SCHEME OF EXAMINATION

and

SYLLABI

for

Master of Technology
Tool Engineering

Offered by

University School of Engineering and Technology

1st SEMESTER TO 4th SEMESTER

GURU GOBIND SINGH
INDRAPRASTHA
UNIVERSITY

Guru Gobind Singh Indraprastha University
Dwarka, Delhi – 110078 [INDIA]
www.ipu.ac.in

MASTER OF TECHNOLOGY
TOOL ENGINEERING
FIRST SEMESTER EXAMINATION

Code No.	Paper ID	Paper	L	T/P	Credits
THEORY PAPER					
ETTE-601		Computer Aided Design and Manufacturing	3	0	3
ETTE-603		Design of Jigs, Fixture and Gauges.	4	0	4
ETTE-605		Tool Material and Heat treatment	4	0	4
ETTE-607		Introduction to Finite Element Methods	3	0	3
ETTE-609		Product Design and Development	4	0	4
ETTE-611		Machining Process and Analysis	4	0	4
PRACTICALS/VIVA VOCE					
ETTE-651		Computer Aided Design and Manufacturing Lab	0	2	1
ETTE-653		Design of Jigs, Fixture and Gauges Lab	0	4	2
ETTE-655		Introduction to Finite Element Methods Lab	0	2	1
TOTAL			**22**	**08**	**26**

MASTER OF TECHNOLOGY
TOOL ENGINEERING
SECOND SEMESTER EXAMINATION

Code No.	Paper ID	Paper	L	T/P	Credits
THEORY PAPER					
ETTE-602		Metrology	3	0	3
ETTE-604		Introduction to Metal forming and Press Tool Design.	3	0	3
ETTE-606		Theory of Die-Casting and Its Design	4	0	4
ETTE-608		Introduction to Plastic and Plastic processing	4	0	4
ETTE-610		CNC Technology and Programming	3	0	3
ETTE-612		Generative Manufacturing	4	0	4
PRACTICALS/VIVA VOCE					
ETTE-652		Metrology Lab	0	2	1
ETTE-654		Introduction to Metal forming and Press Tool Design Lab	0	4	2
ETTE-658		CNC Technology and Programming Lab	0	2	1
ETTE-660		#Seminar	0	4	1
TOTAL			**21**	**12**	**26**

Non- university Examination system (NUES)

Note: The student shall undergo summer training after second semester for duration of not less than four weeks (ETTE 759). After completion of training the student shall submit a report and give a seminar before the entire Tool Engineering faculty of the concerned institute. However, the evaluation will be done at the end of Third Semester.

Imp:- Elective Paper will be floated if one-third of the total students opt for the same. It is advised that the decision about the elective subject for 3rd Semester is done before 15th April every year before end of 2nd Semester. New Electives may be added as per requirement after getting it duly approved by BOS and AC respectively.

MASTER OF TECHNOLOGY
TOOL ENGINEERING
THIRD SEMESTER EXAMINATION

CODE NO	PAPER ID	PAPER	L	T/P	Credits
THEORY PAPER					
ETTE-701		Industrial Automation and Process Control	3	0	3
ETTE-703		Advanced Press Tool Design	3	0	3
ETTE-705		Injection Mould Design and Analysis	4	0	4
ETTE-707		Industrial Management	3	0	3
ELECTIVES (SELECT ANY ONE)					
ETTE-709		Product Reliability and Maintenance	3	0	3
ETTE-711		Introduction of Composite material and Its processing	3	0	3
ETTE-713		Advances in Machining Technology	3	0	3
ETTE-715		Advanced Mould Techniques	3	0	3
PRACTICALS/VIVA VOCE					
ETTE-751		Industrial Automation and process Control Lab	0	2	1
ETTE-753		Advance Press Tool Design Lab	0	4	2
ETTE-755		Injection Mould Design and Analysis Lab	0	4	2
ETTE-757		Minor project*	0	12	6
ETTE-759		#Industrial Training/In-House Training	0	0	1
		Total	**16**	**22**	**28**

Non- university Examination system (NUES)

*For doing the Minor Project, the student shall pickup a topic which may be logically extended to perform his dissertation. Primarily, it shall be a self study mode of learning. Report is to be submitted for internal evaluation before the entire Tool Engineering faculty of the concerned institute. The end semester evaluation shall be on the basis of a comprehensive viva-voce and project report before a committee which may have an external examiner approved by the University.

MASTER OF TECHNOLOGY
(M.TECH) TOOL ENGINEERING
Fourth Semester Examination

Code No.	Paper ID	PAPER	L	T\P	Credits
ETTE-702		Dissertation*	0	0	18
ETTE-704		Seminar and Progress Report#	0	0	4
ETTE-706		Comprehensