attachments, special holding devices for wire cut. Cutting Tools, materials used for electrodes, wire. Die-electric medium Cutting Tool Holders Cutting Parameters: Spark gap, Surfaces finishes. Operations: EDM spark erosion, Wirecut operations.		
	3. Principles:	Principles of EDM process, Operational principles of machines and parts.		
	4. Procedure:	Describe various steps performed in EDM spark erosion and EDM Wirecut operations.	28	-

Units	Detailed Contents	L	P
Unit 3	**3.1 Electro Chemical Machining** 1. Introduction: Electro chemical machining and application. 2. Definition: Concept of main parts and functions of Electro Chemical Machining 3. Principles: Working principle of process. 4. Procedure: Describe various steps performed in Electro Chemical Machining		
	3.2 Ultrasonic Machining 1. Introduction: Ultrasonic machining and application. 2. Definition: Concept of main parts and functions of ultrasonic machining. 3. Principles: Working principle of process. 4. Procedure: Describe various steps performed in Ultrasonic Machining operations.		
	3.3 Abrasive Jet Machining 1. Introduction: Abrasive Jet Machining and application. 2. Definition: Concept of main parts and functions of Abrasive Jet Machining. 3. Principles: Working principle of process. 4. Procedure: Describe various steps performed in Abrasive Jet Machining.		
	3.4 Electronic Beam Machining 1. Introduction: Electronic Beam Machining and application. 2. Definition: Concept of main parts and functions of Electronic Beam Machining 3. Principles: Working principle of process. 4. Procedure: Describe various steps performed in Electronic Beam Machining operations.		
	3.5 Chemical Machining 1. Introduction: Chemical Machining and application. 2. Definition: Concept of main parts and functions of Chemical Machining 3. Principles: Working principle of process. 4. Procedure: Describe various steps performed in Chemical Machining operations.		
	3.6 Electro Chemical Grinding 1. Introduction: Electro chemical grinding and application. 2. Definition: Concept of main parts and functions of Electro Chemical Grinding 3. Principles: Working principle of process. 4. Procedure: Describe various steps performed in Electro Chemical Grinding operations.		
	3.7 Ion Beam Machining 1. Introduction: Ion Beam machining and application. 2. Definition: Concept of main parts and functions of Ion Beam Machining 3. Principles: Working principle of process. 4. Procedure: Describe various steps performed in Ion Beam Machining operations.		

Units	Detailed Contents	L	P
	3.8 Laser Beam Machining 1. Introduction: Laser Beam machining and application. 2. Definition: Concept of main parts and functions of Laser Beam Machining 3. Principles: Working principle of process. 4. Procedure: Describe various steps performed in Laser Beam Machining operations. **3.9 Plasma arc machining** 1. Introduction: Plasma arc machining and application. 2. Definition: Concept of main parts and functions of Plasma arc machining 3. Principles: Working principle of process. 4. Procedure: Describe various steps performed in Plasma arc machining operations. **3.10 Rapid Prototyping** 1. Introduction: Rapid Prototyping and application. 2. Definition: Concept of main parts and functions of Rapid Prototyping 3. Principles: Working principle of process. 4. Procedure: Describe various steps performed in Rapid Prototyping operations.	20	-
Unit 4	**4.1 Polishing, Lapping, Honing** 1. Introduction: Polishing, lapping, honing methods. 2. Definition: Concept and function of polishing, lapping, honing materials and polishing, lapping, honing machines. 3. Principles: Principles of polishing, lapping, honing technique. 4. Procedure: Selection of polishing, lapping, honing materials and polishing, lapping, honing technique for various jobs.	2	-
Unit	**5.1 Electroplating** 1. Introduction: Electro plating technique. 2. Definition: Concept of main functions, features of electro plating process, material used for process. 3. Principles: Working principles of process. 4. Procedure: Describe Various steps performed in electroplating process. **5.2 Hard Chrome Plating** 1. Introduction: Hard Chrome Plating Technique. 2. Definition: Concept of main functions, features of hard chrome plating process, material used for process. 3. Principles: Working principles of process. 4. Procedure: Describe various steps performed in hard chrome plating. **5.3 Blackening** 1. Introduction: Blackening Technique. 2. Definition: Concept of main functions, features of blackening process, material used for process. 3. Principles: Working principles of process. 4. Procedure: Describe various steps performed in blackening.		

Units	Detailed Contents		L	P
	5.4 Shot Blasting			
	1. Introduction:	Shot Blasting Technique.		
	2. Definition:	Concept of main functions, features of shot blasting process, material used for process.		
	3. Principles:	Working principle of process.		
	4. Procedure:	Describe various steps performed in shot blasting process.		
	5.5 Galvanizing			
	1. Introduction:	Galvanizing Technique.		
	2. Definition:	Concept of main functions, features of galvanizing process, material used for process.		
	3. Principles:	Working principle of process.		
	4. Procedure:	Describe various steps performed in galvanizing process.	10	-
		Review & Class Test	5	-
		Total No. of Hours	**90**	**-**

2.5 LIST OF REFERENCE S FOR "WORKSHOP TECHNOLOGY"

AUTHOR	TITLE	PUBLISHER
Chapman A. J.	Workshop Technology (Vol I, II & III)	New Delhi : Amol Publication
Hazra S.K. & Choudhary S.K.	Elements of Workshop Technology	Metropolitan Publishers, Bombay
Raghuwanshi B.S. & Others	Workshop Technology	New Heights, New Delhi
Gupta K.N. & Kaushish J.P.	Workshop Technology (Vol.I to II)	New Heights, New Delhi
Atherton W.H.	Workshop Practice Vol I to V	New Era Publishers, London
Gerling	All About Machine Tools	WILEY Eastern Ltd.
B. Kishore	Tool & Die Maker	Saurabh & Co., Delhi
Hermann & Jutz Eduard Scharkus	Westermann Tables	WILEY Eastern Ltd.
A.B. Gupta	Practical handbook for mechanical engineers	Galgotia Publications, New Delhi

2.6 TOOL DESIGN THEORY – I
(PRESS TOOLS, JIGS & FIXTURES)

Objectives

Understand the facts, concepts, principles and procedures of Tool Design techniques so that this knowledge can be used in Tool Design Practice effectively and efficiently. It is also useful in understanding technology subjects and apply them in the areas such as Workshop Practice, CAD/CAM, Production Planning, Estimation, Industrial Management and Quality Assurance.

Units	Detailed Contents	L	P
1. Introduction	**1.1 Overview of mass production of sheet material components** 1. Introduction: Overview of mass production of sheet material components 2. Definition: Concept of sheet material, sheet material components and application, press tools, presses 3. Principles: Principle of press tools for mass production of sheet material components. 4. Procedure: Study use of sheet material components, use of press tools, presses	4	-
2. Press tool operations	**2.1 Press Tools - Cutting operations** 1. Introduction: Press tool cutting operations. 2. Definition: Press tools and classification, shearing operation, classification of shearing operations, strip layout. 3. Principles: Principle of sharing, die and punch clearance, relation between pierced part/ slug and shearing operation, strip layout. 4. Procedure: Study component. Strip layout/ press tool. Various steps performed in operation.		
	2.2 Press Tools - Non Cutting Operations 1. Introduction: Press tool non-cutting operations. 2. Definition: Plastic deformation and forming, classification of forming operations, spring back, strip layout. 3. Principles: Principle of plastic deformation and forming, clearance, spring back, strip layout. 4. Procedure: Study component/ strip layout/ press tools. Apply various steps performed in operations.		
	2.3 Press Tools - Integrated Operations 1. Introduction: Press tool integrated operations. 2. Definition: Concepts of integrated operations, classification of integrated operations, strip layout. 3. Principles: Principle of integrated operations, strip layout. 4. Procedure: Study component/ strip layout/ press tools, apply various steps performed in operations.	10	-
3. Basic elements of press tools	**3.1 Typical Press Tool & Parts** 1. Introduction: Elements and parts in a typical press tool. 2. Definition: Typical press tools and their parts in cutting operations, non-cutting operation, integrated operation. Concept of material used for different elements.		

Units	Detailed Contents		L	P
	3. Principles:	Principle of alignment and guidance, clearance, stripping and ejection, mounting.		
	4. Procedure:	Study function of press tool, feature and function of each element, material used for each element.	6	-
4. Classification of press tools	**4.1 Cutting Dies**			
	1. Introduction:	Cutting dies and application.		
	2. Definition:	Concept of classification of cutting dies such as Blanking dies, piercing dies, inverted and compound dies operations such as notching, trimming, shaving.		
	3. Principles:	Construction of cutting dies, blank-through, inverted dies, chop off, parting, clearance, selection of die.		
	4. Procedure:	Study construction features and functions of different cutting dies. Various steps performed in cutting dies operations.		
	4.2 Non Cutting Dies			
	1. Introduction:	Non-cutting dies and application.		
	2. Definition:	Concept of classification of non-cutting dies such as bending dies, drawing dies, forming dies, concept of spring back.		
	3. Principles:	Construction of non-cutting dies, bending, drawing and forming, spring back, die cushion, selection of die.		
	4. Procedure:	Study construction features and functions of different non-cutting dies. Various steps performed in non-cutting dies.		
	4.3 Integrated Dies			
	1. Introduction:	Integrate dies and application.		
	2. Definition:	Concept of classification of integrated dies a) Progressive dies b) Combination dies Concept of multi station die.		
	3. Principles:	Principle of construction of integrated dies, blank though, chop off, parting, multi station, selection of operations.		
	4. Procedure:	Study constructional features and functions of different integrated dies, analyze component requirement, select appropriate operations.	10	-
5. Design Parameter	**5.1 Design parameters for shearing**			
	1. Introduction:	Understand design parameters in tool design.		
	2. Definition:	Concept of shearing concept of force, stripping force, cutting clearance, angular clearance, land. Concept of applying cutting clearance. Concept of die life, shear angle.		
	3. Principles:	Principle of shearing, design parameters such as cutting clearance, angular clearance, land with respect to quantity and quality requirements. Principle of sharing and stripping forces, geometrical relationship between component, punch and die, effect of shear angle.		
	4. Procedure:	Identify design parameters with respect to sheet material, press and operation, derive design parameters by using data sheets, tables, formulae, select optimum design parameters.		

Units	Detailed Contents		L	P
	5.2 Design parameters for Strip Layout			
	1. Introduction:	Understand design parameters for strip layouts.		
	2. Definition:	Concept of strip layout, classification of strip layouts, piloting and stopping, strip guiding, economy factor, material condition.		
	3. Principles:	Principle of grain direction, material utilization, work piece and stock strip, stopper and burr side consideration, feeding mechanism, guiding and locating.		
	4. Procedure:	Select design parameters for strip layout, draw alternative layouts and calculate economy factor, select layout for optimum material utilization and tool design.		
	5.3 Design Parameters for elements of Press Tools for cutting operations			
	1. Introduction:	Understand design Parameters for elements of Press Tools for cutting operations		
	2. Definition:	Concept of construction of press tool, classification of die sect, shut height, center of pressure, classification of elements of press tools such as functional elements, guiding and locating elements, supporting and clamping elements, ejecting elements, material selection.		
	3. Principles:	Principle of shearing operation, selection of die set, shut height, center of pressure, geometric and dimensional tolerances, material properties.		
	4. Procedure:	Identify design parameters with respect to sheet material, press and operation, design parameters by using data sheets, tables, formulae, geometrical and dimensional tolerances, material for each element.		
	5.4 Design Parameters for Bending			
	1. Introduction:	Understand design parameters for bending operation.		
	2. Definition:	Bending and its classification, stripping force, blank development, spring back, grain direction, concept of applying clearances.		
	3. Principles:	Principle of plastic deformation, bending and stripping forces, blank development, spring back and grain direction.		
	4. Procedure:	Identify design parameters with respect to sheet material, press and operations, design parameters by using data sheets, tables, formulae.		
	5.5 Design Parameters for elements of Press Tools for bending operations			
	1. Introduction:	Understand design Parameters for elements of Press Tools for bending operations		
	2. Definition:	Concept of construction of press tool, classification of die sets, shut height, center of pressure, classification of elements such as: functional elements, guiding and locating elements, supporting & clamping elements, ejecting elements, concept of material selection.		

Units	Detailed Contents		L	P
	3. Principles:	Principle of bending operation, construction of press tool, selection of die set, shut height, center of pressure, geometric and dimensional tolerances.		
	4. Procedure:	Identify design parameters with respect to sheet material, press and operations, design parameters by using data sheets, tables, formulae, geometrical and dimensional tolerances, material for each element.		
	5.6 Design Parameters for Drawing			
	1. Introduction:	Understand design parameters for drawing.		
	2. Definition:	Concept of drawability, drawing and its classification such as drawing force, blank holding force, stripping force, blank development, spring back, die cushion, wrinkles, puckers and trimming.		
	3. Principles:	Principle of drawability, drawing force, blank holding force, stripping force, blank development, spring back, venting and lubricating, punch and die.		
	4. Procedure:	Identify design parameters with respect to sheet material, press and operations, design parameters by using data sheets, tables, formulae, select optimum design parameters.		
	5.7 Design Parameters for elements of Press Tools for drawing operations			
	1. Introduction:	Understand design parameters for elements of Press Tools for drawing operations		
	2. Definition:	Concept of construction of press tool, classification of die sets, shut height, center of pressure. Classification of elements such as functional elements, guiding and locating elements, supporting and clamping elements, ejecting elements, material section.		
	3. Principles:	Principle of drawing operation, selection of die set, shut height, center of pressure, geometric and dimensional tolerances, material processes.		
	4. Procedure:	Identify design parameters with respect to sheet material, press and operations, derive design parameters by using data sheets, tables, formulae, geometrical and dimensional tolerances, material for each element.		

Units	Detailed Contents		L	P
	5.8 Design Parameters for elements of Press Tools for Integrated Operations			
	1. Introduction:	Understand Design Parameters for elements of Press Tools for Integrated Operations		
	2. Definition:	Classification of press tool for integrated operations a) Progressive Dies b) Combination dies, Concept of construction of press tool, classification of die sets, shut height, center of pressure, classification of elements of press tools such as: functional elements, guiding and locating elements, supporting and clamping elements, ejecting elements, concept of material selection.		
	3. Principles:	Principle of shearing, bending and drawing operations, forming operations, strip layout, selection of die set, shut height, center of pressure, geometric and dimensional tolerances.		
	4. Procedure:	Identify design parameters with respect to sheet material, design parameters by using data sheets, tables, formulae etc, geometrical and dimensional tolerances, material for each element.		
	5.9 Introduction to elements of fine blanking operation			
	1. Introduction:	Fine blanking operation with respect to sheet material and press.		
	2. Definition:	Concept of shearing, concept of construction of elements such as functional elements, guiding and locating elements, supporting and clamping elements, ejecting elements, material selection and lubrication, main features of press for fine blanking operation.		
	3. Principles:	Geometrical and dimensional tolerances, blanking and shearing, construction of tool.		
	4. Procedure:	Study and analyze the component for geometrical and dimensional tolerances, study, observe and identify need and function of the press tool for blanking operation, study and observe the constructional feature, design feature and design parameters of the elements of the press tool with respect to sheet material, press and operation.	40	-
6. Classifi-cation of Presses	**6.1 Classification of Presses**			
	1. Introduction:	Understand presses for press tool operation.		
	2. Definition:	Classification of presses, constructional feature of press for press tools, concept of shut height, die cushion, specification of presses.		
	3. Principles:	Working principle of presses, principle of construction of press, selection of shut height, selection of press.		
	4. Procedure:	Study and analyze the component and press tool operations, select type of press, calculate press tonnage requirement, various steps performed in press working operations.	6	-

Units	Detailed Contents	L	P
7. Material Handling	**7.1 Material feeding and scrap handling** 1. Introduction: Material feeding and scrap handling equipment in press operation. 2. Definition: Classification of material handling equipment and scrap handling equipment, constructional feature of the feeding and scrap handling equipment, safety. 3. Principles: Principle of material feeding equipment, selection of material feeding and scrap handling equipment, principle of gravity, mechanical and slide feeding, material feeding and slide feeding, material feeding and scrap handling equipment, safety to operator, equipment, tools. 4. Procedure: Study blank, slug and strip layout, availability of stock material, press, press tool and feeding mechanism, feeding and scrap handling mechanism.	4	-
8. Estimation	**8.1 Material, machine time and process estimation** 1. Introduction: Estimation methods in tool design and application. 2. Definition: Concept of estimation such as: sheet material, tool material, machine hours, process. 3. Principles: Principle of weight, volume, estimation of machine hours through process planning, material utilization. 4. Procedure: Study component drawing and prepare process sheet, prepare bill of material and estimate material, study detail drawings and calculate machine utilization per unit hour.	6	-
9. Die Maintenance Safety & Storage	**9.1 Die maintenance, safety and storage** 1. Introduction: To understand the standard procedures for maintenance, safety, storage of press tool and machine. 2. Definition: Concept of safety, maintenance, storage. 3. Principles: Principle of safety, maintenance, storage. 4. Procedure: Study mould safety, machine safety and personal safety, standard check list for maintenance of machine and press tool, standard procedure for storage of press tool, apply standard procedures for storage of press tool.	4	-
10. Specifi-cation	**10.1 Specification of material, press tool and press** 1. Introduction: Specification, press tool specification and press specification for tool design. 2. Definition: Material composition and specification, classification of tool material, treatment, work sheet and process sheet, specification of presses. 3. Principles: Principle of material selection, design parameters from work sheet and process sheet, press specification. 4. Procedure: Study tool material specification and composition, use assembly drawing and list tool and press specification.	6	-

Units	Detailed Contents	L	P
11. Jigs & Fixtures	**11.1 Introduction to Jigs & Fixtures** 1. Introduction: Jigs & Fixtures in a manufacturing process and their application. 2. Definition: Concept of functions, features of a Jig & Fixture. Classification of jigs & fixtures. 3. Principles: Principle of functions, features of a Jig & Fixture. Principle of classification. 4. Procedure: Describe functions, features and application of a simple jig & fixture in batch and mass production in a manufacturing industry.		
	11.2 Standard Parts & Devices 1. Introduction: Standard parts and devices in assembly of jig & fixture. 2. Definition: Concept of locating elements, clamping elements, guiding elements, supporting elements, loading and unloading and standard parts. 3-2-1 pin concept of location. 3. Principles: Principle of locating elements, clamping elements, guiding elements, supporting elements, loading and unloading and standard parts. 3-2-1 pin principle of location. 4. Procedure: Describe function, feature and application of standard parts and devices. Procedure for locating work component.		
	11.3 Design parameter for jigs & fixtures 1. Introduction: Design parameter for designing jig & fixtures. 2. Definition: Concept of components, component material, designing parameter, standard parts, assembly of jig & fixtures. 3. Principles: Principle of components, component material, designing parameter, standard parts, assembly of jig & fixtures. 4. Procedure: Study component and its function, analyze steps in designing, consider various parameters. Assembly for use in a manufacturing process.	20	-
12. Plain gauges	**12.1 Plain Limit Gauges & Designing Parameters** 1. Introduction: Plain limit gauges and designing parameters. 2. Definition: Concept and classification of limit gauges, design parameter, material selection, tolerance. Maximum and minimum material condition on Taylor's principle. 3. Principles: Principle of limit gauges, design parameter, material selection, tolerance. Maximum and minimum material condition on Taylor's principle. 4. Procedure: Study use and application, material selection. Analyze design parameters. Apply Taylor's principle for designing plain limit gauges.	7	-
	Review & Class Test	12	-
	Total No. of Hours	**135**	**-**

2.6 LIST OF REFERENCES FOR TOOL DESIGN THEORY AND PRACTICE- "PRESS TOOLS"

AUTHOR	TITLE	PUBLISHER
D. Eugene Ostergaard	Basic Die Making ISBN 07-046090-6	McGraw Hill Book Co.
Prakash H. Joshi	Press Tools Design & Construction ISBN 81-85814-46-5	Wheeler Publishing
American Society of Tool & Manufacturing Engineers (F.W. Wilson)	Fundamental of Tool Design ISBN 0-87692-058-10	Prentice Hall of India Pvt. Ltd. New Delhi
C. Donaldson, George H. Lecain V.C. Goold	Tool Design ISBN 0-07-099274-6	Tata McGraw Hill
A. Kumar	Fundamentals of Tool Design	Dhanpat Rai & Co.
CITD (ISTE)	Tool Engineering Parameters	CITD (ISTE)- Hyderabad
TETCOS	Transparencies	Education & Training Consultants, Banglore
FIBRO	Standard Catalogues	--
Surrender Kumar & Umesh Chandra	Production Engg. Design	Satya Prakashan, New Delhi
Donaldson	Fundamental of tool design	Tata McGraw Hill

2.7 TOOL DESIGN PRACTICE - I
(PRESS TOOLS, JIGS & FIXTURES)

Objectives

Understand the facts, concepts, principles and procedures to calculate design parameters, verify designs using data books and information and validate the design from tried out component.

It also describes the use of CAD/CAM to produce press tools for emerging needs of sheet material components in various applications. It also describes concepts, principles and procedures to design and draw press tools for a given component, so that the same can be manufactured to produce components of right quality and quantity.

Note: List of exercises. Design parameters, flow chart appended for Tool Design Practice.

Units	Detailed Contents		L	P
1. Elements of Design Process	**1.1 Introduction to tool design practices – layouts**			
	1. Introduction:	Design layout practice for typical/ specific press tool.		
	2. Definition:	Concept of assembly drawing layout, bill of material and tool data, details drawing layout.		
	3. Principles:	Principles of design layout, drawing norms and practice.		
	4. Procedure:	Draw typical tool design layout, standard practice and conventions for one specific press tool.		
	1.2 Overview of principles			
	1. Introduction:	Press tool design principles and their relationship with typical component, press tool and press.		
	2. Definition:	Concept of component features, press tool features, press features, material properties.		
	3. Principles:	Principle of sheet material processing, press tool construction.		
	4. Procedure:	Explain feature of a typical / specific press tool in relation with component and press.	4	4
2. Press tool parts	**2.1 Drawing of press tool parts and elements**			
	1. Introduction:	Standard catalogue and application.		
	2. Definition:	Concept of press tool parts, standard elements and representation, data sheets.		
	3. Principles:	Principle of press tool parts and standard elements, standardization, interchangeability.		
	4. Procedure:	Draw using standard catalogues press tool parts and standard elements.		
	2.2 Die sets			
	1. Introduction:	Die sets and application.		
	2. Definition:	Concept of elements of die sets, classification, feeding equipment clamping die set and component loading, presses, concept of material.		
	3. Principles:	Principle of selection of die set, component loading, feeding, clamping, die set and press tool, geometric and dimensional tolerances and fits.		
	4. Procedure:	Draw die sets with die set elements, apply geometric and dimensional tolerances and fits.	4	20

Units	Detailed Contents	L	P
3. Components / Layouts	**3.1 Strip layout** 1. Introduction: Strip layout for optimum utilization and application. 2. Definition: Concept and classification of strip layouts. 3. Principles: Principle of grain direction. Burr side, material utilization, productivity. 4. Procedure: Study component, select method for strip layout, draw different strip layouts for the component, calculate economy factor and evaluate strip layout for optimization. **3.2 Blank development** 1. Introduction: Blank development and its application. 2. Definition: Concept of blank development, allowances. 3. Principles: Principle of blank development. 4. Procedure: Study design parameters for development of given components, draw development of blank.	2	15
4. Data / Work Sheet	**4.1 Design parameters** 1. Introduction: Understand design paramagnets. 2. Definition: Concept and classification of design parameters with respect to press tool, material, press and operation. 3. Principles: Principle of component geometry, dimensional tolerances, quality and quantity requirements, design parameters with respect to press tool, material and press. 4. Procedure: Study component specification, use design parameters with respect to press tool, material and press, use data book, standards for optimum selection of design parameters. **4.2 Process sheet and work sheet** 1. Introduction: Process sheet and work sheet for optimum press tool design and try-out. 2. Definition: Concept of process sheet, work sheet. 3. Principles: Principle of sheet material, press tool and press, design parameters. 4. Procedure: Study component and component drawing and prepare process sheet, calculate design parameters with respect to sheet material, press tool and press. Prepare process sheet and work sheet.	2	10
5. Conceptual designs	**5.1 Sketching conceptual designs** 1. Introduction: Understand conceptual design and its application. 2. Definition: Concepts of conceptual design, evaluation. 3. Principles: Principle of conceptual design, developing alternatives, selecting optional design. 4. Procedure: Study component / component drawing, develop alternative conceptual design using data sheet, process sheet. Develop alternative conceptual designs, evaluate and compare alternative conceptual designs using design parameters, select optional design.	4	10

Units	Detailed Contents		L	P
6. Design of press tools	**6.1 Draw assembly and detail drawings**			
	1. Introduction:	Assembly and detail drawing for manufacturing of press tool.		
	2. Definition:	Concept of drawing and layout for assembly and details, verification of design.		
	3. Principles:	Principle of drawing layout for press tool, drawings norms and practices.		
	4. Procedure:	Draw component drawing, draw blank development if required, design and draw strip layout if required, prepare process sheet and worksheet from design parameters, draw detail drawing with geometrical dimension, tolerancing.	5	60
7. Press tool data	**7.1 Tool data, bill of material and procedure for processing**			
	1. Introduction:	Tool data, bill of material and application.		
	2. Definition:	Concept of tool data, tool material selection, processing materials, handling and storage.		
	3. Principles:	Principle of tool data, tool material selection, processing materials, handling and storage.		
	4. Procedure:	Study worksheet and prepare tool data, prepare bill of material, prepare processing material list, handling procedure for press tool and components.	2	6
8. CAD	**8.1 Introduction to design of press tools using CAD software**			
	1. Introduction:	CAD softwares for design and development.		
	2. Definition:	Concept of 2D drawing and 3D modeling, design parameter, software package.		
	3. Principles:	Principle of product design and development, design parameters and modeling, assembly modeling, data exchange.		
	4. Procedure:	Design and develop 3D model of component and strip layout, design and develop assembly model and detail model, prepare bill of material. Analyze parts for interference, data transfer for machining.	2	10
9. Jigs & fixtures design	**9.1 Principle of design of jigs & fixtures**			
	1. Introduction:	Understand principles of design for jigs & fixtures.		
	2. Definition:	Concept of location, guiding, clamping, loading and unloading, material selection. Related BIS standards for fasteners.		
	3. Principles:	Principle of location, guiding, clamping, loading and unloading, material selection. Related BIS standards for fasteners.		
	4. Procedure:	Study various elements of jigs & fixtures. Prepare details of designing parameters. Describe procedures for designing jig & fixture.		

Units	Detailed Contents		L	P
	9.2 Design and drawing of assembly and detail parts of jigs & fixtures			
	1. Introduction:	Understand design and drawing of assembly and detail parts of jigs & fixtures.		
	2. Definition:	Concept and classification of jigs & fixtures, various types of jigs & fixtures, design parameters, standard practice of design, assembly and detail drawing.		
	3. Principles:	Principle of jigs & fixtures, various types of jigs & fixtures, design parameters, standard practice of design, assembly and detail drawing.		
	4. Procedure:	Study work component, prepare design parameters, use standards. Draw assembly and detail drawing of jigs & fixture design.	5	30
10. Gauges design	**10.1 Design and drawing of plain limit gauges**			
	1. Introduction:	Understand design and drawing of plain limit gauges.		
	2. Definition:	Concept of limit gauges. Types of gauges, design parameters, GO & NOT-GO concept. Taylor's principle for designing limit gauges.		
	3. Principles:	Principle of limit gauges. Types of gauges, design parameters, GO & NOT-GO concept. Taylor's principle for designing limit gauges.		
	4. Procedure:	Material selection, GO & NOT-GO ends of gauge. Draw and design plain gauge limit.	5	10
		Review & Class Test	-	15
		Total No. of Hours	**35**	**190**

2.7 LIST OF EXERCISES FOR TOOL DESIGN PRACTICE-I (PRESS TOOLS, JIGS & FIXTURE)

Sr. No.	Exercise	Remarks
1.	Press tool parts and die sets	
2.	Strip layout and blank development	
3.	Blanking / piercing tool with box stripper	
4.	Compound tool	
5.	Bending tool (U-Type)	
6.	Single draw table	
7.	Progressive tool (two to three stations)	
8.	Combination tool (Invented blank and draw tool)	
9.	Checking of design and assembly (details drawing)	
10.	Jigs design (2-3)	
11.	Fixture design (2-3)	
12.	Simple gauges design (2-3)	

Note: List of design parameters and flow chart annexed for Tool Design Practice.

2.7 LIST OF DESIGN PARAMETERS – HINTS

I - COMMON DESIGN PARAMETERS
(Cutting, Non- Cutting, Integrated Operations)

a. Die Sets
b. Punches
c. Dies
d. Stripper Tunnel
e. Pilots and stoppers
f. Punch holders
g. Material selection & Heat treatment

II - DESIGN PARAMETERS - CUTTING OPERATIONS

a. Shear force
b. Cutting clearance
c. Burr side consideration
d. Angular clearance & land
e. Strip-layout and economy factor
f. Calculation of plate thicknesses – die, stripper, Punch holder, Top plate, Bottom plate.
g. Die life considerations
h. Stripping force and Springs selection
i. Shut height and punch length calculation
j. Shank location calculation (Centre of Pressure)

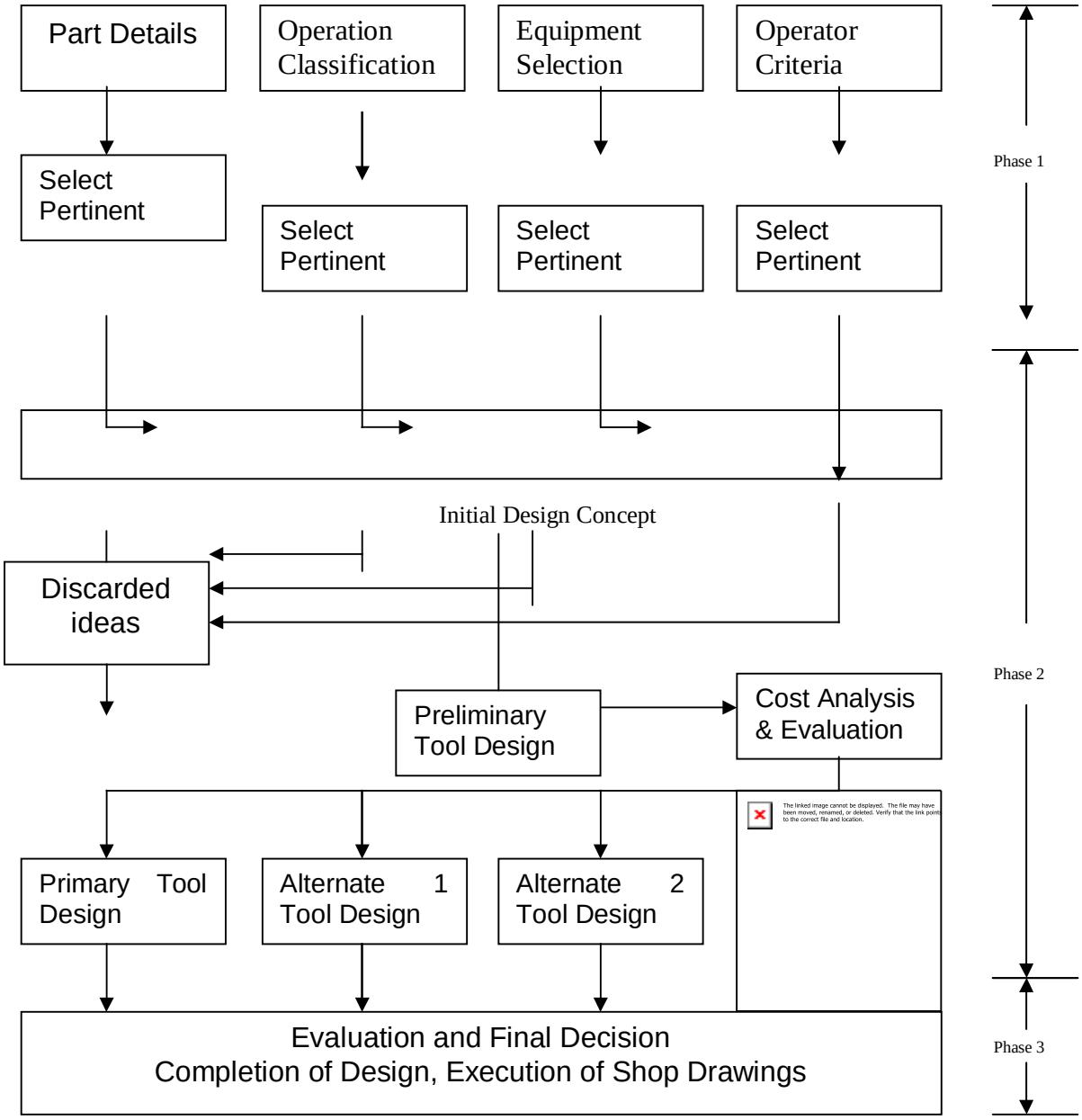
III - DESIGN PARAMETERS - BENDING OPERATIONS

a. Bending force
b. Ejection force
c. Blank holding force
d. Blank Development
e. Spring back calculation

IV - DESIGN PARAMETERS - DRAWING OPERATIONS

a. Drawing force
b. Ejection force
c. Blank holding force
d. Blank development
e. No. of draws

2.7 FLOW CHART FOR DEVELOPMENT OF DESIGN SOLUTIONS – HINTS



2.7 LIST OF REFERENCES FOR TOOL DESIGN THEORY AND PRACTICE- "PRESS TOOLS"

AUTHOR	TITLE	PUBLISHER
D. Eugene Ostergaard	Basic Die Making ISBN 07-046090-6	McGraw Hill Book Co.
Prakash H. Joshi	Press Tools Design & Construction ISBN 81-85814-46-5	Wheeler Publishing
American Society of Tool & Manufacturing Engineers (F.W. Wilson)	Fundamental of Tool Design ISBN 0-87692-058-10	Prentice Hall of India Pvt. Ltd. New Delhi
C. Donaldson, George H. Lecain V.C. Goold	Tool Design ISBN 0-07-099274-6	Tata McGraw Hill
A. Kumar	Fundamentals of Tool Design	Dhanpat Rai & Co.
CITD (ISTE)	Tool Engineering Parameters	CITD (ISTE) – Hyderabad
TETCOS	Transparencies	Education & Training Consultants, Banglore
FIBRO	Standard Catalogues	--
Surrender Kumar & Umesh Chandra	Production Engg. Design	Satya Prakashan, New Delhi
Donaldson	Fundamental of tool design	Tata McGraw Hill

2.8 TOOL DESIGN THEORY-II
(PLASTIC MOULDS)

Objectives

This subject is intended to know the facts, concepts, principles and procedures of Tool Design Techniques so that this knowledge can be used in Tool Design Practice effectively and efficiently. It is also useful in understanding subject and apply them in the areas such as Workshop Practice, CAD/CAM, Production Planning, Estimation, Industrial Management and Quality Assurance.

Units	Detailed Contents	L	P
1. Introduction	**1.1 Overview of mass production of moulded plastic components.** 1. Introduction: Overview of mass production of moulded plastic components. 2. Definition: Concept of classification of industrial application of plastics, plastics material and mould material, application of moulding machine and equipment, application of moulds. 3. Principles: Principles of mass production of plastic components, relationship of component, mould design, mould, moulding machine and process. 4. Procedure: Study and observe relationship between: material, machine & equipment, mould, process.	5	-
2. Moulding operations	**2.1 Injection Moulding** 1. Introduction: Injection moulding machine and process. 2. Definition: Concept of parts & function of injection moulding machine such as clamping, heating & feeding, ejection. Injection moulding process elements such as machine, material and mould. 3. Principles: Principles of injection moulding machine and parts, injection moulding processes, parameters, selection of injection moulding machines. 4. Procedure: Study and observe various parts and function of injection moulding machines. **2.2 Compression Moulding** 1. Introduction: Compression moulding machine and process. 2. Definition: Parts & function of compression moulding machines such as clamping, heating, feeding. Process set-up data. Compression moulding process elements: Machine, material & mould. 3. Principles: Principles of compression moulding machine and parts, parameters, compression moulding processes. 4. Procedure: Observe and study various parts, functions of compression moulding machines and their process application. **2.3 Transfer moulding** 1. Introduction: Transfer moulding presses and processes. 2. Definition: Parts and function of transfer moulding press, types of transfer moulding presses, process set-up data. Transfer moulding process elements with respect to press, material, mould.		

Units	Detailed Contents		L	P
	3. Principles:	Principles of transfer moulding press and its parts, transfer moulding processes, parameters.		
	4. Procedure:	Study and observe various parts and functions of transfer moulding press and transfer moulding process.		
	2.4 Blow Moulding			
	1. Introduction:	Blow moulding machine and blow moulding process.		
	2. Definition:	Parts and function of blow moulding machines such as clamping, heating, ejection. Classification of blow moulding machines, process set-up data.		
	3. Principles:	Principles of blow moulding machine and parts, blow moulding processes.		
	4. Procedure:	Study and observe various parts and functions of blow moulding machine and process.		
	2.5 Rotational Moulding			
	1. Introduction:	Rotational moulding machine and process.		
	2. Definition:	Parts and function of rotational moulding machine, classification of rotational moulding machines, process set-up data.		
	3. Principles:	Principles of rotational moulding machine and parts, rotational moulding processes, process set-up data.		
	4. Procedure:	Study and observe the various parts and functions of rotational moulding machine and presses.		
	2.6 Thermoforming			
	1. Introduction:	Thermoforming equipment and thermoforming process.		
	2. Definition:	Concept of thermoforming sheet, thermoforming process elements, classification of thermoforming equipment.		
	3. Principles:	Principles of thermoforming equipment, thermoforming process.		
	4. Procedure:	Study and observe functions of various thermoforming equipment and process.	15	-
3. Elements of mould & their functions	**3.1 Injection mould elements & function- core & cavity, mould base, feeding system, cooling system, ejection system, core & cavity retainer plates**			
	1. Introduction:	Understand core and cavity, mould base, feeding system, cooling system, ejection system, core & cavity retainer plates.		
	2. Definition:	Classification and functions of core & cavity, mould base, feeding system, cooling system, ejection system, core & cavity retainer plates. Material used for core & cavity, mould base, feeding system, cooling system, ejection system, core & cavity retainer plates.		
	3. Principles:	Principle of core & cavity, mould base, feeding system, cooling system, ejection system, core & cavity retainer plates. Material used for core & cavity, mould base, feeding system, cooling system, ejection system, core & cavity retainer plates.		
	4. Procedure:	Study of component drawing / sample. Describe function and features of various elements of injection mould.		

Units	Detailed Contents		L	P
	3.2 Blow mould			
	1. Introduction:	Blow moulds and application.		
	2. Definition:	Classification and function of various blow mould and its parts.		
	3. Principles:	Principles of blow moulding process.		
	4. Procedure:	Describe features and functions of various blow moulds.	12	-
4.Classification of moulds	**4.1 Injection moulds classification based on day light, ejection, feed system**			
	1. Introduction:	Injection moulds classification based on day light, ejection, feed system.		
	2. Definition:	Concept of two plate mould, three plate mould, stripper plate mould, stack mould. Concept of ejection and feed system in mould.		
	3. Principles:	Principle of parting surface, multi-day light, injection moulding process. Principle of ejection and feed system mould.		
	4. Procedure:	Describe functions and construction of various types of moulds based on daylight, ejection, feed system.		
	4.2 Blow Moulds			
	1. Introduction:	Blow moulds and application.		
	2. Definition:	Classification of blow moulds, mould parts.		
	3. Principles:	Principles of injection blow mould, extrusion blow mould.		
	4. Procedure:	Study and observe construction, function of blow mould.	8	-
5. Design parameters for mould, material & machine	**5.1 Injection Moulds**			
	1. Introduction:	Understand design parameters in injection moulds.		
	2. Definition:	Concept of design parameters pertaining to mould, machine and material. Quality and quantity required. Properties of plastic material.		
	3. Principles:	Principles of design parameters for mould, material and machine, quality and quantity requirements.		
	4. Procedure:	Identify design parameters relevant to mould, material and machine. Use recommended data, formula and table.		
	5.2 Blow moulds			
	1. Introduction:	Understand design parameters in blow mould.		
	2. Definition:	Concept of design parameters pertaining to mould, machine and material. Quality and quantity requirement, properties of plastic materials.		
	3. Principles:	Principle of design parameters for mould, material and machine, quality and quantity requirements.		
	4. Procedure:	Identify design parameters relevant to mould, material and machine. Use recommended data. Select and use formula, tables.		
	5.3 Mould polishing and surface treatment			
	1. Introduction:	Understand polishing surface treatment of mould parts.		
	2. Definition:	Classification of polishing equipment: manual polishing kits, power assisted polishing kits. Classification of surface finishing: electro plating, etching. Classification of surface roughness values.		

Units	Detailed Contents		L	P
	3. Principles:	Principle of surface treatment, polishing technique.		
	4. Procedure:	Study and identify surface texture requirement. Describe polishing requirement and technique.	20	-
6. Pre & Post moulding operations	**6.1 Pre moulding technique**			
	1. Introduction:	Pre moulding techniques.		
	2. Definition:	Classification of polishing equipment: manual polishing kits, power assisted polishing kits. Classification of surface finishing: electro plating etching. Classification of surface roughness values.		
	3. Principles:	Principles of surface roughness values.		
	4. Procedure:	Study and identify texture requirement. Describe polishing requirement and technique.		
	6.2 Post moulding technique			
	1. Introduction:	Post moulding technique.		
	2. Definition:	Classification of post moulding techniques: trimming, use of fixtures, coating, surface decoration. Classification of related equipment.		
	3. Principles:	Principles of post moulding processing techniques, selection of related equipment.		
	4. Procedure:	Study post-moulding requirements. Describes post-moulding techniques and related equipment.	4	-
7. Estimation	**7.1 Estimation parameters of mould, machine and process**			
	1. Introduction: Estimation parameters of mould, machine andprocess.			
	2. Definition:	Material estimation for plastic and mould. Machine time estimation for mould making, cycle time estimation (for injection, compression and blow mould).		
	3. Principles:	Principle of material weight and volume, principle of estimation time using process analysis for mould making and cycle time.		
	4. Procedure:	Study component drawing and estimate plastic material requirement, bill of material and estimate plastic for mould, detail drawing and calculate hours for making of mould. Describe procedure for estimating moulding cost per unit.	4	-
8. Maintenance safety and storage	**8.1 Maintenance, safety and storage with respect to mould and machine**			
	1. Introduction:	Maintenance, safety and storage with respect to mould and machine.		
	2. Definition:	Concept of safety, maintenance, storage.		
	3. Principles:	Principle of safety, maintenance, storage.		
	4. Procedure:	Study and observe mould safety, machine safety and operator safety. Study standard check list for maintenance of machine and mould. Describe standard procedures for storage of moulds.	4	-

Units	Detailed Contents		L	P
9. Specification	**9.1 Specification of mould, material and machine**			
	1. Introduction:	Specification pertaining to mould, material and machine for tool design data.		
	2. Definition:	Concept of mould specification, plastic material specification, machine specification.		
	3. Principles:	Principle of specification of mould, material and machine.		
	4. Procedure:	Study specification of mould, moulding machine, processing material.	4	-
10. Introduction to simulation package	**10.1 Introduction to simulation packages (optional for learning-not for examination)**			
	1. Introduction:	Simulation packages and application.		
	2. Definition:	Concept of process parameters. Classification of simulation packages.		
	3. Principles:	Principles of selection of process parameters.		
	4. Procedure:	Demonstration of simulation packages. Study and observe use of simulation packages.	4	-
		Review & Class Test	10	-
		Total No. of Hours	**90**	**-**

2.8 LIST OF REFERENCES FOR TOOL DESIGN THEORY & PRACTICE – II (PLASTIC MOULDS)

AUTHOR	TITLE	PUBLISHER
Dominick V. Rosato & Donald V. Rosato	Injection Molding Handbook	CBS Publishers & Distributors, New Delhi
Dominick V. Rosato & Donald V. Rosato	Blow Moulding Handbook	CBS Publishers & Distributors, New Delhi
A. S. Athalye	Plastics Materials Handbook Vol. I & II	Multi-tech Publishing co. Mumbai
A. S. Athalye	Moulding of Plastics	Multi-tech Publishing co. Mumbai
A. S. Athalye	Injection Moulding	Multi-tech Publishing co. Mumbai
A. Kumar	Fundamentals of Tool Design	Dhjanpat Rai & Co.
Chandra & Mishra	Rubber & Plastic Technology	CBS Publishers & Distributor, New Delhi
Prof. Dr. Ing. Paul Thienel	Special Injection Moulding Processes	ISK. Iseriohner Kuntstoff-Technologie – GmbH Iserlohn (Germany)
Throne J. L.	Thermoforming	SPE Books From Hanser Publishers

2.9 TOOL DESIGN PRACTICE – II
(PLASTIC MOULDS)

Objectives

The subject is indented to know concepts, principles and procedures to design and draw Plastic Moulds for a given component, so that the same can be manufactured to produce components from plastics materials of right quality and quantity. It also describes the concepts, principles and procedures to calculate Design Parameters, verify designs using data books and information and validate the design from the tried out component. It is also useful in understanding technology subjects and apply them in the areas such as Workshop Practice, CAD / CAM, Production Planning, Estimation, Industrial Management and Quality Assurance.

Note: List of exercises, design parameters, flow chart appended for tool design practice.

Units	Detailed Contents		L	P
1. Elements of design process	**1.1 Introduction to mould design practice**			
	1. Introduction:	Layout of mould design and use.		
	2. Definition:	Layout (Assembly drawing), Bill of material, Detail Drawing Layout.		
	3. Principles:	Principles of design layout, drawing norms & practice.		
	4. Procedure:	Study and observe typical tool design layouts, application of designs in manufacturing of moulds.		
	1.2 Overview of principle for material, mould, machine			
	1. Introduction:	Principles for component mould, machine & material.		
	2. Definition:	Features of component, mould, machine, material properties.		
	3. Principles:	Principles of plastic processing mould construction.		
	4. Procedure:	Study feature of mould material with component and machine.	2	4
2. Mould parts	**2.1 Drawing mould parts from standard catalogues**			
	1. Introduction:	Standard catalogues and their application.		
	2. Definition:	Concept of design of mould parts, mould parts from standard catalogues.		
	3. Principles:	Principle of selection of standard mould parts. Drawing and design.		
	4. Procedure:	Study & select standard mould parts, draw the standard mould parts.		
	2.2 Drawing of mould housing and bases			
	1. Introduction:	Mould housing, bases and their application.		
	2. Definition:	Classification of mould housing and bases, mould element and functions, material used for mould elements. Assembly & detail drawings.		
	3. Principles:	Principles of assembly and detail drawing, mould housing and bases, mould base material.		
	4. Procedure:	Draw assembly and details of mould housing and bases.		
	2.3 Representation of standard elements			
	1. Introduction:	Representation of standard elements.		
	2. Definition:	Classification of standard elements, designation of standard elements.		
	3. Principles:	Principle of selection of standard elements, designation of standard elements.		
	4. Procedure:	Draw standard elements and their nomenclature.	2	12

Units	Detailed Contents	L	P
3. Components & Layouts	**3.1 Component drawing** 1. Introduction: Allowances for component drawing and use. 2. Definition: Concept of shrinkage, allowances. 3. Principles: Principles of shrinkage and allowances. 4. Procedure: Study component, determine dimensions allowances. Draw component drawing. **3.2 Runner and gating system layout** 1. Introduction: Runner and gating system layout 2. Definition: Classification of feed system, runner and gate. 3. Principles: Principles of layout of cavities, feed system, layout of runner and gating system. 4. Procedure: Study component drawing / sample. Draw runner and gating system layout. **3.3 Cooling/ heating layout** 1. Introduction: Cooling & heating circuit in moulds. 2. Definition: Concept of mould construction & design, core & cavity, cooling/heating circuit. 3. Principles: Principles of mould construction, cooling/heating layout. 4. Procedure: Select & draw typical circuit layout with details.	2	10
4. Work/ Data Sheet	**4.1 Calculate design parameters with respect to mould, material and m/c.** 1. Introduction: Understand design parameters for optimum mould design. 2. Definition: Classification of design parameters with respect to mould, material & machine, Classification of design parameters according to the mould operations. 3. Principles: Principle of component geometry, dimensional tolerances. Quality and quantity requirement pertaining to mould, material and machine. 4. Procedure: Study component specification, use design parameters with respect to mould, material and machine, use data book, standards for optimum selection of design parameters. **4.2 Preparation of work/ data sheet for mould, material and machine** 1. Introduction: Work sheet for mould design and application. 2. Definition: Concepts of mould, plastics materials specification, estimation of material, machining hours and process parameters, data sheet formats. 3. Principles: Principles of component geometry, dimensional tolerance, mould design, application of design parameters. 4. Procedure: Use information data sheet. Describe data sheet for mould design, material and machine.	2	6
5. Conceptual design	**5.1 Sketching conceptual designs** 1. Introduction: Understand alternative conceptual design. 2. Definition: Concept of conceptual design, evaluation. 3. Principles: Principles of conceptual design, developing alternatives, selecting the optimum design. 4. Procedure: Study the component drawing / sample. Develop conceptual design using data sheet, alternative conceptual designs using design parameters. Select the optimal design.	2	6

Units	Detailed Contents		L	P
6. Design of mould	**6.1 Draw assembly and detail drawing of mould**			
	1. Introduction:	Assembly & detailed drawings for manufacturing of mould.		
	2. Definition:	Concept of use of design data sheet. Concept of drawing & layout for assembly and details.		
	3. Principles:	Principle of drawing of mould layout, drawing norms & practices.		
	4. Procedure:	Select process sheet & worksheet for the selected optimal design. Use concept drawing. Draw assembly and detailed drawings of mould.	-	20
7. Mould Data	**7.1 Bill of material**			
	1. Introduction:	Bill of Material and use.		
	2. Definition:	Concept of mould materials, standard parts, processing materials.		
	3. Principles:	Principle of bill of material, selection of material, standard parts material for processing.		
	4. Procedure:	Study data sheet & work sheet, prepare bill of material.		
	7.2 Mould data			
	1. Introduction:	Mould data in the production of components.		
	2. Definition:	Concept of machine set-up, processing parameters.		
	3. Principles:	Principle of material selection, selection of machine, processing parameters.		
	4. Procedure:	Study standards, norms & prepare data for machine set-up, prepare processing data.	2	6
8. CAD	**8.1 Introduction to software packages**			
	1. Introduction:	Software packages and application.		
	2. Definition:	Concept of software packages. Classification of software packages.		
	3. Principles:	Principles of thermosetting material processing using software, thermosetting material processing using software, elastomer processing using software.		
	4. Procedure:	Study & identify the plastics processing software packages.		
	8.2 Design of moulds with CAD			
	1. Introduction:	CAD software for mould design.		
	2. Definition:	Concept of 3D model. Concept of data book. Concept of software package.		
	3. Principles:	Principle of 3D model, assembly modeling, use of data books.		
	4. Procedure:	Design and develop the 3D model of the component, design and develop the assembly model, detail model and prepare the bill of material.	-	6
		Review & Class Test	-	8
		Total No. of Hours	**12**	**78**

2.9 LIST OF EXERCISES FOR TOOL DESIGN PRACTICE-II (PLASTIC MOULDS)

Sr. No.	Exercises	Remarks
1.	Simple mould for injection, blow moulding.	
2.	Standard parts.	
3.	Mould bases (Thermoplast).	
4.	Conventional two plate mould for injection, blow moulding for single cavity and multi-cavity.	
5.	Moulds for injection (external and internal undercuts, threaded component).	
6.	3-Plate moulds for injection.	
7.	Runner-less-insulated, hot runner (thermoplast)	**Optional exercise**
8.	Checking of design and drawing	

Note: Design parameters for injection mould, blow mould and flow chart appended for reference.

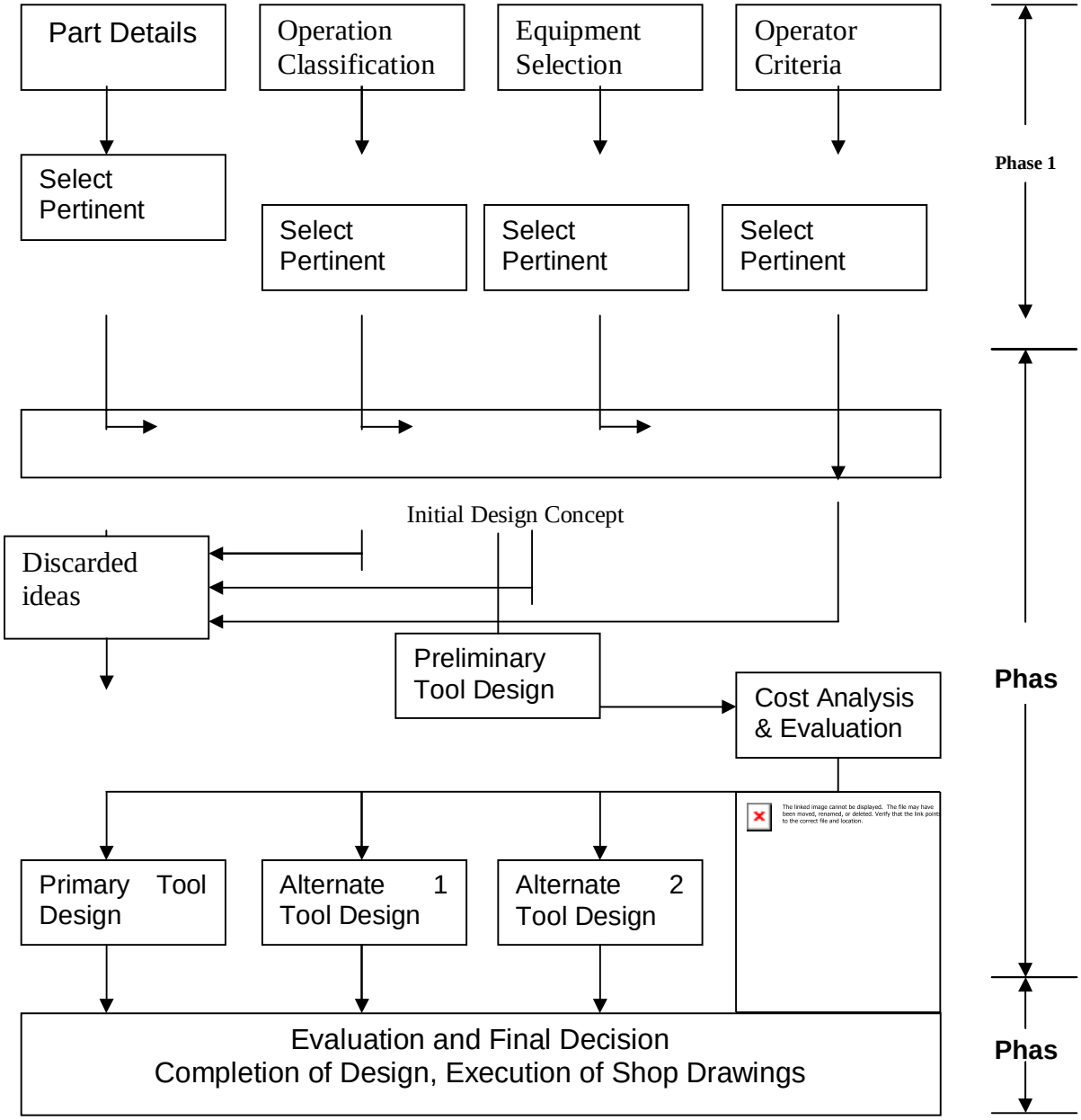
2.9 DESIGN PARAMETERS
INJECTION MOULD (THERMOPLASTICS)

MOULD	MATERIAL	MACHINE
1. Detail no. of cavities 2. Injection pressure 3. Clamping force 4. Gate size 5. Runner size 6. Sprue size 7. Shot weight 8. Projected area of cavities 9. Solidifying time (incl. Mould temp) 10. Ejection force 11. Heat to be transferred per hr 12. Amount of water to be circulated/hr 13. Length & location of cooling channel 14. Cooling period 15. Determining total cycle time 16. Drafts & tapers 17. Venting dimension 18. Split movement related calculations 19. Calculations related to establishment of hot runner system. 20. Mould shut height. 21. Calculation related to unscrewing mechanism	1. Shrinkage value 2. Specific gravity 3. Specific heat 4. Moulding temperature 5. Heat content –cal/gm	1. Clamping force 2. Plasticising capacity 3. Injection pressure 4. Shot capacity 5. Clamping area 6. Cylinder temperature 7. Distance between tiebars 8. Platen layout 9. Register ring bore size 10. Nozzle data 11. Machine daylight 12. Nature of ejection mechanism

BLOW MOULD

MOULD	MATERIAL	MACHINE
1. Blow time 2. Cooling Period 3. Pinch – off selection from standards 4. Venting 5. Clamping area	1. Shrinkage 2. Blow Temperature	1. Clamping Force 2. Parison Design 3. Die Swell 4. Cycle time

2.9 PLASTIC MOULDS
FLOW CHART FOR DEVELOPMENT OF DESIGN SOLUTIONS



2.9 LIST OF REFERENCES FOR TOOL DESIGN THEORY & PRACTICE – II (PLASTIC MOULDS)

AUTHOR	TITLE	PUBLISHER
Dominick V. Rosato & Donald V. Rosato	Injection Molding Handbook	CBS Publishers & Distributors, New Delhi
Dominick V. Rosato & Donald V. Rosato	Blow Moulding Handbook	CBS Publishers & Distributors, New Delhi
A. S. Athalye	Plastics Materials Handbook Vol. I & II	Multi-tech Publishing co. Mumbai
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B. Kumar	Fundamentals of Tool Design	Dhjanpat Rai & Co.
Prof. Dr. Ing. Paul Thienel	Special Injection Moulding Processes	ISK. Iseriohner Kuntstoff-Technologie – GmbH Iserlohn (Germany)
Throne J. L.	Thermoforming	SPE Books From Hanser Publishers

2.10 WORKSHOP PRACTICE – II

Objectives

At the end of 2nd year, the student will be able to acquire skills in the precision machining processes, various machining operations and assembly of press tools, injection moulds and jigs & fixtures. The traineewill learn concepts, principles and procedures for making precisions parts and assembly of components of press tools, plastic moulds, jigs & fixtures.

Units	**Detailed Contents**	**Time allotted**	
		Weeks	**Hours**
UNIT-I Make multifunctional tools integrating skills of – Bench work – Turning – Milling – Surface grinding – Cylindrical grinding (Internal &External)	1.1 Make guided press tools and parts of press tools. – Blanking tool – Piercing tool – Progressive tool – Compound tool – Parts assembly and try-out	12	540
	1.2 Make injection mould and parts of injection mould – Single cavity injection mould – Multi cavity injection mould – Standard parts – Assembly & try-out	6	270
	1.3 Make jigs & fixtures – Standard parts – Locating device – Clamping device – Assembly & try-out	6	270
	Total Nos.	**-**	**1080**

Note: Shoptalk @ 3 periods per week is included in the total number of hours.

3.1 HYDRAULICS & PNEUMATICS

Objectives

The subject is intended to understand the facts, concepts, principles of Hydraulic & Pneumatics in tool design, advanced machine tool technology, CNC technology. It also aims at developing skills in building up simple circuits and further helps in trouble shooting in machine tools application and maintenance. This technology of low cost automation helps in reducing cost of production and increasing productivity, quality effectively.

Note: Related practical classes will be conducted for internal assessment only.

Units	Detailed Contents	L	P
1. Introduction	**1.1 Overview of application of Hydraulics & Pneumatics** 1. Introduction: Overview of Hydraulics & Pneumatics 2. Definition: Concept of Hydraulic & Pneumatic system in tool engineering, jigs & fixtures, plastic moulds, die casting dies & forging dies, machine tools. 3. Principles: Principle of low cost automation, hydraulics & pneumatics. 4. Procedure: Study application of Hydraulic & Pneumatic system in machine tools in Tool Room situation.		
	1.2 Introduction to Hydraulics & Pneumatics 1. Introduction: Hydraulics & Pneumatics and application. 2. Definition: Concept of Hydraulic & Pneumatic system. Block diagram of basic Hydraulic & Pneumatic system. 3. Principles: Working principle of Hydraulic & Pneumatic system with the help of block diagram. 4. Procedure: Study and describe elements of Hydraulics & Pneumatics with the help of diagram.	3	-
2.Fundamental principles	**2.1 Properties of Air** 1. Introduction: Properties of air and application. 2. Definition: Concept of pressure, pressure head, pressure drop, force, power, work, flow though pipes, expansion and compression of gases, gas laws. Charls & Boyles pressure laws, general gas equation. 3. Principles: Principle of pressure, force, power, flow rate, pressure drop, and pressure head. Gas laws with the pneumatic system. 4. Procedure: Study basic properties of air related to the pneumatic system.		
	2.2 Properties of fluid 1. Introduction: Properties of fluids and application. 2. Definition: Concept of density, specific volume, specific weight, specific gravity, viscosity, compressibility, surface tension, effect of temperature on viscosity. Types of fluid flow. Pascal's law (transmission of force by fluids), pressure measurement. Bourdon's tube pressure gauge with units. 3. Principles: Principle of viscosity, temperature, specific weight, specific gravity, density, pressure. Types of flow and the Pascal's law with hydraulic system.		

Units	Detailed Contents		L	P
	4. Procedure:	Study basic properties of fluids related to hydraulic system.	7	-
3. Energy supply elements	**3.1 Energy supply element related to pneumatics**			
	1. Introduction:	Supply elements for pneumatics and application.		
	2. Definition:	Concept of air compressors, air filters, air lubricators, air regulators, air dryers. Structure and single flow of pneumatic system. Air generation and distribution system.		
	3. Principles:	Principle of air compressor, air filters, air lubricator, air regulators, air dryers.		
	4. Procedure:	Study function and construction of air compressor, air filters, air dryers, air lubricators, air regulators. ISO symbols related to energy supply elements in pneumatics.		
	3.2 Energy supply element related to Hydraulics			
	1. Introduction:	Supply element for Hydraulics and application.		
	2. Definition:	Concept of hydraulic pumps, drive system, filter & reservoir, cooler, heater, oil level gauge, temperature gauge. Structure and signal flow of hydraulic system. Hydraulic supply and distribution system.		
	3. Principles:	Working principle of hydraulic pumps, filters & reservoirs, cooler & heater, oil level gauge & temperature gauge.		
	4. Procedure:	Study construction and the function of elements of hydraulic power pack such as hydraulic pumps, drive system, filter, reservoir, cooler, heater with ISO symbols.	12	4
4. Valves	**4.1 Direction control valves and pressure control valves**			
	1. Introduction:	Direction control valves and pressure control valves.		
	2. Definition:	ISO symbol designation, function of Direct control valves. Pressure control valve. Types of control valves.		
	3. Principles:	Working principle of Direct control valve, pressure control valve.		
	4. Procedure:	Describe functions and various parts of direct control valves, function & various parts of pressure control values.		
	4.2 Non – return valve, flow control valve, combination valve, Two pressure valves, shuttle valve, quick exhaust valves			
	1. Introduction:	Non-return valve, flow control valve, two pressure valves, shuttle valve, quick exhaust valve, combination valve		
	2. Definition:	ISO symbol designation, function of non-return valve, flow control valve, two pressure valve, shuttle valve, quick exhaust valve, combination valve (time delay valve, adjustable pressure sequence valve).		
	3. Principles:	Working principle of non-return valve, flow control valves, two pressure valves, shuttle valves, quick exhaust valves, combination valve.		
	4. Procedure:	Describe function and construction of non-return valves, flow control valves, two pressure valve, shuttle valve, combination valve and quick exhaust valve.	10	6

Units	Detailed Contents	L	P
5. Output elements	**5.1 Types of actuators linear, rotary (output elements)** 1. Introduction: Actuators, types & application. 2. Definition: Concept of actuator, types of actuators and output elements. Linear motion actuators, rotary motion actuators. 3. Principles: Working principle of actuators, linear motion actuators, rotary motion actuators with ISO symbols. 4. Procedure: Describe construction, function, application of linear motion actuators and rotary motion actuators with ISO symbols.	8	5
6. Circuit design and application	**6.1 Circuit design and application** 1. Introduction: Basic circuit design and application. 2. Definition: Concept and control system, circuit design and diagram. 3. Principles: Principle of control system, circuit design and diagram. Selection of suitable cylinder or motor, suitable valves, suitable energy supply element. 4. Procedure: Connect all elements as per circuit diagram. Select suitable cylinder or motor, valve, fluid supply element. Describe hydraulic and pneumatic control system in press tools, moulds, jigs & fixtures and machine tools.	20	10
	Review & Class Test	5	-
	Total No. of Hours	**65**	**25**

3.1 LIST OF REFERENCES FOR "HYDRAULICS & PNEUMATICS"

AUTHOR	TITLE	PUBLISHER
P. Croser	Pneumatics (Festo) Basic Level T P 101 Text Book	Festo Didactic Germany
D. Merkle	Hydraulics (Festo) Basic Level TP 501 Text Book	Festo Didactic Germany
S.R. Majumdar	Pneumatic System	Tata McGraw-Hill Publishing Co. Ltd. New Delhi
W. Bolten	Pneumatic and Hydraulic System	Butter Worth, Heinemann, Great Britain
Chris Stacey	Practical Pneumatics	Dilys Alam Great Britain
A.S. Sarao D.K. Khosla	Hydraulics & Hydraulic Machines	Satya Prakshan, New Delhi
D. Waller H. Werner	Pneumatic (Festo) Basic Level TP 101 Work Book	Festo Germany
N. Reulecke M. Schwart	Hydraulic (Festo) Basic Level TP501 Work Book	Festo Germany
CD-Fluid SIM-P	Pneumatics Simulation Program	Festo Germany
CD-Fluid SIM-H	Hydraulics Simulation Program	Festo Germany

3.2 ELECTRICAL & ELECTRONICS ENGINEERING

Objectives

This subject is intended to understand concepts, principles and procedures of operating and maintaining electrical installation, electrical machines and electronics equipments in Tool Rooms. This enables student to use knowledge and skills in CNC technology and workshop practice. It is also useful to understand the electrical safety and industrial management.

Units	Detailed Contents	L	P
1. A. C. Fundamen-tal	**1.1 Introduction to Electricity & A. C. circuits** 1. Introduction: Single phase and three phase circuits and application. 2. Definition: Concept of alternating current, single phase and three phase system. 3. Principles: Principle of electricity (voltage & current), single phase and three phase system. 4. Procedure: Describe basics of electricity, alternating current fundamental and relative terms, effect of AC voltage on pure resistance, inductance and capacitance, basics of three phase AC.	7	-
2. Electrical machines	**2.1 Transformer** 1. Introduction: Transformer and application. 2. Definition: Concept of mutual induction, single phase and three-phase transformer, EMF equation of transformer, specification of transformer. 3. Principles: Principle of mutual induction, single phase and three-phase transformer, EMF equation of transformer, specification of transformer. 4. Procedure: Describe working of transformer, construction of transformer, single phase and three phase transformer, methods of cooling of transformer, maintenance of transformer.		
	2.2 D.C. Motor & Generator 1. Introduction: DC generator, motor and application. 2. Definition: Concept of back EMF, EMF equation of generator, specification of DC generator and motor. 3. Principles: Principle of working of DC motor series, shunt and compound motor. 4. Procedure: Describe construction of DC generator and applications of DC motor and generator, comparison of shunt and series motor.		
	2.3 Three phase and single phase induction motor 1. Introduction: Three phase and single phase induction motor and application. 2. Definition: Concept of induction motor, specification of induction motor. 3. Principles: Principle of working of three phase induction motor, single phase induction motor, starting of induction motor.		

Units	Detailed Contents		L	P
	4. Procedure:	Describe working principle of induction motor, construction of three phase squirrel cage induction motor, types of starting of three phase induction motor, application of three phase and single phase induction motor.		
	2.4 Alternator			
	1. Introduction:	Alternator, types and application.		
	2. Definition:	Concept of energy conversion from Mechanical to Electrical, EMF equation.		
	3. Principles:	Working principle of alternator.		
	4. Procedure:	Describe working principle of alternator, construction of alternator, applications of alternator.	25	-
3. Utilization of electrical power	**3.1 Electrical wiring installation and testing**			
	1. Introduction:	Electrical wiring installation and testing.		
	2. Definition:	Concept of electrical wiring, testing of electrical installation.		
	3. Principles:	Principle of various types of wiring, domestic wiring circuits, testing of electrical installation.		
	4. Procedure:	Describe different types of wiring, comparison of different types of wiring, study of I.E. (Indian electricity) rules related to testing of an electrical installation.		
	3.2 Electrical heating and welding			
	1. Introduction:	Electrical heating and welding.		
	2. Definition:	Concept of electrical heating, electrical welding.		
	3. Principles:	Principle of electrical heating, electrical welding.		
	4. Procedure:	Describe types of electrical heating, various types of furnaces, electrical arc welding.	8	-
4. Safety	**4.1 Electrical safety and earthing**			
	1. Introduction:	Earthing and benefits of safety measures.		
	2. Definition:	Concept of electrical safety, electrical earthing.		
	3. Principles:	Principle of earthing and earth resistance.		
	4. Procedure:	Describe electrical shock, effects and first aid, necessity of earthing and earth resistance, methods of earthing.	4	-
5. Measure-ment of electrical quantity	**5.1Electrical measuring instruments**			
	1. Introduction:	Electrical measuring instruments and application.		
	2. Definition:	Concept of electrical measuring instruments, moving iron and moving coil instruments.		
	3. Principles:	Principle of working of moving iron and moving coil instruments, working of energy meter.		
	4. Procedure:	Describe working and types of electrical measuring instruments, methods of connections of electrical measuring instruments, working and application of multimeter.	10	-

Units	Detailed Contents		L	P
6. Electronics	**6.1 Basic electronics**			
	1. Introduction:	Semiconductor devices.		
	2. Definition:	Concept of semiconductor diodes, semiconductor transistors.		
	3. Principles:	Principles of working of diodes, working of transistors and thyristor family.		
	4. Procedure:	Describe working, types and characteristics of semiconductor diodes, working, types and characteristics of BJT (Bi-junctional transistor), FET (Field effect transistor), UJT (Uni-junctional transistor) & thyristor family.		
	6.2 Power supply			
	1. Introduction:	Rectifiers and filters and application.		
	2. Definition:	Concept of rectifiers, filters.		
	3. Principles:	Working principle of rectifier, filters.		
	4. Procedure:	Describe half wave and full wave rectifiers, bridge rectifiers.		
	6.3 Amplifier			
	1. Introduction:	Amplifier and application.		
	2. Definition:	Concept of amplifier, CE, CB and CC configuration.		
	3. Principles:	Working principle of amplifier.		
	4. Procedure:	Describe CE (Common Emitter), CB (Common Base) and CC (Common Colletor) amplifier, single phase amplifier.		
	6.4 Servo motor and stepper motor			
	1. Introduction:	Servo motor and stepper motor and application.		
	2. Definition:	Concept of servo motor, stepper motor.		
	3. Principles:	Principle of servo motor, stepper motor.		
	4. Procedure:	Describe working principle, construction and application of servo motor, working principle, construction and application of stepper motor.		
	6.5 Digital and analog principles			
	1. Introduction	Operational amplifier and logic gates.		
	2. Definition:	Concept of analog circuits, digital circuits.		
	3. Principles:	Working principle of operational amplifier, logic gates.		
	4. Procedure:	Describe operational amplifier, logic gates and truth table.	30	-
		Review & Class Test	6	-
		Total No. of Hours	**90**	-

3.2 LIST OF REFERENCES FOR "ELECTRICAL & ELECTRONICS ENGINEERING"

AUTHOR	TITLE	PUBLISHER
B. L. Theraja	Fundamental of Electrical Engg. & Electronics	S. Chand & Company Ltd., New Delhi
H. Cotton	Electrical technology	CBS Publisher & Distributers, New Delhi
CIMI Chennai	A Practical book on Electrical safety	CIMI, Chennai.
R. P. Jain	Modern Digital Electronics	Tata Mc Graw Hill Publishing Company Ltd., New Delhi
B. L. Theraja	Electrical Technology vol – I	S. Chand & Company Ltd., New Delhi
B. L. Theraja	Electrical Technology vol – II	S. Chand & Company Ltd., New Delhi
Dr. A. K. Tondon Dr. A. Subba Rao Parag R. Desai Dr. S. Kulkarni	A course in control Engineering	Dhanpat Rai & Sons, New Delhi.

3.3 COMPUTER APPLICATION-II
(PRACTICE-ORIENTED EXERCISES)

Objectives

This subject describes the facts, concepts, principles and procedures of computer applications so that this knowledge can be used in solving Engineering applications efficiently and effectively. It is useful in the application of computers in areas like CNC technology, Tool Design and Computer Aided Design.

The course is also aimed at developing knowledge and skills in object oriented programming based on C/C++ and VB-6 languages. This will help students to develop project and inventory programs. This also enables to understand the Hardware and Networking concepts and opportunity to learn latest technology through the use of Internet.

Note: The related theory will be imparted to students in practical class.
Only practical and viva-voce will be conducted for practical examination.

Units	Detailed Contents	L	P
1. Data base management system	**1.1 Planning & creating a database (lab talk)** 1. Introduction: Creating Database and use. 2. Definition: Concept of database creation, creating a table, entering and modifying data, primary key selection, features of menu. 3. Principles: Principle of database creation, creating a table, entering and modifying data, primary key selection, features of menu. 4. Procedure: Develop creation of database using a wizard & creation of a database, creation and modification of tables, relationships, use of external data, modification of field properties, adding of fields in design view.		
	1.2 Creating and using form (lab talk) 1. Introduction: To create, modify and print forms. 2. Definition: Concept of form creation and printing, form modification, formatting & changing properties. 3. Principles: Principles of creating forms, printing forms, modifying form design, formatting & arranging form controls, changing control properties. 4. Procedure: Develop procedure for creating forms, procedure to print forms, procedure to search in forms, create forms for multiple tables, and modify form design.		
	1.3 Creating reports (lab talk) 1. Introduction: Creating reports and application. 2. Definition: Concept of creating modifying & saving report, formatting controls, customizing headers & footers. 3. Principles: Principles of creating, modifying & saving a report, customizing headers & footers, adding & deleting controls, formatting controls. 4. Procedure: Study creation of a report, modification of a report, group and sort data, save a report.		
	1.4 Creating Queries (lab talk) 1. Introduction: Creating query in database management system. 2. Definition: Concept of using calculation in queries, modifying a query, creating query, building summary of queries.		

Units	Detailed Contents		L	P
	3. Principles:	Principles of creating a query, modifying a query, sorting a query, printing a query results, building summary of queries.		
	4. Procedure:	Creation of a simple query, Study adding and removing fields from a query, procedure to sort a query, using calculations in a query.	4	10
2. Programming language	**2.1 Introduction to C/C++ (lab talk)**			
	1. Introduction:	C / C++ in solving Engg. problems and for customizing of CAD, CAM Software.		
	2. Definition:	Define programming, familiarize C / C++ as a programming language, the features of C / C++, writing a simple program		
	3. Principles:	Principles of programming, programming using C / C++, features of C / C++, writing a program code, program output.		
	4. Procedure:	Understand the programming, familiarize with C / C++ as a programming language, write a simple program.		
	2.2 Variables & operators			
	1. Introduction:	Variables and operators in a programming language.		
	2. Definition:	Concept of variables, constants, operators.		
	3. Principles:	Principles of variables, operators, constants.		
	4. Procedure:	Study use of variables and the standards to define variables, develop use of operators and constants.		
	2.3 Control flow, functions, organized variables, pointers			
	1. Introduction:	System principle of control flow.		
	2. Definition:	Concept of looping and types of loops, types loops, types of jumping statements, define functions, arrays, unions, structures, pointers.		
	3. Principles:	Principles of using while, do-while, for loops, using break, switch, go to statement, writing functions & using them. Principles of arrays, structures, unions. Pointers.		
	4. Procedure:	Understand while, do-while & for loops, jumping statements like break, switch, go to. Familiarize with functions, arrays, structures, unions, pointers.		
	2.4 Preprocessor & other computer Features, Input / Output			
	1. Introduction:	Preprocessor & functioning of Input/Output files.		
	2. Definition:	Define files, Input/output files. Buffered standard Input/output.		
	3. Principles:	Principles of creating files, getting output, giving input, functioning of preprocessor.		
	4. Procedure:	Understand functions of a preprocessor. Understand the files. Understand Buffered standard Input/Output.		
	2.5 OOPs, C++ features, classes in C++			
	1. Introduction:	Understand OOP, classes & features of C++.		
	2. Definition:	Define OOP, define classes in C++, list features of C++, define inheritance.		

Units	Detailed Contents		L	P
	3. Principles:	Principle of using OOP concept, defining classes C++, writing a C++ program, features of C++.		
	4. Procedure:	Understand concept of OOP, features of C++, develop classes in C++, develop a simple program in C++.	8	25
3. Visual Basic 6	**3.1 Introduction to VB 6**			
	1. Introduction:	Features of visual Basic and controls used in VB & application of VB.		
	2. Definition:	Features of VB, concept of data access, application development, control & application, design capabilities.		
	3. Principles:	Principles of data access, development tools, application development, controls & application design capabilities.		
	4. Procedure:	Understand the features in VB, access data, develop tools required; develop control & application design capabilities.		
	3.2 Working with VB development environment & building objects in VB.			
	1. Introduction:	Understand development of interface & study object building to print & development.		
	2. Definition:	Concept of interface development, menus, coding environments, object development.		
	3. Principles:	Principles of developing an interface, menus, coding environment, developing objects in VB.		
	4. Procedure:	Study to develop an interface, menus in VB, coding environment, objects in VB.		
	3.3 Connecting to database			
	1. Introduction:	Connecting to database and work with report designer.		
	2. Definition:	Concept of database interface, designing database, menus in report generation.		
	3. Principles:	Principles of developing database interface, designing database, report generation.		
	4. Procedure:	Development of database interface, database designing, write generation of reports.		
	3.4 Designing user interfaces			
	1. Introduction: To create user interface.			
	2. Definition:	Concept of using toolbars, building menu interface, testing interface, using animation & time events, toolbar interface features.		
	3. Principles:	Principles of using toolbars, building toolbar interface, menu interface, testing the interface, using animation & time events, building a sample application, programming a user interface, testing an application.		
	4. Procedure:	Study toolbars, building of toolbar interface, build menu interface, testing interface, options on status bar, animation & time events, build a sample application, programming a user interface, designing a user interface.	6	20

Units	Detailed Contents		L	P
4. Networking/ Communi-cation	**4.1 Introduction to LAN / WAN/MAN**			
	1. Introduction:	LAN, WAN, MAN in the communication system & networking and application.		
	2. Definition:	Concept of networking, LAN, WAN. Difference between LAN, WAN, MAN.		
	3. Principles:	Principles of communication. Principles of networking, Principles of LAN, WAN, MAN. Web features.		
	4. Procedure:	Study LAN, WAN. MAN, use of networking, procedure of communication.		
	4.2 Introduction to Internet			
	1. Introduction:	Internet & email and application.		
	2. Definition:	Concept of Internet & modem, addressing system, different types of networking & hardware.		
	3. Principles:	Principles of accessing Internet, email, networking hardware, networking.		
	4. Procedure:	Study evolution of Internet, advantages of Internet, communication protocol of Internet, addressing system in Internet, procedure to access the Internet. Study types of networks & hardware used in networking.	2	10
		Review & Class Test	-	5
		Total No. of Hours	**20**	**70**

3.3 LIST OF REFERENCES FOR "COMPUTER APPLICATION – II"

AUTHOR	TITLE	PUBLISHER
Y.Kanetkar ISBN-81-7655-040-5	Let us C	BPB New Delhi
Noel Jerke 0-070463666-9	Visual Basic 6	TMH-New Delhi
Alan Simpson/ Robinson ISBN-81-7656-093-6	Mastering Access 2000	BPB New Delhi
Yashwant Kanetkar ISBN-81-85814-84-8	Working with C	BPB New Delhi
P.B. Mahapatra ISBN-81-85814-84-8	Thinking in C & C++	A.H. Wheeler & Co. Ltd. New Delhi
Balaguruswamy	C++	Tata McGraw Hill, New Delhi
Keneth Pugh	C language for programmers	BPB New Delhi
Jesse Liberty ISBN-81-7635-007-9	C++ in 24 Hrs.	Techmedia New Delhi
Byran Cottfried ISBN-0-07-024035-3	Programming with C	Tata MC Graw Hill New Delhi
Yashwant Kanetkar ISBN-81-7656-067-7	Let us C++	BPB New Delhi
Preston Gralla	How the Internet works	Techmedia New Delhi
Neil Jenkins Stan Schatt ISBN-81-203-1081-0	Understanding local area network	Presentice Hall of India Pvt. Ltd. New Delhi
Shanon Crawford ISBN-81-7029-316-2	Your first modem	BPB New Delhi
Frank J. Derfler/ freed	How networks work	Techmedia New Delhi
Renu Vig and Ekta Walia	Fundamentals of database management system	ISTE, Learning material centre, New Delhi

3.4 COMPUTER AIDED DESIGN
(PRACTICE-ORIENTED EXERCISES)

Objectives:

This practice-oriented subject describes the facts, concepts, principles and procedures of computer aided design used in manufacturing and quality control to express the ideas, convey instructions through design for carrying out jobs in tool and die technology. It is also useful in understanding technology subjects such as workshop practice, CNC technology. It also describes the concepts, principles and procedure of developing models and designs using CAD softwares for computer aided manufacturing.

Note: 1. The related theory will be imparted to students in practical class.
Only practical and viva-voce will be conducted for practical examination.
2. MDT-3 will be used as reference.

Units	Detailed Contents		L	P
1. Creation & editing of 3-D objects	**1.1 Drawing isometric views – practice (lab talk)**			
	1. Introduction:	Understand isometric views.		
	2. Definition:	Definition of WCS, UCS, point filters, elevation, drawing basic entities, concept of isometric axes, isometric lines, isometric planes, isometric model.		
	3. Principles:	Principle of isometric projections, co-ordinate x, y, z, UCS, point filters and elevation, drawing lines, arcs i.e. basic entities.		
	4. Procedure:	Procedure to draw an isometric view using various methods, create drawing using commands.		
	1.2 Working with wire frame model – practice			
	1. Introduction:	Understand wire frame model in design process.		
	2. Definition:	Definition of Basic entities (lines and arcs), Elevation, Point filters, UCS.		
	3. Principles:	Principles of co-ordinate x, y, z. UCS, point filters and elevation, drawing lines, arcs / basic entities.		
	4. Procedure:	Procedure to draw wire frame models using various methods, create model using commands.		
	1.3 Introduction to parametric sketches – practice			
	1. Introduction:	Parametric sketches and application.		
	2. Definition:	Definition of Constraints, construction geometry, cut line sketch, Degree of freedom, Feature, Geometric Constraints, Path sketch, split line.		
	3. Principles:	Principle of parametric sketching, degrees of freedom, lines & size location.		
	4. Procedure:	Procedure to draw parametric sketches, demonstration, create parametric sketches using commands.		
	1.4 Surface modeling			
	1. Introduction:	Surface modeling and application.		
	2. Definition:	Definition of argumented line, base surface, derived surface, motion based surface, skin surface, surface normal.		
	3. Principles:	Principle of co-ordinate x, y, z. UCS, WCS, lines, curves / basis entities.		
	4. Procedure:	Procedure to create and edit surface models, create model using commands.	5	20

Units	Detailed Contents	L	P
2. Creation/ editing of simple assemblies up to 6 elements	**2.1 Assembling parts up to 6 elements – practice** 1. Introduction: Understand assembling of parts. 2. Definition: Definition of Assembly catalog, Material Assembly Constraint, Insert, Assembly tree and constraints, Bottom-up design, Root, Localized part. 3. Principles: Principle of logical assembling, parametric sketching, degrees of freedom. 4. Procedure: Procedure for assembling parts using demonstration, create assembly drawing up to 6 elements. **2.2 Assembling with external references** 1. Introduction: Understand external references for assembling of parts. 2. Definition: Definition of assembly catalog, assembly tree, attach, detach, external reference, insert constraint, path, scene, trail, tweak. 3. Principles: Principle of parametric sketching, external referencing. 4. Procedure: Procedure for drawing, create part files, assembly file by externally referencing part files, practice externally reference assembly commands, assembly drawing, create assembly drawing. **2.3 Creating orthographic views and sectioning details** 1. Introduction: Orthographic views and sectioning details and application. 2. Definition: Definition of drawing new view, edit scale, create view, base view, parent view, reference dimension. 3. Principles: Principle of engineering drawing (plan, front view, side view) 4. Procedure: Procedure to draw orthographic and sectional views, create orthographic and section views using commands.	5	20
3. Creation/ editing of simple assemblies for press tools	**3.1 Assembling parts – practice** 1. Introduction: Understand assembly modeling concept in managing parts and sub-assembly. 2. Definition: Definition of Assembly catalog, Material Assembly constraint, Insert, assembly free and constraints, bottom-up design, Root, Localized parts. 3. Principles: Principle of logical assembling, parametric sketching, degrees of freedom. 4. Procedure: Procedure for assembling parts using demonstration, draw assembly drawing. **3.2 Assembling with external references – practice** 1. Introduction: Understand true parametric assembly design in original parts design. 2. Definition: Definition of assembly catalog, assembly tree, attach, detach, external reference, insert constraints, path, scene, trail, tweak.		

Units	Detailed Contents		L	P
	3. Principles:	Principle of parametric sketching, external referencing.		
	4. Procedure:	Create part files, assembly drawing, assembly file by externally referencing part files, practice externally reference assembly commands, create assembly drawing.		
	3.3 Creating orthographic views and sectioning details – practice			
	1. Introduction:	Understand drawing and documentation.		
	2. Definition:	Definition of drawing new view, edit scale, create view, base view, model view, parent view, reference dimension.		
	3. Principles:	Principle of engineering drawing (plan, front view, top view)		
	4. Procedure:	Procedure to draw orthographic and sectional views, create orthographic and sectional views using commands.	5	30
	Review & Class Test		-	5
	Total No. of Hours		**15**	**75**

3.5 CNC TECHNOLOGY

Objectives

The student will be able to understand facts, principles and procedure of CNC Technology. This is sophiscated and modern concept of manufacturing components with the help of CNC machine tools. It makes use of CNC programming for CNC control and the sequence of operations are preformed following commands built in the program.

The technology is adopted advantageously for complex and complicated contour of the components. Metal cutting has become faster, repetitive, error free replacing manual skills and operations with assured quality of product. The technology is rapidly becoming more economical with the growth of computerization in the filed of Tool & Die Technology.

Units	Detailed Contents	L	P
1. Introduction	**1.1 An overview of CNC Technology** 1. Introduction: An overview of CNC machining. 2. Definition: Concept of NC, CNC, DNC machining. Advantages of CNC over conventional machining process. Merits and demerits of CNC machining. Environmental control for CNC machines. 3. Principles: Working principle of NC, CNC & DNC machining. 4. Procedure: Study and observe various steps in NC, CNC & DNC machining.	4	-
2. Classifi-cation of NC system	**2.1 Classification based on feed back control** 1. Introduction: Classification based on feed back control 2. Definition: Concept and classification based on feed back control such as open loop control system, close loop control system. Feed back devices. 3. Principles: Principle of feed back control. 4. Procedure: Study and observe feed back control system. **2.2 Classification based on control system feature** 1. Introduction: Classification based on control system feature. 2. Definition: Concept and classification based on system features such as point-to-point control, straight line control, continuous control system. 3. Principles: Principle of control system features. 4. Procedure: Study and observe control system features. **2.3 Classification based on co-ordinate system** 1. Introduction: Classification based on co-ordinate system 2. Definition: Concept and classification based on co-ordinates of points such as absolute co-ordinates, incremental co-ordinate system. 3. Principles: Principle of absolute and incremental co-ordinate system. 4. Procedure: Study and observe absolute and incremental co-ordinate system. **2.4 Classification based on identification of axis** 1. Introduction: Classification based on identification of axis 2. Definition: Concept and classification based on identification of axes such as linear axis, rotary axis. 3. Principles: Principle of axis identification. 4. Procedure: Study and observe identification of axis in CNC machines.	4	-

Units	Detailed Contents	L	P
3. Funda-mental of part prog-rammming	**3.1 Manual part programming** 1. Introduction: Manual part programming and application. 2. Definition: Concept of NC codes, programming format, G&M codes. Point-to-Point, straight line, curved surface programming. 3. Principles: Principle of manual programming. ISO standards. 4. Procedure: Study and prepare manual part programming based on manufacturer instructions and ISO standards.		
	3.2 Computer aided part programming 1. Introduction: Computer aided part programming and application. 2. Definition: Concept of NC programming on computer. Concept of sub-routines, Do-loops, fixed/ canned cycles. 3. Principles: Principle of CNC programming. 4. Procedure: Study and prepare CNC part programming	12	-
4. Tooling for CNC machines	**4.1 Tooling for CNC machines** 1. Introduction: Tooling for CNC machines and application. 2. Definition: Concept of design features of cutting tools for CNC, Auto tool changers. 3. Principles: Principle of selection of cutting tools, auto tools changers. 4. Procedure: Study and observe tools for CNC machining and automatic tool changers.	2	-
5. Specifi-cation of CNC machines	**5.1 Specification of CNC machines** 1. Introduction: Specification of CNC machines and purpose. 2. Definition: Concept of co-ordinates, spindle rpm, linear and rotary axis of rotation. Machine control system / unit of CNC, cooling system. 3. Principles: Principle of selection of machine control system for CNC machining. 4. Procedure: Study and identify specification of CNC machines.	2	-
6. CNC operations and machines	**6.1 CNC Lathe** 1. Introduction: CNC lathe and turning operations. 2. Definition: Concept of machine control system, main parts, construction features such as machine reference, work reference and reference plane. Tool and radius compensation. 3. Principles: Working principle of machine control unit, CNC part programming. Selection of machining variable, system inspection for component accuracy. 4. Procedure: Study and observe various turning operations on CNC lathe.		
	6.2 CNC Milling 1. Introduction: CNC milling and milling operations. 2. Definition: Concept of machine control unit, main parts, construction features such as machine reference, work reference, reference plane. Selection of tools, tool setting. 3. Principles: Working principle of machine control unit, selection of machining variables. Tool setting. 4. Procedure: Study and observe various milling operation on CNC milling.		

Units	Detailed Contents	L	P
	6.3 CNC machining center 1. Introduction: CNC machining center and various operations. 2. Definition: Concept of Milling, Drilling, Reaming, Tapping. Accessories and attachments for various operations, construction features. 3. Principles: Principle of accessories and attachments for various operations on machining center. 4. Procedure: Study and observe machining center and accessories and attachments for various operations.		
	6.4 CNC EDM-Spark erosion 1. Introduction: CNC EDM-spark erosion and operations. 2. Definition: Concept of electric discharge machining, dielectric medium, cutting tools, machine variables for spark erosion. Design parameters of tools for spark erosion in CNC machining. 3. Principles: Principle of EDM, dielectric medium, selection of machining variable and part programming. 4. Procedure: Study and observe various operations in CNC EDM-spark erosion.		
	6.5 CNC EDM-Wirecut 1. Introduction: CNC EDM-wirecut and operation. 2. Definition: Concept of electric discharge machining with wirecut operations, wire as cutting tool and selection, machining variable, construction features of wirecut EDM. 3. Principles: Principle of wirecut EDM, machining variable and part programming. 4. Procedure: Study and observe various operations in CNC wirecut EDM.		
	6.6 CNC Grinding Machines 1. Introduction: CNC Grinding machine and grinding operations. 2. Definition: Concept of machine control unit, construction details, design of grinding features and grinding variables. Machine and work references, selection of grinding wheel in CNC part programming. 3. Principles: Principle of CNC programming for external and internal cylindrical grinding operations. 4. Procedure: Study and observe CNC programming for various operations in CNC grinding machines.	16	-
	Review & Class Test	5	-
	Total No. of Hours	**45**	-

3.5 LIST OF REFERENCES FOR "CNC TECHNOLOGY"

AUTHOR	TITLE	PUBLISHER
Kundra T.K. Rao P.N. Tewari N.K.	Numerical control & computer aided manufacturing	Tata McGraw Hill, New Delhi
Pabla B.S.	CNC machines	Newage International Pvt. Ltd. Publisher, New Delhi
Krar Steve Gill Arthur	CNC Technology & Programming	McGraw Hill, New York
Lynch Mike	Computer numerical control advanced techniques	McGraw Hill, New York
Lynch Mike	Managing computer numerical control operations	Society of Manufacturings Engineers, Dearborn
Smith Graham	CNC Machining Technology	Springer Verlog, Michigon, New York
Nanfarra Frank Uccello Tony	The CNC Work Book An introduction to CNC	Addison – Wesley, New Delhi

3.6 TOOL DESIGN THEORY-III
(PLASTIC MOULDS)

Objectives

This subject is intended to know the facts, concepts, principles and procedures of Tool Design Techniques so that this knowledge can be used in Tool Design Practice effectively and efficiently. It is also useful in understanding subject and applies them in the areas such as Workshop Practice, CAD/CAM, Production Planning, Estimation, Industrial Management and Quality Assurance.

Units	Detailed Contents	L	P
1. Introduction	**1.1 Overview of mass production of moulded plastic components.** 1. Introduction: Moulds, their drawings, mould design, moulding machines and equipment, plastic material and their relationship. 2. Definition: Concept of classification of industrial application of plastics, plastics material and mould material, application of moulding machine and equipment, application of moulds. 3. Principles: Principles of mass production of plastic components, relationship of component, mould design, mould, moulding machine and process. 4. Procedure: Study and observe relationship between: material, machine & equipment, mould, process.	5	-
2. Review of moulding operations	**2.1 Injection Moulding** 1. Introduction: Injection moulding machines and process. 2. Definition: Concept of parts & function of injection moulding machine such as clamping, heating & feeding, ejection. Injection moulding process elements such as machine, material and mould. 3. Principles: Principles of injection moulding machine and parts, injection moulding processes, parameters, selection of injection moulding machines. 4. Procedure: Study and observe various parts and function of injection moulding machines. **2.2 Compression Moulding** 1. Introduction: Compression moulding machines and process. 2. Definition: Parts & function of compression moulding machines such as clamping, heating, feeding. Process set-up data. Compression moulding process elements: Machine, material & mould. 3. Principles: Principles of compression moulding machine and parts, parameters, compression moulding processes. 4. Procedure: Observe and study various parts, functions of compression moulding machines and their process application. **2.3 Transfer Moulding** 1. Introduction: Transfer moulding presses and processes. 2. Definition: Parts and function of transfer moulding press, types of transfer moulding presses, process set-up data. Transfer moulding process elements with respect to press, material, mould.		

Units	Detailed Contents		L	P
	3. Principles:	Principles of transfer moulding press and its parts, transfer moulding processes, parameters.		
	4. Procedure:	Study and observe various parts and functions of transfer moulding press and transfer moulding process.		
	2.4 Blow Moulding			
	1. Introduction:	Blow moulding machine and blow moulding process.		
	2. Definition:	Parts and function of blow moulding machines such as clamping, heating, ejection. Classification of blow moulding machines, process set-up data.		
	3. Principles:	Principles of blow moulding machine and parts, blow moulding processes.		
	4. Procedure:	Study and observe various parts and functions of blow moulding machine and process.		
	2.5 Rotational Moulding			
	1. Introduction:	Rotational moulding machine and process.		
	2. Definition:	Parts and function of rotational moulding machine, classification of rotational moulding machines, process set-up data.		
	3. Principles:	Principles of rotational moulding machine and parts, rotational moulding processes, process set-up data.		
	4. Procedure:	Study and observe the various parts and functions of rotational moulding machine and presses.		
	2.6 Thermo Forming			
	1. Introduction:	Thermoforming equipment and thermoforming process.		
	2. Definition:	Concept of thermoforming sheet, thermoforming process elements, classification of thermoforming equipment.		
	3. Principles:	Principles of thermoforming equipment, thermoforming process.		
	4. Procedure:	Study and observe functions of various thermoforming equipment and process.	15	-
3. Elements of mould & their functions	**3.1 Compression mould elements & function: Core & Cavity, Mould Base, feeding system, heating system, ejection system**			
	1. Introduction:	Understand core & cavity, mould base, feeding system, heating system, ejection system.		
	2. Definition:	Classification and functions of core & cavity, mould base, feeding system, heating system, ejection system. Material used for core & cavity, mould base, feeding system, heating system, ejection system.		
	3. Principles:	Principle of component geometry. Selection and layout of core & cavity, mould base, feeding system, heating system, ejection system. Material used for core & cavity, mould base, feeding system, heating system, ejection system.		
	4. Procedure:	Study component drawing / sample. Describe function and feature of various elements of compression mould.		

Units	Detailed Contents		L	P
	3.2 Transfer mould			
	1. Introduction:	Transfer mould and application.		
	2. Definition:	Types of transfer mould and its elements, heating elements and controls.		
	3. Principles:	Principles of transfer mould, temperature control, parting surface, ejection system.		
	4. Procedure:	Describe elements of transfer mould and its functions.		
	3.3 Rotational mould			
	1. Introduction:	Rotational mould and application.		
	2. Definition:	Classification and function of various rotational mould and their parts.		
	3. Principles:	Principles of rotational moulding process.		
	4. Procedure:	Describe elements of rotational mould and their functions.		
	3.4 Thermoforming mould			
	1. Introduction:	Thermoforming mould and application.		
	2. Definition:	Concept of thermoforming mold, mould construction with respect to process.		
	3. Principles:	Principle of thermoforming process, ejection, cooling and feeding.		
	4. Procedure:	Describe application of types of thermoforming mold.	12	-
4. Classification of moulds	**4.1 Compression moulds**			
	1. Introduction:	Understand compression moulds.		
	2. Definition:	Positive mould, semi positive mould, flash mould: open flash mould, closed flash mould, inclined flash mould. Landed positive type.		
	3. Principles:	Principles of compression moulds, mould construction.		
	4. Procedure:	Describe function and description of compression moulds.		
	4.2 Transfer Moulds			
	1. Introduction:	Understand transfer moulds.		
	2. Definition:	Plunger type transfer mould: a) Top plunger type b) Bottom plunger type c) Side plunger type. Screw type transfer mould.		
	3. Principles:	Principles of transfer moulds, mould construction.		
	4. Procedure:	Describe function and construction of transfer moulds.		
	4.3 Rotational Parts			
	1. Introduction:	Understand rotational moulds.		
	2. Definition:	Types of rotation mould: Sheet metal rotational mould, light metal rotational mould, electro forming or electroplated mould.		
	3. Principles:	Principles of rotational moulds, mould construction.		
	4. Procedure:	Describe function and construction of rotational moulds.		
	4.4 Thermo forming moulds			
	1. Introduction:	Understand thermoforming moulds.		
	2. Definition:	Classification of thermoforming moulds, parts and function of thermoforming moulds.		
	3. Principles:	Principles of thermoforming moulds, mould construction.		
	4. Procedure:	Describe function and construction of thermoforming moulds.	8	-

Units	Detailed Contents		L	P
5. Design parameters for mould, material & machine	**5.1 Compression moulds**			
	1. Introduction:	Understand design parameters in compression mould.		
	2. Definition:	Concept of design parameters pertaining to mould, machine and material. Quality and quantity requirement. Properties of plastic materials.		
	3. Principles:	Principle of design parameters for mould, material and machine, quality and quantity requirements.		
	4. Procedure:	Identify design parameters relevant to mould, material and machine. Use recommended data, select and use formula, tables.		
	5.2 Transfer moulds			
	1. Introduction:	Understand design parameters in transfer mould.		
	2. Definition:	Concept of design parameters pertaining to mould, machine and material. Quality and quantity requirement, properties of plastic materials.		
	3. Principles:	Principle of design parameters relevant to mould, material and machine, quality and quantity requirements.		
	4. Procedure:	Identify design parameters relevant to mould, material and machine. Use recommended data, select and use formula, tables.		
	5.3 Mould polishing and surface treatment			
	1. Introduction:	Mould polishing surface treatment of mould parts.		
	2. Definition:	Classification of polishing equipment: manual polishing kits, power assisted polishing kits. Classification of surface finishing: electro plating, etching. Classification of surface roughness values.		
	3. Principles:	Principle of surface treatment, polishing technique.		
	4. Procedure:	Study and identify surface texture requirement. Describe polishing requirement and technique.	20	-
6. Pre & post moulding operations	**6.1 Pre moulding technique**			
	1. Introduction:	Pre moulding technique.		
	2. Definition:	Classification of polishing equipment: manual polishing kits, power assisted polishing kits. Classification of surface finishing: electro plating etching. Classification of surface roughness values.		
	3. Principles:	Principles of surface roughness values.		
	4. Procedure:	Study and identify texture requirement. Describe polishing requirement and technique.		
	6.2 Post moulding technique			
	1. Introduction:	Post-moulding technique.		
	2. Definition:	Classification of post moulding techniques: trimming, use of fixtures, coating, surface decoration. Classification of related equipment.		
	3. Principles:	Principles of post moulding processing techniques, selection of related equipment.		
	4. Procedure:	Study post-moulding requirements. Describes post-moulding techniques and related equipment.	4	-

Units	Detailed Contents		L	P
7. Estimation	**7.1 Estimation parameters of mould, machine and process**			
	1. Introduction:	Estimation parameters of mould, machine and process.		
	2. Definition:	Concept of material estimation for plastic and mould. Machine time estimation for mould making, cycle time estimation (for injection, compression and blow mould)		
	3. Principles:	Principle of material weight and volume, principle of estimation time using process analysis for mould making and cycle time.		
	4. Procedure:	Study component drawing & estimate plastic material requirement, bill of material & estimate plastic for mould, detail drawing & calculate hours for making of mould. Describe procedure for estimating moulding cost per unit hour.	4	-
8. Maintenance safety and storage	**8.1 Maintenance, safety and storage with respect to mould and machine**			
	1. Introduction:	To understand need of mould and machine maintenance, safety and storage.		
	2. Definition:	Concept of safety, maintenance, storage.		
	3. Principles:	Principle of safety, maintenance, storage		
	4. Procedure:	Study and observe mould safety, machine safety and operator safety. Study standard check list for maintenance of machine and mould. Describe standard procedures for storage of moulds.	4	-
9. Specification	**9.1 Specification of mould, material and machine**			
	1. Introduction:	Specification pertaining to mould, material and machine for tool design data.		
	2. Definition:	Concept of mould specification, plastic material specification, machine specification.		
	3. Principles:	Principle of specification of mould, material and machine.		
	4. Procedure:	Study specification of mould, moulding machine, processing material.	4	-
10. Introduction to simulation package	**10.1 Introduction to simulation packages (optional for learning-not for examination)**			
	1. Introduction:	Simulation packages and application.		
	2. Definition:	Concept of process parameters. Classification of simulation packages.		
	3. Principles:	Principles of selection of process parameters.		
	4. Procedure:	Demonstration of simulation packages. Study and observe use of simulation packages.	4	-
		Review & Class Test	10	-
		Total No. of Hours	**90**	-

3.6 LIST OF REFERENCES FOR
TOOL DESIGN THEORY & PRACTICE – III
(PLASTIC MOULDS)

AUTHOR	TITLE	PUBLISHER
Dominick V. Rosato & Donald V. Rosato	Injection Molding Handbook	CBS Publishers & Distributors, New Delhi
Dominick V. Rosato & Donald V. Rosato	Blow Moulding Handbook	CBS Publishers & Distributors, New Delhi
A. S. Athalye	Plastics Materials Handbook Vol. I & II	Multi-tech Publishing co. Mumbai
A. S. Athalye	Moulding of Plastics	Multi-tech Publishing co. Mumbai
A. S. Athalye	Injection Moulding	Multi-tech Publishing co. Mumbai
Chandra & Mishra	Rubber & Plastic Technology	CBS Publishers & Distributor, New Delhi
A. Kumar	Fundamentals of Tool Design	Dhanpat Rai & Co.
Prof. Dr. Ing. Paul Thienel	Special Injection Moulding Processes	ISK. Iseriohner Kuntstoff-Technologie – GmbH Iserlohn (Germany)
Throne J. L.	Thermoforming	SPE Books From Hanser Publishers

3.7 TOOL DESIGN PRACTICE – III
(PLASTIC MOULDS)

Objectives

This subject is intended to know the concepts, principles and procedures to design and draw Plastic Moulds for a given component, so that the same can be manufactured to produce components from plastics materials of right quality and quantity. It also describes the concepts, principles and procedures to calculate Design Parameters, verify designs using data books and information and validate the design from the tried out component. It is also useful in understanding technology subjects and apply them in the areas such as Workshop Practice, CAD / CAM, Production Planning, Estimation, Industrial Management and Quality Assurance.

Note: List of exercises, design parameters, flow chart appended for tool design practice.

Units	Detailed Contents		L	P
1. Elements of design process	**1.1 Introduction to mould design practice**			
	1. Introduction:	Layout of mould design and use.		
	2. Definition:	Layout (Assembly drawing), Bill of material, Detail Drawing Layout.		
	3. Principles:	Principles of design layout, drawing norms & practice.		
	4. Procedure:	Study and observe typical tool design layouts, application of designs in manufacturing of moulds.		
	1.2 Overview of principle for material, mould, machine			
	1. Introduction:	Overview of principle for material, mould, machine		
	2. Definition:	Features of component, mould, machine, material properties.		
	3. Principles:	Principles of plastic processing, mould construction.		
	4. Procedure:	Study feature of mould material with component and machine.	2	4
2. Mould parts	**2.1 Drawing mould parts from standard catalogues**			
	1. Introduction:	Standard catalogues and their use.		
	2. Definition:	Concept of design of mould parts, mould parts from standard catalogues.		
	3. Principles:	Principle of selection of standard mould parts. Drawing and design.		
	4. Procedure:	Study & select standard mould parts, draw the standard mould parts.		
	2.2 Drawing of mould housing and bases			
	1. Introduction:	Mould housing and bases and application.		
	2. Definition:	Classification of mould housing and bases, mould element and functions, material used for mould elements. Assembly & detail drawings.		
	3. Principles:	Principles of assembly and detail drawing, mould housing and bases, mould base material.		
	4. Procedure:	Draw assembly and details of mould housing and bases.		
	2.3 Representation of standard elements			
	1. Introduction:	Designation of standard elements.		
	2. Definition:	Classification of standard elements, designation of standard elements.		
	3. Principles:	Principle of selection of standard elements, designation of standard elements.		
	4. Procedure:	Draw standard elements and their nomenclature.	2	12

Units	Detailed Contents		L	P
3. Components & Layouts	**3.1 Component drawing**			
	1. Introduction:	Allowances for component drawing and use.		
	2. Definition:	Concept of shrinkage, allowances.		
	3. Principles:	Principles of shrinkage and allowances.		
	4. Procedure:	Study component, determine dimensions allowances. Draw component drawing.		
	3.2 Runner and gating system layout			
	1. Introduction:	Runner and gating system layout		
	2. Definition:	Classification of feed system, runner and gate.		
	3. Principles:	Principles of layout of cavities, feed system, layout of runner and gating system.		
	4. Procedure:	Study component drawing / sample. Draw runner and gating system layout.		
	3.3 Cooling/ heating layout			
	1. Introduction:	Cooling & heating circuit in moulds.		
	2. Definition:	Concept of mould construction & design, core & cavity, cooling/heating circuit.		
	3. Principles:	Principles of mould construction, cooling/heating layout.		
	4. Procedure:	Select & draw typical circuit layout with details.	2	10
4. Work/ Data Sheet	**4.1 Calculate design parameters with respect to mould, material and machine**			
	1. Introduction:	Understand design parameters for optimum mould design.		
	2. Definition:	Classification of design parameters with respect to mould, material & machine, Classification of design parameters according to the mould operations.		
	3. Principles:	Principle of component geometry, dimensional tolerances. Quality and quantity requirement pertaining to mould, material and machine.		
	4. Procedure:	Study component specification, use design parameters with respect to mould, material and machine, use data book, standards for optimum selection of design parameters.		
	4.2 Preparation of work/ data sheet for mould, material and machine			
	1. Introduction: Work sheet for mould design and application.			
	2. Definition:	Concepts of mould, plastics materials specification, estimation of material, machining hours and process parameters, data sheet formats.		
	3. Principles:	Principles of component geometry, dimensional tolerance, mould design, application of design parameters.		
	4. Procedure:	Use information data sheet. Describe data sheet for mould design, material and machine.	2	6
5. Conceptual design	**5.1 Sketching conceptual designs**			
	1. Introduction:	Understand alternative conceptual design.		
	2. Definition:	Concept of conceptual design, evaluation.		
	3. Principles:	Principles of conceptual design, developing alternatives, selecting the optimum design.		
	4. Procedure:	Study the component drawing / sample. Develop conceptual design using data sheet, alternative conceptual designs using design parameters. Select the optimal design.	2	6

Units	Detailed Contents		L	P
6. Design of mould	**6.1 Draw assembly and detail drawing of mould**			
	1. Introduction:	Assembly and detailed drawings for manufacturing of mould.		
	2. Definition:	Concept of use of design data sheet. Concept of drawing & layout for assembly and details.		
	3. Principles:	Principle of drawing of mould layout, drawing norms & practices.		
	4. Procedure:	Select process sheet & worksheet for the selected optimal design. Use concept drawing. Draw assembly and detailed drawings of mould.	-	20
7. Mould Data	**7.1 Bill of material**			
	1. Introduction:	Bill of Material and use.		
	2. Definition:	Concept of mould materials, standard parts, processing materials.		
	3. Principles:	Principle of bill of material, selection of material, standard parts material for processing.		
	4. Procedure:	Study data sheet & work sheet, prepare bill of material.		
	7.2 Mould data			
	1. Introduction:	Mould data in the production of component.		
	2. Definition:	Concept of machine set-up, processing parameters.		
	3. Principles:	Principle of material selection, selection of machine, processing parameters.		
	4. Procedure:	Study standards, norms & prepare data for machine set-up, prepare processing data.	2	6
8. CAD	**8.1 Introduction to software packages**			
	1. Introduction:	Software packages and application.		
	2. Definition:	Concept of software packages. Classification of software packages.		
	3. Principles:	Principles of thermosetting material processing using software, thermosetting material processing using software, elastomer processing using software.		
	4. Procedure:	Study and identify the plastics processing software packages.		
	8.2 Design of moulds with CAD			
	1. Introduction:	CAD software for mould design.		
	2. Definition:	Concept of 3D model. Concept of data book. Concept of software package.		
	3. Principles:	Principle of 3D model, assembly modeling, use of data books.		
	4. Procedure:	Design and develop the 3D model of the component, design and develop the assembly model, detail model and prepare the bill of material.	-	6
		Review & Class Test	-	8
		Total No. of Hours	**12**	**78**

3.7 LIST OF EXERCISES FOR TOOL DESIGN PRACTICE-III (PLASTIC MOULDS)

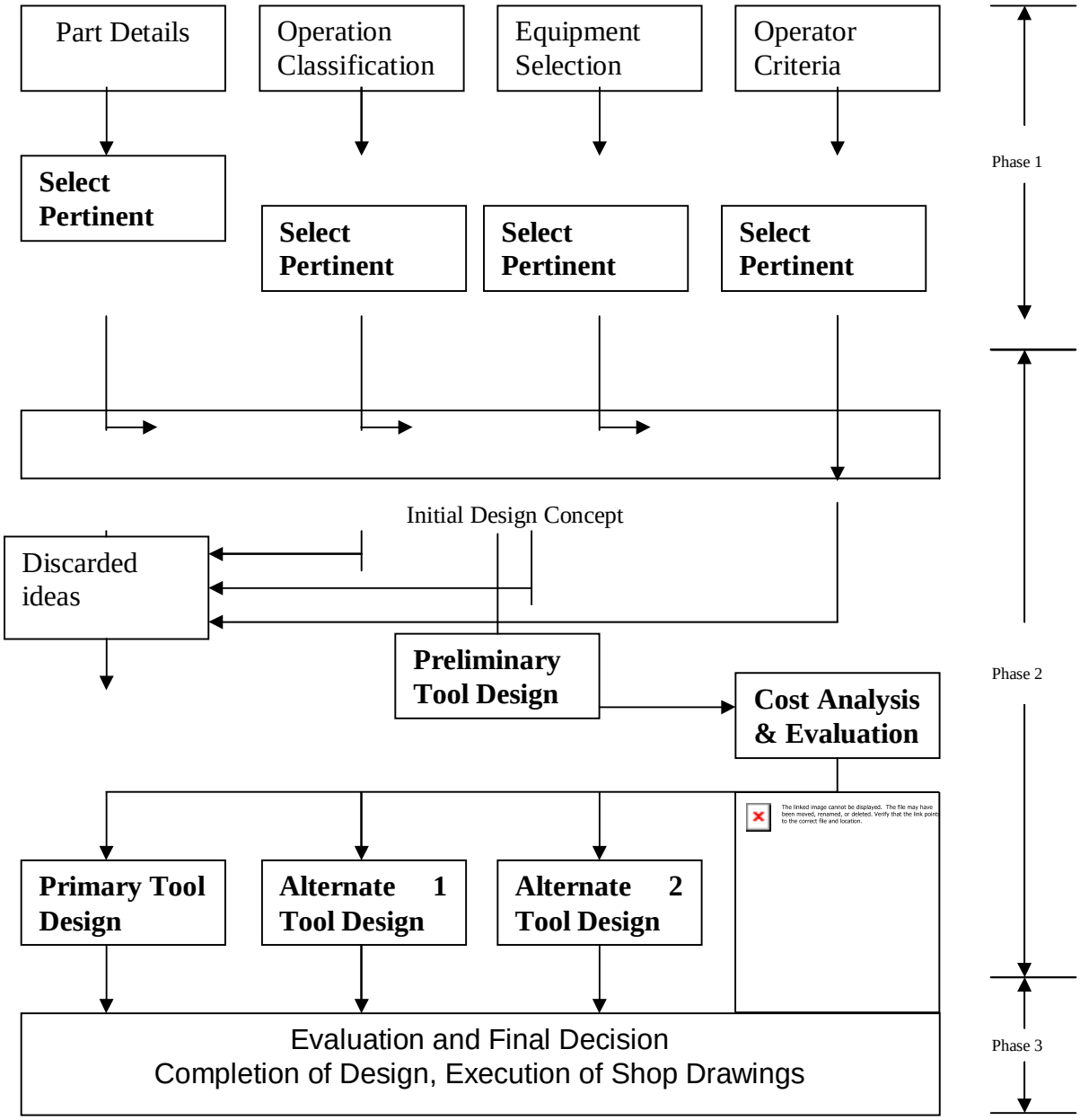
Sr. No.	Exercises	Remarks
1.	Simple mould for compression moulding.	
2.	Standard parts	
3.	Mould bases (thermosets)	
4.	Conventional two plate mould for compression moulding for single cavity and multi-cavity.	
5.	Moulds for compression and transfer moulding (external and internal undercuts, threaded component)	
6.	3-Plate mould for compression and transfer moulding.	
7.	Runner-less-insulated, Hot runner (thermoset)	**Optional exercise**
8.	Checking of design and drawing	
9.	Mould for thermoforming, rotational moulding	**Optional exercise**

Note: Design parameters for compression and transfer mould and flow chart appended for reference.

3.7 DESIGN PARAMETERS
Compression & Transfer Mould (Thermosets)

MOULD	MATERIAL	MACHINE
1. Minimum Moulding Pressure' 2. Depth of Cavity Well or Loading Space 3. Flash Thickness Allowance 4. Transfer Pot Calculation : a) Total area of pot b) Volume of pot c) Depth of pot 5. Sprue, gate & runner dimensions. 1. Shut height 2. Curing Period 3. Mould Temperature 4. Transfer Speed & Pressure 5. Standard Heating Elements 6. Clamping area	1. Bulk Factor 2. Weight of Moulding 3. Total Volume of Loose Powder 4. Moulding Temperature 5. Preheating 6. Shrinkage	1. Machine Shut height 2. Clamping Force 3. Ejection 4. Platen Layout 5. Cycle time 6. Temperature control

3.7 PLASTIC MOULDS
FLOW CHART FOR DEVELOPMENT OF DESIGN SOLUTIONS



3.7 LIST OF REFERENCES FOR
TOOL DESIGN THEORY & PRACTICE – III
(PLASTIC MOULDS)

AUTHOR	TITLE	PUBLISHER
Dominick V. Rosato & Donald V. Rosato	Injection Molding Handbook	CBS Publishers & Distributors, New Delhi
Dominick V. Rosato & Donald V. Rosato	Blow Moulding Handbook	CBS Publishers & Distributors, New Delhi
A. S. Athalye	Plastics Materials Handbook Vol. I & II	Multi-tech Publishing co. Mumbai
A. S. Athalye	Moulding of Plastics	Multi-tech Publishing co. Mumbai
A. S. Athalye	Injection Moulding	Multi-tech Publishing co. Mumbai
Chandra & Mishra	Rubber & Plastic Technology	CBS Publishers & Distributor, New Delhi
Kumar	Fundamentals of Tool Design	Dhjanpat Rai & Co.
Prof. Dr. Ing. Paul Thienel	Special Injection Moulding Processes	ISK. Iseriohner Kuntstoff-Technologie – GmbH Iserlohn (Germany)
Throne J. L.	Thermoforming	SPE Books From Hanser Publishers

3.8 TOOL DESIGN THEORY – IV
(FORGING & CASTING DIES)

Objectives

This subject is intended to know the facts, concepts, principles and procedures of Tool Design Techniques so that this knowledge can be used in Tool Design Practice effectively and efficiently. It is also useful in understanding technology subjects and apply them in the areas such as Workshop Practice, CAD / CAM, Production Planning, Estimation, Industrial Management and Quality Assurance.

Units	Detailed Contents	L	P
1. Introduction to forging dies	**1.1 Overview of mass production of forged components** 1. Introduction: An Overview of mass production of forged components 2. Definition: Concept of forging process, forging equipment, forged materials and forging die features. 3. Principles: Principles of forging process, forging equipment, forged materials and forging die features. 4. Procedure: Study use of raw material, forging equipment & forging dies. Design drawing and forged components.	2	-
2. Forging operations	**2.1 Closed die hammer forging operation** 1. Introduction: Closed die hammer forging operations. 2. Definition: Concept of forging hammer & main parts, closed forged die elements, different operations such as preforging, fuller, edger, blocker, finisher, bender. Concept of trimming tool. 3. Principles: Principles of metal flow in hammer forgings, closed forging die elements. Various forging operations. 4. Procedure: Study & observe forging process for various forged components using closed die forging hammer. Application of trimming tool.		
	2.2 Closed die press forging operation 1. Introduction: Closed die press forging operations. 2. Definition: Concept of forging press & main parts, closed die elements, different operations such as reduce rolled form, blocker, finisher, bender. 3. Principles: Principles of metal flow in press forging, press forging operations. 4. Procedure: Study & observe forging process for forged components using closed die & forging press.		
	2.3 Upsetting die forging and cold forging operation 1. Introduction: Upsetting die & cold forging operations. 2. Definition: Concept of upsetting forging and cold forging, die elements and forging equipment. 3. Principles: Principles of metal flow in upsetting and cold forging, forging equipment. 4. Procedure: Study & observe upsetting operations. Describe various steps in cold forging operation.		

Units	Detailed Contents	L	P
	2.4 Forging defects and remedies 1. Introduction: Overview of forging defects & remedies. 2. Definition: Concept of forging defects, classification of defects during processing. 3. Principles: Principle of defects & causes in forged components and remedies. 4. Procedure: Observe various forged components. Use check lists to identify defects and remedies.	10	-
3. Elements of forging dies	**3.1 Elements of various forging dies and their function** 1. Introduction: Elements of forging dies & die impressions such as fuller, edger, bender, blocker, finisher. 2. Definition: Concept of top die, bottom die. (Fixed die & movable die in upsetter dies). Impressions and operations. Alignment of dies and reference edges. 3. Principles: Principle of plastic deformation (elongation, gathering, filling the cavities), sequence of operations. 4. Procedure: Study & observe forging operation, features and functions of elements of various forging dies.	2	-
4. Classifi-cation of forging dies	**4.1 Classification of various forging dies** 1. Introduction: Forging dies and classification. 2. Definition: Concept and classification such as open die, closed die, upsetting dies, cold forging dies and extrusion dies for forging. 3. Principles: Principle of die construction, selection of die construction. 4. Procedure: Study and observe construction of dies. Features and functions of various forging dies.	2	-
5. Tool design parameters	**5.1 Design of component drawing** 1. Introduction: Design of component Drawing. 2. Definition: Concept of machining allowances, parting line position, balancing of parting line. draft angle, web dimensions, rib dimensions, corner, fillet & other radii, forging tolerances. 3. Principles: Principles of selection of various parameters, preparing forging drawing of component. 4. Procedure: Procedure for selection of parameters for forging drawing component.		
	5.2 Design of forging tools such as fuller, edger, bender, blocker, finisher. 1. Introduction: Design of fuller, edger, bender, blocker and finisher. 2. Definition: Concept of designing parameters of forging tools such as fuller, edger, blocker and finisher. 3. Principles: Principle of metal flow, dimensions and tolerancing. Selection of optimal design parameters for forging tools. 4. Procedure: Design and draw detail drawing, assembly drawing of forging dies & tools. Various steps in selection of optimal design parameters.		

Units	Detailed Contents		L	P
	5.3 Design of trimming tool			
	1. Introduction:	Design of trimming tool.		
	2. Definition:	Concept of hot shearing, trimming equipment, trimming load and trimming tool.		
	3. Principles:	Principle of load calculation, selection of trimming equipment, selection of design parameter.		
	4. Procedure:	Design and draw detail parts and assembly drawing of trimming tool.	20	-
6. Specifi-cation & estimation	**6.1 Specification of dies, material and machine**			
	1. Introduction:	Specification of dies, material and machine.		
	2. Definition:	Concept of forging tool, material and forging equipment.		
	3. Principles:	Principle of forging dies, tools, material and equipment.		
	4. Procedure:	Study and specify forging dies, tools, material and forging equipment.		
	6.2 Estimation of forging dies, material and machine.			
	1. Introduction:	Estimation of material, machining hours and process (cycle time).		
	2. Definition:	Concept of material, forging die, machine time estimation for die making. Cycle time estimation for forging process.		
	3. Principles:	Principle of material weight and volume. Principle for estimation using process sheet analysis for die making and cycle time.		
	4. Procedure:	Study component drawing, estimate material requirement, bill of material and material for forging die. Detail drawing and machining hours for making forging die. Describe procedure for estimating die forging cost per unit hour.	4	-
7. Maintenance safety & storage	**7.1 Maintenance, Safety & Storage of forging die, tools & material.**			
	1. Introduction:	Maintenance, Safety & Storage of forging die, tools & material.		
	2. Definition:	Concept of maintenance, safety and storage of dies, tools and material.		
	3. Principles:	Principle of maintenance, safety and storage of dies, tools and material.		
	4. Procedure:	Study and observe die safety, machine safety and operator safety. Study standard checklist for maintenance of forging dies and tools. Procedure for storage of forging dies and tools.		
	7.2 Handling of dies and material			
	1. Introduction:	Handling of dies, raw material and forged components.		
	2. Definition:	Concept of movement of dies, raw material and forged components.		
	3. Principles:	Principle of movement of dies, raw material and forged components.		
	4. Procedure:	Study and observe methods of handling dies, raw material and forged component.	4	-

Units	Detailed Contents	L	P
8. Introduction to casting dies	**8.1 Overview of mass production of die casting parts** 1. Introduction: Casting dies, metals used for casting, casting machine and their relationship. 2. Definition: Concept of castable metals, die casting process, machines, casting dies. 3. Principles: Principle of mass production, casting metal, die casting component, die casting machines, casting dies as process of mass production. 4. Procedure: Castable metals, die casting machines, casting dies as process of mass production.	2	-
9. Die casting operations	**9.1 Gravity die casting** 1. Introduction: Gravity die casting process and it's application. 2. Definition: Concept of gravity die casting, concept of metal moulds and casting. Process setup data, casting process elements such as die and metal. 3. Principles: Principle of gravity die casting die, set-up parameters, selection of metal. 4. Procedure: Study and describe gravity die casting process. **9.2 Pressure die casting (cold & hot chamber)** 1. Introduction: Cold and hot chamber die casting process and application. 2. Definition: Concept of parts and functions of cold and hot chamber die casting machines, die casting process, casting die. Clamping, heating and feeding, ejection system. 3. Principles: Principle of cold and hot chamber die casting machine and parts. Die casting process. 4. Procedure: Study and observe various parts and functions of cold and hot chamber die casting process. **9.3 Defects and remedies** 1. Introduction: Various defects and remedies for casting components. 2. Definition: Concept of die casting, defects caused in processing and their remedies. 3. Principles: Principle of die casting, defects and their remedies caused in processing. 4. Procedure: Identify various defects in die cast component. Analyze possible causes for defects and remedies.	4	-
10. Elements of die casting dies	**10.1 Elements of feeding, cooling and ejection systems** 1. Introduction: Elements of feeding, cooling and ejection systems 2. Definition: Concept and classification of feeding, cooling and ejection system. 3. Principles: Principle of feeding, cooling and ejection system. 4. Procedure: Describe cooling, feeding and ejection system for die casting dies.	4	-

Units	Detailed Contents		L	P
11. Classifi-cation of casting dies	**11.1 Cold chamber and hot chamber dies**			
	1. Introduction:	Cold chamber and hot chamber dies.		
	2. Definition:	Concept & classification of dies, cold & hot chamber die, die casting dies parts and functions.		
	3. Principles:	Principle of hot & cold chamber die casting die, parts and construction.		
	4. Procedure:	Study and describe function and construction of cold and hot chamber die casting dies.		
	11.2 Gravity die casting dies			
	1. Introduction:	Gravity die casting dies.		
	2. Definition:	Concept of gravity die casting die, die parts and functions.		
	3. Principles:	Principle of gravity die casting die, casting process, selection of die.		
	4. Procedure:	Study and observe function and construction of gravity casting dies.	2	-
12. Design parameters	**12.1 Pressure die casting dies-cold & hot chamber**			
	1. Introduction:	Understand design parameters in pressure die casting dies (cold & hot chamber).		
	2. Definition:	Concept of design parameters for pressure die casting dies, machine and parts. Concept of quality and quantity, construction of die. Properties of material for die casting.		
	3. Principles:	Principle of design parameters for pressure die casting dies, machine and parts. Concept of quality and quantity, construction of die. Properties of material for die casting.		
	4. Procedure:	Identify design parameter for pressure die casting, material and machine. Use recommended data (technological values). Apply formulae and standard tables for cold & hot chamber dies.		
	12.2 Gravity die casting dies			
	1. Introduction:	Understand gravity die casting dies.		
	2. Definition:	Concept of design parameters for gravity die casting and material. Concept of quality and quantity. Properties of material for gravity die casting.		
	3. Principles:	Principle of design parameters for gravity die casting, quality and quantity requirements.		
	4. Procedure:	Identify design parameters for gravity die casting and material. Use recommended data (technological values).	20	-
13. Specifi-cation & estimation	**13.1 Specification of die, material and machine**			
	1. Introduction:	Specification of die, material and machine and use.		
	2. Definition:	Concept of die casting die specification, die casting metal specification, machine specification.		
	3. Principles:	Principle of specification of die casting die, material and machine.		
	4. Procedure:	Describe specification of die casting die, die casting machine, metal specification.		

Units	Detailed Contents		L	P
	13.2 Estimation of die, material and machine			
	1. Introduction:	Estimation of die, material and machine and use.		
	2. Definition:	Concept of material, casting die, machine time estimation for die making. Cycle time for casting process.		
	3. Principles:	Principle of material weight and volume. Principle for estimation of time using process analysis for die making and cycle time.		
	4. Procedure:	Study component drawing and estimate material, bill of material and material for casting die. Detail drawing and machining hours for casting dies. Describe procedure for estimating die casting cost per unit hour	4	-
14. Maintena-nce, safety &storage	**14.1 Maintenance, safety and storage of dies, tools & material**			
	1. Introduction:	Maintenance, safety and storage of dies, tools & material		
	2. Definition:	Concept of safety of die, material and machine.		
	3. Principles:	Principle of safety, maintenance and storage.		
	4. Procedure:	Study and observe die safety, machine safety and personal safety. Study standard checklist for maintenance of machine and casting dies. Describe procedure for storage of die casting dies.		
	14.2 Handling of dies and material			
	1. Introduction:	Pre-casting and post casting techniques.		
	2. Definition:	Concept and classification of pre-casting and post-casting techniques. Selection of equipment.		
	3. Principles:	Principle of pre-casting and post-casting techniques. Selection of equipment.		
	4. Procedure:	Describe types of pre-casting and post-casting techniques and related equipments.	3	1
15. Computer aided design analysis	**15.1 Introduction of simulation and analysis packages (optional for learning-not for examination)**			
	1. Introduction:	Simulation packages and application.		
	2. Definition:	Concept of process parameters. Classification of simulation packages.		
	3. Principles:	Principle of selection of process parameters using software package.		
	4. Procedure:	Demonstration of simulation packages. Study and observe the use of simulation packages.	2	-
		Review & Class Test	5	-
		Total No. of Hours	**90**	-

3.8 LIST OF REFERENCES FOR TOOL DESIGN THEORY – IV (FORGING & CASTING DIES)

AUTHOR	TITLE	PUBLISHER
Edward M. Mielnik	Metal working Science & Engineering	Mc Graw Hill, Inc
A. Thomas	Forging Hand book Forging Methods	Drop forging Research association Shepherd street SHEFFIELD, 7BA
American Society for Metals	Forging Design Hand book A.S.M.	Metal Park Ohio – 44073
American Iron & Steel Institute	Principles of Forging Design	New York 10017
R. Sharan S.N. Prasad N.P. Saxena	Forging Die Design & Practice	S. Chand & Co. New Delhi
T.G. Byrer	Forging Hand book	American Society for Metals
E.A. Hermen	Die casting dies designing	The Society of Die Casting Engineers
Shahjahan	CITD Handout	CITD Hyderabad
Phillip F. Ostwald & Jairo Munoz	Manufacturing process and systems ISBN 0-471-04741-4 (alk. Paper)	John Wiley & Sons.
R. Thomas Wright	Manufacturing systems	The Goodheart-Willcox Co.
V. Vladimi Rov	Dies, moulds and jigs	Mir Publisher
CITD	CITD Handout on ”Metal and alloys for die casting”	CITD Hyderabad
CITD	CITD Handout on “Design techniques-Die casting dies”	CITD Hyderabad
CITD	CITD Handout on “Gate calculation for die casting dies”	CITD Hyderabad
CITD	CITD Handout on “Design of die casting”	CITD Hyderabad

3.9 TOOL DESIGN PRACTICE – IV
(FORGING & CASTING DIES)

Objectives

This subject describes the concepts, principle and procedures to design and draw forging and casting dies for given components so that the same can be manufactured to produce components of right quality and quantity. It also describes to calculate design parameters, verify designs, using data sheets and information to validate the design from the tried out component. It is also useful in understanding technology subjects and apply them in the areas such as workshop practice, CAD & CAM, production planning, estimation, industrial management and quality assurance.

NOTE: List of exercises, design parameters and flow chart appended herewith for reference.

Units	Detailed Contents	L	P
1. Elements of design for forging dies	**1.1 Introduction to forging die design practices** 1. Introduction: Typical die design and drawing of forging die and application. 2. Definition: Concept of die layout and detail drawing, drawing of component, data sheet and bill of material. 3. Principle Principle of die layout, drawing norms and practices. 4. Procedure: Study and observe typical tool design layout, detail and assembly drawing of forging die and tool.		
	1.2 Overview of principles 1. Introduction: Design principle for forging die, material and hammer/ press. 2. Definition: Concept of forging die, hammer & presses. Classification of forging die. 3. Principle Principle of forging operation, forging die, hammer & presses. Classification of forging die. 4. Procedure: Study features and function of forging die and equipment for forged component.	2	-
2. Standard parts of dies	**2.1 Standard parts of forging dies** 1. Introduction: Standard parts of forging dies. 2. Definition: Concept of hammer keys, fixing keys, shank, dowel, dowel slot. 3. Principle Principle of location, clamping of die block. 4. Procedure: Study and draw standard die block for hammer and press forging.	2	6
3. Component & layout	**3.1 Drawing of forging components** 1. Introduction: Drawing of forging components and application. 2. Definition: Concept of allowances, parting line, balancing of parting line, draft angle, corner and fillet radius, web, rib and boss. Dimensioning and tolerancing. 3. Principle Principle of allowances, parting line, balancing of parting line, draft angle, corner and fillet radius, web, rib and boss. Dimensioning and tolerancing. 4. Procedure: Study component drawing or sample. Use geometrical and dimensional tolerances. Draw component drawing for forging operations.	2	5

Units	Detailed Contents		L	P
4. Forging data sheet	**4.1 Work data sheet for forging die, material and equipment**			
	1. Introduction:	Work data sheet for forging die, material and equipment.		
	2. Definition:	Concept of data sheet, forging process, stock size.		
	3. Principle	Principle of selection of data for material, die and equipment. Principle of die design, application of design parameters.		
	4. Procedure:	Prepare work data sheet for forging die, material and equipment.	-	5
5. Conceptual design	**5.1 Sketching conceptual designs**			
	1. Introduction:	Understand sketching conceptual designs for forged components.		
	2. Definition:	Concept of forging drawing, raw material size and weight, material utilization, performing operations, sequence of operations.		
	3. Principle	Principle of material utilization, performing operations, selection of sequence of operations.		
	4. Procedure:	Decide stock dimensions. Describe forging operations to optimize the conceptual design.	-	8
6. Design parameters for forging dies	**6.1 Design & drawing fuller, edger, blocker, bender, finisher & trimming tool**			
	1. Introduction:	Understand design and drawing fuller, edger, blocker, bender, finisher & trimming tool.		
	2. Definition:	Concept of sequence operations and die layout, detail drawing. Design parameters. Concept of trimming tool layout and detailed drawing.		
	3. Principle	Principle of selection of sequence of operations and die layout. Principle of trimming tool layout and detail drawing. Design parameters.		
	4. Procedure:	Select die block. Draw detail drawing of forging die & tool.	7	35
7. CAD for forged components	**7.1 Modeling forged components using CAD**			
	1. Introduction:	CAD, MDT software for modeling.		
	2. Definition:	Concept of creating the part. Concept of volume.		
	3. Principle	Principle of creating the part, volume calculation.		
	4. Procedure:	Model the component using CAD software. Find volume of forged component.	-	6
8. Elements of design for casting dies	**8.1 Introduction to casting die practice**			
	1. Introduction:	Layout of casting die designs.		
	2. Definition:	Concept of layout (Assembly drawing), bill of material, detail drawing.		
	3. Principle	Principle of deign layout and detail drawing, drawing norms and practice.		
	4. Procedure:	Study and observe tool design layout.		

Units	Detailed Contents		L	P
	8.2 Overview of principle			
	1. Introduction:	Design principles for die casting die, material and machine.		
	2. Definition:	Concept of feature of component, casting die and machine. Property of material.		
	3. Principle	Principle of dies casting process, construction of die casting dies.		
	4. Procedure:	Study feature of component, die casting die, material and machine.	2	-
9. Standard parts of dies	**9.1 Standard die set bases for die casting die**			
	1. Introduction:	Standard die set bases for die casting die and application.		
	2. Definition:	Concept and classification of die set and bases, material for die set. Assembly and detail drawing.		
	3. Principle	Principle of die set and bases, material for die set. Assembly and detail drawing.		
	4. Procedure:	Draw assembly and detail drawing of die set and base.		
	9.2 Representation of standard elements			
	1. Introduction:	Representation of standard elements.		
	2. Definition:	Concept and classification of standard elements, nomenclature of standard elements.		
	3. Principle	Principle of selection of standard elements from catalogues. Representation of standard elements.		
	4. Procedure:	Draw standard elements and their representation.	3	8
10. Component & layout	**10.1 Component drawing**			
	1. Introduction:	Component drawing and application.		
	2. Definition:	Concept of shrinkage, allowances, limits & fits.		
	3. Principle	Principle of shrinkage and allowances.		
	4. Procedure:	Study component / sample, use geometrical and dimensional tolerances. Draw component drawing.		
	10.2 Runner and gating system layout			
	1. Introduction:	Runner and gating system layout.		
	2. Definition:	Concept and classification of feeding system, runner & gate.		
	3. Principle	Principle of selection of feed system, layout of runner and gating system.		
	4. Procedure:	Study component drawing/ sample. Select runner and gating system. Draw runner and gating system layout.		
	10.3 Cooling layout			
	1. Introduction:	Cooling layout.		
	2. Definition:	Concept of core & cavity, die casting construction. Concept of cooling.		
	3. Principle	Principle of cooling layout, selection of cooling layout.		
	4. Procedure:	Select and draw cooling layout system.	3	8

Units	Detailed Contents		L	P
11. Work data sheet	**11.1 Design parameter for die material and machine**			
	1. Introduction:	Understand design parameter for die material and machine		
	2. Definition:	Concept and classification of design parameters based on die, material and machine.		
	3. Principle	Principle of component geometry, quality and quantity requirement. Selection of design parameters based on die, material and machine.		
	4. Procedure:	Study and use design parameters based on die material and machine. Calculate and verify design parameter.		
	11.2 Data sheet for die, material and machine			
	1. Introduction:	Data sheet for die, material and machine and application.		
	2. Definition:	Concept and specification of die, material and machine, process parameter. Concept of data sheet.		
	3. Principle	Principle of die, material and machine, process parameter. Concept of data sheet.		
	4. Procedure:	Prepare data sheet for die, material and machine.	3	7
12. Conceptual design	**12.1 Sketching conceptual design**			
	1. Introduction:	Understand alternative sketching conceptual design.		
	2. Definition:	Concept of design of casting die, selection of optimal design parameters. Concept of conceptual design, evaluation of alternative design.		
	3. Principle	Principle of conceptual design, developing alternatives, selection of optimum design.		
	4. Procedure:	Study component drawing/ sample. Use work data sheet to develop the conceptual design and evaluate.	3	5
13. Design of die casting dies	**13.1 Draw assembly and detail drawing of die casting dies.**			
	1. Introduction:	Draw assembly and detail drawing of die casting dies.		
	2. Definition:	Concept of design data sheet, drawing and layout for assembly and detail drawing.		
	3. Principle	Principle of drawing norms and practices, drawing of die casting die design and layout.		
	4. Procedure:	Use process sheet and work sheet from design parameter for optimal design. Draw assembly and detail drawing of die casting die.	3	27
14. Die casting dies	**14.1 Bill of material**			
	1. Introduction:	Bill of material and its use.		
	2. Definition:	Concept of bill of material, casting die material, standard parts, material for processing.		
	3. Principle	Principle of bill of material, standard parts, material for processing.		
	4. Procedure:	Study data sheet and work sheet. Prepare bill of material.		

Units	Detailed Contents		L	P
	14.2 Die casting data			
	1. Introduction:	Die casting data and its use.		
	2. Definition:	Concept of machine set-up, processing parameters.		
	3. Principle	Principle of material selection, selection of machine, processing parameters.		
	4. Procedure:	Study standard norms and prepare data for machine set-up, die casting data.	-	4
15. CAD	**15.1 Introduction to software packages**			
	1. Introduction:	Software packages and application.		
	2. Definition:	Concept and classification of software packages.		
	3. Principle	Principle of processing of non-ferrous metal using software package.		
	4. Procedure:	Study and identify non-ferrous metal processing software package.		
	15.2 Design of die casting with CAD (optional for learning not for examination)			
	1. Introduction:	Design of die casting with CAD.		
	2. Definition:	Concept of using software package, 3D modeling, assembly modeling.		
	3. Principle	Principle of 3D modeling, assembly modeling, selection of design parameters.		
	4. Procedure:	Design and develop 3D model of component. Design and develop assembly and detail drawing and bill of material.	-	6
		Review & Class Test	-	20
		Total No. of Hours	**30**	**150**

3.9 List of exercises for Tool Design Practice – IV
(Forging & Casting Dies)

Sr. No.	Exercises	Remarks
1.	Forging Die for double ended spanner of some standard size.	
2.	Forging Die for reducing socket of some standard size	
3.	Trimming tool for double ended spanner or reducing socket	
4.	Pressure die casting Die – single & multi-cavity cold chamber process	
5.	Pressure die casting Die – single & multi-cavity hot chamber process	
6.	Die sets / bases for pressure die casting die and standard parts	
7.	Checking of design and drawing	

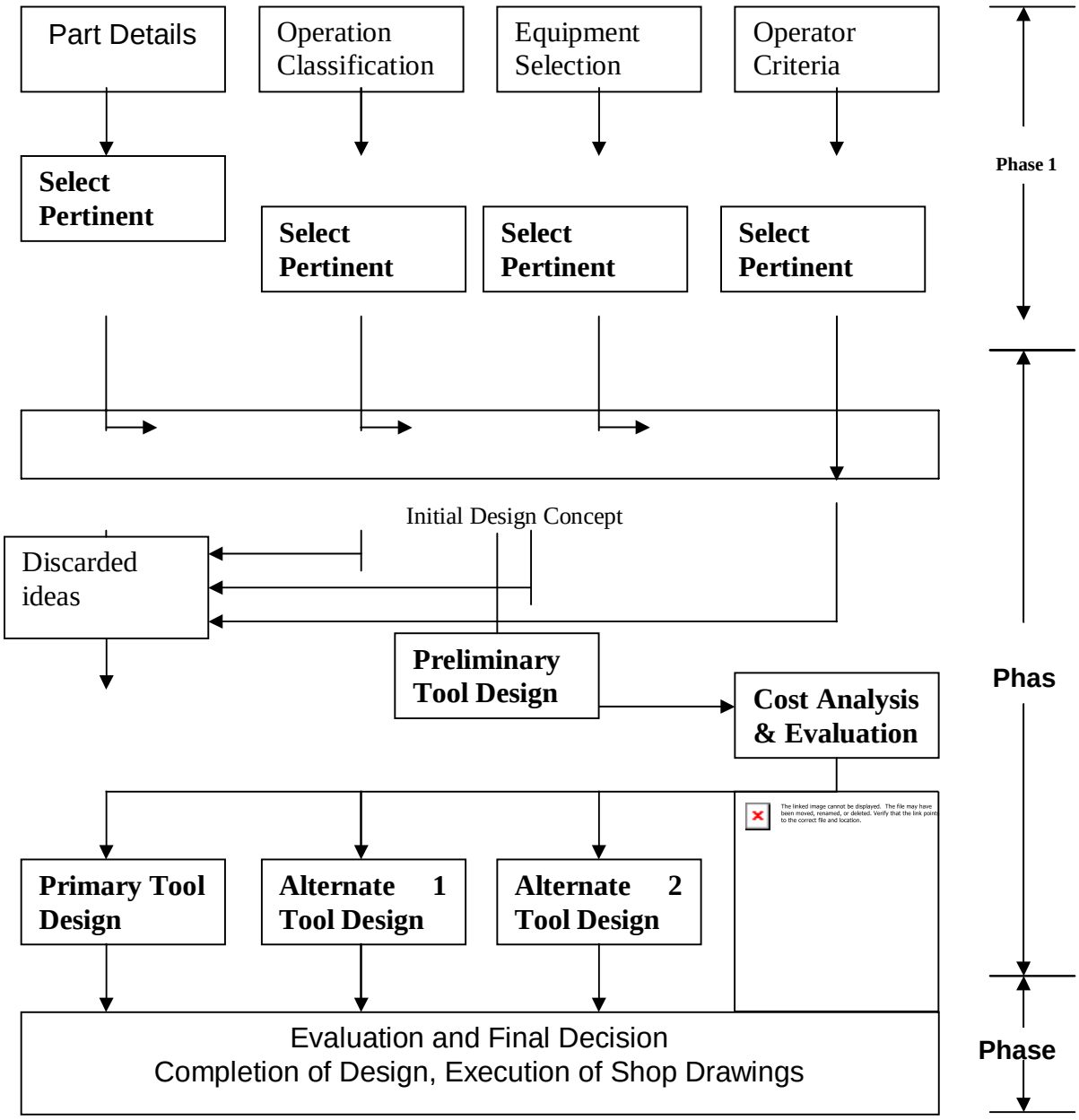
Note: 1. Adequate choice may be provided in the question paper on designing of Forging & Casting Dies.
2. Design parameter of Die Casting Dies and flow chart appended herewith.

3.9 DESIGN PARAMETERS FOR DIE CASTING DIES (HOT CHAMBER & COLD CHAMBER)

*** Hot Chamber Dies**

DIE	MATERIAL	MACHINE
1. Number of cavities	1. Specific Gravity	1. Injection pressure
2. Injection pressure	2. Melting Temperature	2. Registering hole size
3. Injection Time	3. Shrinkage	**3.** Nozzle *****
4. Ejection Temperature	4. Solidns temperature	4. Platen sizes
5. Die Temperature	5. Specific Heat	5. Shut height / Day light
6. Cycle Time	6. Castablity	6. Ejection Stroke
7. Runner Area	7. Hot Shortness	7. Minimum Thickness
8. Gate Dimensions (L x b x t)	8. Ageing	8. Maximum Thickness
9. Number of Gates	9. Thermal Conductivity	9. Variable Clamping Force
10. Cavity balancing		10. Tie Bar Distance (H x V)
11. Tie bar loading		11. Clamping holes on both platens
12. Short sleeves(Design & Fitment)		12. Knock holes on both platens
13. Over Flows		13. Plunger diameter
14. Push Back Pins		
15. Vents		
16. Shot weight		
17. Ejector assembly		
18. Sprue *****		
19. Sprue bush *****		
20. Die Heating		
21. Die hardness		
22. Projected area		
23. Surface area of cavity		
24. Temp. of shot cylinder		
25. Min. wall thickness		
26. Runner Velocity		
27. Gate Velocity		
28. Filling rate		
29. Die Dimensions		
30. Parting Surface Matching		
31. Die Lifting Holes		
32. Die Bolsters		
33. Core & Cavities Draft		
34. Die Polishing		
35. Guide Pillars & Bushes		
36. Splits		

3.9 FLOW CHART FOR DEVELOPMENT OF DESIGN SOLUTIONS (FORGING & CASTING DIE DESIGN)



3.9 LIST OF REFERENCES FOR TOOL DESIGN PRACTICE – IV (FORGING & CASTING DIES)

AUTHOR	TITLE	PUBLISHER
Edward M. Mielnik	Metal working Science & Engineering	Mc Graw Hill, Inc
A. Thomas	Forging Hand book Forging Methods	Drop forging Research association Shepherd street SHEFFIELD, 7BA
American Society for Metals	Forging Design Hand book A.S.M.	Metal Park Ohio – 44073
American Iron & Steel Institute	Principles of Forging Design	New York 10017
R. Sharan S.N. Prasad N.P. Saxena	Forging Die Design & Practice	S. Chand & Co. New Delhi
T.G. Byrer	Forging Hand book	American Society for Metals
E.A. Hermen	Die casting dies: Designing the society of die casting engineers	The Society of Die Casting Engineers
Shahjahan	CITD Hanout	CITD
A. Kumar	Fundamentals of Tool Design	Dhjanpat Rai & Co.
R. Thomas Wright	Manufacturing systems	The Goodheart-Willcox Co.
V. Vladimi Rov	Dies, moulds and jigs	Mir Publisher
CITD	CITD Handout on ”Metal and alloys for die casting”	CITD Hyderabad
CITD	CITD Handout on “Design techniques-Die casting dies”	CITD Hyderabad
CITD	CITD Handout on “Gate calculation for die casting dies”	CITD Hyderabad
CITD	CITD Handout on “Design of die casting”	CITD Hyderabad

3.10 WORKSHOP PRACTICE-II

Objectives

At the end of 3rd year, the students will be able to acquire skills in CNC Technology. The trainee will learn knowledge in programming on CNC machines and achieve skills in the handling of CNC machines. The integrated skills on CNC machines and conventional machines enables trainee to make complicated type of components and parts of press tools, plastic moulds, jigs & fixtures.

Units	**Detailed Contents**	**Time allotted**	
		Weeks	**Hours**
UNIT – I Basic CNC programming and machining of tool & die parts	1.1 CNC turning, programming and machine handling 1.2 CNC Milling, programming and machine handling 1.3 EDM 1.4 Wire EDM, programming and machine handling 1.5 CAD/CAM – programming & simulation on softwares	10	450
UNIT-II Manufacturing of tools & dies ordered by external customers	2.1 Manufacture of jigs & fixtures 2.2 Manufacture of press tools 2.3 Manufacture of moulds 2.4 Trouble shooting and repair of tools & dies	16	720
	Total Nos.	**26**	**1170**

Note: Shoptalk @ 3 periods per week is included in the total number of hours.

4.1 ENTREPRENEURSHIP DEVELOPMENT

Objective

This is a human science subject intended to make students aware about importance of entrepreneurship and to teach students the basic concepts, principles and procedures related to the entrepreneurship development. The students are exposed to the real life problems related to an entrepreneurship or business by case study and visits to the industrial establishments of similar nature.

Note: There will be no external examination on this subject. Sessional marks on the basis of internal assessment will be awarded.

Units	Detailed Contents	L	P
1. Introduction	1.1 Introduction to Entrepreneurship development.	2	-
2. Information gathering for identification of Opportunity	2.1 The concept of entrepreneurship, entrepreneur opportunity & innovation. 2.2 The information sources for business opportunity. 2.3 Information gathering techniques. 2.4 Identification of product or services for getting business.	8	-
3. Product & service design	3.1 Specifications. 3.2 Industrial survey. 3.3 Principle of market survey. 3.4 Analysis of survey data & product/service design.	4	-
4. Project formulation for establishing own business	4.1 System concept & project format based on job design for manufacturing product or creating service capabilities. 4.2 Estimation of resource required for establishing the enterprise or starting business. 4.3 The procedure of project report writing for getting approval from financing agencies for starting enterprise or service.	6	-
5. Acquisition of resources required for starting business	5.1 The concept of quality resources, preparation of specification & identification of specific need of physical resources, human resource, energy resource & finance. 5.2 Approach for the resources. 5.3 Making payments of resources received.	5	-
6. Establishing & running the enterprise	6.1 The concept of managing enterprise. 6.2 Production & sale of product / service business	4	-
7. Budgeting & accounting for running the enterprise	7.1 Concept of Budget / Accounting. 7.2 Budget preparation. 7.3 Procedure of accounting / expenditure. 7.4 Preparation of Balance sheet.	5	-
8. Evaluation & quality control	8.1 Concept of evaluation & quality control. 8.2 Principles of evaluation & quality control. 8.3 Procedure of evaluation & quality control.	6	-
9. Assignment to each trainee / student as project report	9.1 Prepare a project report for setting up a small industry mentioning all essential inputs and outputs in order to obtain registration as small scale industry.	-	-
	Review & Class Test	5	-
	Total No. of Hours	**45**	**-**

4.2 INDUSTRIAL MANAGEMENT

Objectives

This subject is classified as Management Science. It is intended to teach the students/ trainees the facts, concepts, principles and procedure of management studies, human behavior, organizational structure, supervisory functions, accountancy & purchase functions so that this knowledge can be used in shop floor human management. This knowledge can also be used to develop entrepreneurship and understand Industrial Legislation for better communication between staff and management.

Units	Detailed Contents	L	P
1. Introduction	**1.1 System concept, management concept and scientific management** 1. Introduction: Overview of system concept & Management. 2. Definition: Concept of Management, classification of Management, scientific management. Concept of system, system designs. 3. Principles: Principles of system design. Principles of management, scientific management. 4. Procedure: Study procedure for designing a system. Study the functions of management, scientific management.	4	-
2. Human Relation	**2.1 Patterns of Human Behaviour** 1. Introduction: The influence of Human behaviour in organization. 2. Definition: Concept of Industrial Psychology. Concept of Individual behaviour, group behaviour. Concept of morale, motivation. 3. Principles: Principles of Industrial Psychology. Principles of behaviour (Individual & group), Principles of Personnel Management, Causes & effect of morale, Causes & effect of motivation. 4. Procedure: Study Industrial Psychology. Factors affecting the Human behaviour (Individual & group). Methods to improve morale, methods to improve motivation.	4	-
3. Structure of industrial organization	**3.1 Organization structure** 1. Introduction: Overview of organization structure. 2. Definition: Concept of organization, organization structure. Concept of authority & responsibilities, span of control, goal achievement. Concept of line & staff function, delegation of function, organizational chart. 3. Principles: Principles of organizational structure, authority & responsibilities, delegation of function. Principles of co-ordination & communications. span of control, line & staff function, organizational chart. 4. Procedure: Study the Organization structure, goals of Organization, Design of organizational structure, developing organizational chart.		
	3.2 Dynamic organization 1. Introduction: Overview of dynamic organization. 2. Definition: Concept of Dynamic organization, growth and decay, effective communication, motivation and morality and leadership. 3. Principles: Principles of dynamic organization, growth & decay, effective communication, motivation & morality and leadership.		

Units	Detailed Contents		L	P
	4. Procedure:	Study the phases of dynamic organization, growth and decay, leadership qualities, communication impact, motivation and morale factors.		
	3.3 Types of organization in industry			
	1. Introduction:	Overview of types of organization in Industry.		
	2. Definition:	Concept of single ownership, partnership & classification, joint stock company & classification. Co-operative organization & classification. State & central government owned organization & classification.		
	3. Principles:	Principles of application of each type of Organization.		
	4. Procedure:	Study functions and features of each type of organization.	8	-
4. Supervision & leadership	**4.1 Duties of supervisor and leadership**			
	1. Introduction:	Overview of supervisor role in an Organization.		
	2. Definition:	Concept & classification of Management (Top, middle, Junior Management). Concept & classification of Leadership.		
	3. Principles:	Principles of Management (Top, middle, Junior), supervision & leadership.		
	4. Procedure:	Study the levels of Management. Duties & responsibilities of supervisor towards: management, workers, fellow supervisors, characteristics of good leadership.		
	4.2 Effective supervision			
	1. Introduction:	Overview of Supervisor role in an Organization.		
	2. Definition:	Concept of effective supervision, towards work and people. Concepts of achieving target, Controlling cost, Cooperation, Improvement in work system, Motivation, Team development, Discipline, Management of change, Human Relations, Leadership, Communication,		
	3. Principles:	Principles of qualification & qualities of Supervisor, effective supervision towards work & people.		
	4. Procedure:	Study the qualification & qualities of Supervisor. Factors of effective supervision towards work & people.		
	4.3 Supervisor's activities			
	1. Introduction:	Overview of Supervisor's activities.		
	2. Definition:	Concept of Daily schedule, weekly schedule, monthly schedule, yearly schedule, monitoring, reviewing, corrective action.		
	3. Principles:	Principles of preparation of daily, weekly, monthly & yearly schedules. Principles of monitoring. Principles of reviewing and corrective action.		
	4. Procedure:	Study the preparation of schedules. Monitoring schedules & reviewing with corrective action.	10	-
5. Industrial Legislation	**5.1 History & necessity of industrial legislation**			
	1. Introduction:	History & necessity of industrial legislation.		
	2. Definition:	Concept of Industrial legislation, social justice, social equality, National economy, international uniformity.		

Units	Detailed Contents		L	P
	3. Principles:	Principles of Industrial legislation: Laws related to working conditions, Laws related to wages, Laws related to associations, Laws related to social insurance.		
	4. Procedure:	Study the principles of Industrial legislation and types of laws.		
	5.2 Factory Act 1948			
	1. Introduction:	Overview of Factory Act, 1948.		
	2. Definition:	Concept of Factory Act, 1948. Concept of terms related to Factory Act (Factory, manufacturing process, worker, Adult, child, power, machinery, occupier of factory). Concept of Registration. Concept of Health, safety, hours of work, work environment, employee welfare & leave with wages.		
	3. Principles:	Principles of Factory Act. Principles of Registration. Principles of Health, safety, hours of work, work environment, employee welfare & leave with wages.		
	4. Procedure:	Study Factory Act 1948. Main provisions & scope of Factory Act. Scope & application on health, hours of work, work environment, employee welfare & leave with wages.		
	5.3 Laws related to wages & welfare			
	1. Introduction:	Overview of laws related to wages & welfare.		
	2. Definition:	Concept of payment of wages act, 1936, minimum wages act, 1948, workmen's compensation act, ESI act, EPF act.		
	3. Principles:	Principles of payment of wages act, minimum wages act, workmen's compensation act, ESI act, EPF act.		
	4. Procedure:	Study the different acts related to wages & welfare with main provisions and scope.		
	5.4 Laws related to association			
	1. Introduction:	Overview of laws related to association and trade union.		
	2. Definition:	Concept of Trade Union Act. 1926, industrial dispute act., contract labour act.		
	3. Principles:	Principles of association and trade union, industrial dispute act., contract labour act.		
	4. Procedure:	Describe main provision and scope of trade union act. Industrial dispute act & contract labour act with their scope.	4	-
6. Wages and incentives	**6.1 Wages and incentives**			
	1. Introduction:	Overview of wages & incentive in an Organization.		
	2. Definition:	Concept & classification of wages. Classification of incentives.		
	3. Principles:	Factors influencing wages. Factors influencing incentives.		
	4. Procedure:	Study the classification of wages & factors influencing wages. Classification of incentives & factors influencing incentives.	2	-
7. Accounting & budgeting	**7.1 Accounting & book keeping**			
	1. Introduction:	Overview of accounting system.		
	2. Definition:	Concept & classification of "capital", Accounting & Book keeping.(Double entry system), assets & liabilities, journal & ledger, profit & loss, balance sheet.		

Units	Detailed Contents		L	P
	3. Principles:	Principles for preparation of accounting & book keeping, preparation of journal & ledger, calculation of profit & loss, preparation of balance sheet.		
	4. Procedure:	Study the preparation of journal & ledger. Preparation of profit & loss and balance sheet.		
	7.2 Budgeting			
	1. Introduction:	Overview of budget & budget control.		
	2. Definition:	Concept of budget, budget control, classification of budget (Fixed, variable).		
	3. Principles:	Principles for preparation of budget (functional), operation of budget control.		
	4. Procedure:	Study the budget as a means of planning, control & coordination. Study the operation of budget control.		
	7.3 Taxes and Duties			
	1. Introduction:	Overview of taxation.		
	2. Definition:	Concept & classification of direct and indirect taxes. Concept and classification of duties.		
	3. Principles:	Principles of direct and indirect taxes. Principle of duties.		
	4. Procedure:	Study taxation system and duties systems. Applicability of different taxes.	4	-
8. Purchase management	**8.1 Purchasing**			
	1. Introduction:	Overview of purchasing.		
	2. Definition:	Concept of purchasing, economical order quantity, inventory control, storing and planning.		
	3. Principles:	Principles of purchasing, seller & buyer relationship, cost reduction and economical buying order.		
	4. Procedure:	Describe fundamentals of scientific purchasing, procedure of purchasing.		
	8.2 Characteristics & types of contract			
	1. Introduction:	Overview of contracting.		
	2. Definition:	Concept of contracting, costing, accounting, manufacturing and buying.		
	3. Principles:	Principles of contracting , vendor development, costing & accounting, manufacturing and buying.		
	4. Procedure:	Study the characteristics of contract and types of contract.		
	8.3 Procedure of contracting			
	1. Introduction:	Overview of documents of contracting.		
	2. Definition:	Concept of costing & accounting, loss & profit. Concept of sourcing.		
	3. Principles:	Principles of purchasing. Contracting principles and principles of economics.		
	4. Procedure:	Study the procedure of contracting.	4	-
		Review & Class Test	5	-
		Total No. of Hours	**45**	-

4.2 LIST OF REFERENCES FOR INDUSTRIAL MANAGEMENT

AUTHOR	TITLE	PUBLISHER
O.P. Khanna	Industrial Engineering & Management	Dhanpatrai Publication Pvt. Ltd., New Delhi
T.R. Bunga N.K. Agrawal S.C. Sharma	Industrial Engineering & Management Science	Khanna Publishers Delhi.
Learning Resources Development Center	Industrial Management	Department of Technical Education, Ahmedabad
TTTI Bhopal	Industrial Management	TTTI Bhopal
National Productivity Council	Management Guide Series 1 to 26	National Productivity Council Utpadakta Bhavan, Lodi Road, New Delhi 110003
Kiyoshi Suzaki	The new shop floor management	The Free Press

4.3 INDUSTRIAL ENGINEERING

Objectives

This subject is from Engineering science group intended to teach the students/ trainees, the concepts, principles and procedures of work study (method study, work measurement) in order to increase productivity. It also aims to teach principle of plant location and plant layout. CPM & PERT, the network techniques are intended to understand project planning and time estimation to evaluate the project planning process.

Units	Detailed Contents	L	P
1. Introduction	**1.1 Industrial Engineering and application** 1. Introduction: Overview of Industrial Engineering and application. 2. Definition: Concept of Industrial Engineering. Concept of system. Concept of Men, Material & equipment, Industrial Engineering activities such as work study, plant layout & material handling, inventory control. 3. Principles: Principles of Industrial Engineering, production management system, resources, system evaluation, productivity & industrial engineering. 4. Procedure: Development of Industrial Engineering and Application of Industrial Engineering.	2	1
2. Plant Layout	**2.1 Methods and procedure of plant layout** 1. Introduction: Overview of plant layout 2. Definition: Concept of plant, plant location, factors governing plant location, plant layout. Classification of plant layout and concept of work station. 3. Principles: Principles of plant location, plant layout, work station design, design of different plant layouts. 4. Procedure: Explain methods of plant layout and procedure for making plant layout.	4	-
3. Productivity and work study	**3.1 Productivity** 1. Introduction: Overview & influence of Productivity. 2. Definition: Concept of productivity, factors affecting productivity, productivity measures. 3. Principles: Principles of productivity, productivity measurement, increasing of productivity. 4. Procedure: Explain factors affecting productivity, resources for increasing productivity and kinds of productivity measures. **3.2 Method study** 1. Introduction: Overview & application of method study. 2. Definition: Concept of work study, method study, micro motion study, symbols. Concept of flow process chart, operation process chart, Man-Machine chart, simo chart, flow diagram, string diagram, motion economy. 3. Principles: Principles of work study, method studies, recording data, work selection, Principles of examining the facts. Developed & improved method, installation & maintenance of improved method. Charts & diagrams used in method study, motion economy.		

Units	Detailed Contents		L	P
	4. Procedure:	Procedure of method study and preparation of charts & diagrams.		
	3.3 Work measurement			
	1. Introduction:	Overview & application of work measurement.		
	2. Definition:	Concept of work study, work measurement, uses of time study, time study methods, time study recording, methods of rating, allowances & standard data, work sampling.		
	3. Principles:	Principles of work measurement, Time study methods, allowances, recording, determining standard data, rating techniques, work sampling.		
	4. Procedure:	Explain work measurement and technique of time study. Standard time, rating factors and performance rating, various allowances. Procedure for developing Normal distribution curve (work sampling)	12	-
4. Value analysis	**4.1 Value analysis process**			
	1. Introduction:	Overview of value analysis & its application.		
	2. Definition:	Concept of value Engineering, function / utility, value & classification.		
	3. Principles:	Principles of value engineering i.e. Function, Material, labour, process, standardization.		
	4. Procedure:	Describe procedure for carrying value analysis i.e. Blast, create, Refine.	2	-
5. Network analysis	**5.1 Network analysis process**			
	1. Introduction:	Overview of Network Techniques of CPM & PERT (critical path method, project evaluation and review technique).		
	2. Definition:	Concept of Network analysis, classification of Network technique. Concept of CPM and PERT technique.		
	3. Principles:	Principle of CPM & PERT, time estimation in CPM & PERT.		
	4. Procedure:	Explain procedure to plan and control projects through CPM & PERT.	10	-
6. Quality management	**6.1 Inspection**			
	1. Introduction:	Overview of Inspection & Inspection department.		
	2. Definition:	Concept of inspection, Classification of inspection, incoming inspection, inprocess inspection, finished goods inspection.		
	3. Principles:	Principles of inspection, selection of kind of inspection, inspection standards, incoming inspection, inprocess inspection, finished goods inspection.		
	4. Procedure:	Procedure for inspection. Organization & functions of inspection department.		
	6.2 Statistical quality control			
	1. Introduction:	Overview of Statistical Quality Control.		
	2. Definition:	Concept of Standard deviation, Statistical Quality Control, SQC Tables. Control charts for variables and attributes.		

Units	Detailed Contents		L	P
	3. Principles:	Principles of standard deviation, statistical quality control. Control charts for variables and attributes.		
	4. Procedure:	Explain procedure to establish standard deviation, generation of X & R charts, generation of P & C charts.		
	6.3 ISO 9000 quality system			
	1. Introduction:	Overview of ISO 9000 Quality system.		
	2. Definition:	Concept of Inspection, Quality control & Quality Assurance, Quality system standards. Concept of ISO 9000 Quality system documentation structure. Concept of terminology such as Quality, Quality policy, Quality planning, Quality management system, Quality Audit.		
	3. Principles:	Principles of Quality system standards, elements of ISO 9000 Quality system.		
	4. Procedure:	Explain procedure for installation of ISO 9000 Quality system.		
	6.4 Total quality management			
	1. Introduction:	Overview of Total Quality Management.		
	2. Definition:	Concept of Quality Management, Total Quality Management, Tools for Total Quality Management.		
	3. Principles:	Principles of continuous Improvement, elements of Total Quality Management, tools for Total Quality control, total Quality Management structure.		
	4. Procedure:	Explain procedure for implementation of total quality management.	10	-
		Review & Class Test	5	-
		Total No. of Hours	**45**	**-**

4.3 LIST OF REFERENCES FOR INDUSTRIAL ENGINEERING

AUTHOR	TITLE	PUBLISHER
O.P. Khanna	Industrial Engineering & Management	Dhanpatrai Publication Pvt. Ltd., New Delhi
T.R. Bunga N.K. Agrawal S.C. Sharma	Industrial Engineering & Management Science	Khanna Publishers Delhi.
Learning Resources Development Center	Industrial Management	Department of Technical Education, Ahmedabad
National Productivity Council	Management Guide Series 1 to 26	National Productivity Council Utpadakta Bhavan, Lodi Road, New Delhi 110003
Kiyoshi Suzaki	The new shop floor management	The Free Press

4.4 PRODUCTION PLANNING & COST ESTIMATION

Objectives

The subject is intended to understand concepts, principles and procedure of production planning and cost estimation. The knowledge is acquired in learning the process planning, production control and elements of cost structure. The knowledge and skill is useful in designing tools and dies, production processes, workshop practice and industrial management.

Units	Detailed Contents	L	P
1. Introduction	**1.1 Production and methods of production** 1. Introduction: To understand production and Methods of production. 2. Definition: Concept of production system, inputs, manufacturing process, output. 3. Principles: Principle of production system, job production, batch production, mass production. 4. Procedure: Study of production system and method of production. **1.2 Productivity** 1. Introduction: Overview of productivity & its influence in industry. 2. Definition: Concept of productivity, factors influencing productivity. 3. Principles: Principles of productivity, productivity improvement. 4. Procedure: Study production & productivity, factors influencing productivity.	4	-
2. Production Planning	**2.1 Stores & Inventory Control** 1. Introduction: Overview of stores and inventory control. 2. Definition: Concept of storing, centralize and decentralize store, economical order quantity, ABC analysis, inventory control with respect to cost reduction, EOQ model. 3. Principles: Principle of store layout and store management, economical inventory, ABC curve plotting, EOQ model. 4. Procedure: Store and store function. Storing procedure. Documentation of store. Meaning and importance of inventory control. **2.2 Material Planning** 1. Introduction: Overview of material planning and its importance. 2. Definition: Concept of material planning, master schedule, bill of material. Concept of inventory. 3. Principles: Principles of material requirement planning, operating cycle. 4. Procedure: Study importance of material planning. Information required for material planning. **2.3 Process Planning** 1. Introduction: Overview of process planning and a process sheet. 2. Definition: Concept of process planning, information required for process planning, economical sequencing, resources, quality control. 3. Principles: Principles of process planning, optimising sequence of operations, resources, quality control.	10	-

Units	Detailed Contents	L	P
	4. Procedure: Preparation of working drawings. Selection of manufacturing process. Machine capacity & machine / equipment selection, operation planning & tooling requirement, preparation of documents such as operation & route sheets.		
3. Production Control	**3.1Routing and scheduling** 1. Introduction: Overview of routing and scheduling phases of production control. 2. Definition: Concept of Routing, scheduling, critical ratio scheduling, production control. Concept of charts. 3. Principles: Principles of production control, scheduling, critical ratio scheduling, routing, generation of charts. 4. Procedure: Importance and objective of scheduling, manufacturing methods and scheduling. Use of control charts in scheduling.		
	3.2 Loading, dispatching and follow-up 1. Introduction: Overview of loading, dispatching and follow up process. 2. Definition: Concept of loading, dispatching & follow up, job cards, progress card, auditing, value analysis. 3. Principles: Principles of loading, dispatching & follow up, planning and re-planning, tooling and gauges, utilization of man, machine & material, delivery schedules. 4. Procedure: Procedure for loading, inspection, dispatching, follow up.	6	-
4. Elements of cost	**4.1 Cost structure** 1. Introduction: Overview of cost elements and break even analysis. 2. Definition: Concept of cost, fixed cost, variable cost, labour cost, material cost, prime cost, factory cost. Concept of break even analysis, graphical representation. 3. Principles: Principles of cost, fixed cost, variable cost, labour cost, material cost, prime cost, factory cost. Principles of break even analysis, graphical representation. 4. Procedure: Explain various elements of cost, graphical diagram of cost structure, graphs of Break even point.		
	4.2Overheads & depreciation 1. Introduction: Overview of allocation of overheads and depreciation. 2. Definition: Concept of overheads, sinking fund method, depreciation, straight line method. 3. Principles: Principles of allocation of overheads & Depreciation, selection of method. 4. Procedure: Procedure for calculating the overheads and allocation, calculating the depreciation cost.	10	-
5. Cost estimation	**5.1 Components of job estimation** 1. Introduction: Application of cost estimation. 2. Definition: Concept of estimate and cost, pricing, profit and loss. 3. Principles: Principles of realistic estimates, proper selection of machines & other resources, cost comparison, cost, profit & loss. 4. Procedure: Explain various components of cost with. reference to drawing. Describe components of job estimate.		

Units	Detailed Contents	L	P
	5.2 Estimating procedure and estimation of cost of component 1. Introduction: Overview of estimating procedure. 2. Definition: Concept of reading drawings, manufacturing procedure, time estimation. Concept of estimation of cost, material cost, overhead cost. 3. Principles: Principles of estimation, raw material estimation, selection of process planning, time estimation, overhead expenses. 4. Procedure: List out elements of estimate, calculate the material cost, estimate time for each operation, add the overhead expenses. Find out the total estimated cost.	10	-
	Review & Class Test	5	-
	Total No. of Hours	**45**	**-**

4.4 LIST OF REFERENCES FOR "PRODUCTION PLANNING & COST ESTIMATION"

AUTHOR	TITLE	PUBLISHER
M. Adithan B.S. Pabla	Production Engineering, Estimating & costing	Konark Publishers, New Delhi
T.R. Banga N.K. Agarwal S.C. Sharma	Industrial Engineering & Managemer Science	Khanna Publishers, New Delhi
Rory Burke	Project Management	John Wiley & Sons Ltd.
O.P. Khanna	Industrial Engineering & Management	Dhanpat Rai Publishers, New Delhi
T.R. Banga S.C. Sharma	Industrial Organisation & Engineering Economics	Khanna Publisher, New Delhi

4.5 IN-PLANT TRAINING / ON THE JOB TRAINING

OBJECTIVE

In the 4th year during in-plant training, the trainee will be able to apply his knowledge and skills acquired upto the 3rd year level. The trainee will be working in various technical departments of MSME Technology Center/ any Reputed industry of relevant field in actual in-service conditions. In process, it aims at learning all essential skills associated with becoming of a good technician or supervisor.

Units	Detailed Contents	Time allotted	
		Weeks	Hours
I. Advanced production including related planning operations.	In-plant training/ OJT is based on actual working situation in various departments of Technology center/ Industry such as: – Design – PPC – Consultancy & Marketing – Heat Treatment – Maintenance & Safety – Inspection & QC – Conventional Machining – CNC machining – Tool assembly etc.,	27	1215
	Total Nos.	**27**	**1215**

4.6 PROJECT WORK

Objectives

Project work aims at developing innovative skills in the student whereby he applies the totality of knowledge and skills gained through the regular training and in-plant training. The suitable work order of the customer from Industry is identified and assigned to the trainee to complete the Tool within the scheduled program. Each student is essentially required to plan, manufacture, process-inspection, try-out and finally obtain inspection report from inspection department ensuring quality standards maintained by Tool Room.

Units	**Detailed Contents**	**Time allotted**	
		Weeks	**Hours**
I. Manufacture of project work related to the Industry.	1.1 Development & Mfg. of assigned engineering product/ Toll, Die, Jigs and Fixtures etc. 1.2 Prepare a project report mentioning the process and procedure carried by the trainee for completing the tool as project work. The project report must contain all inspection reports of each components and final inspection report.	14	630
	Total Nos.	**14**	**630**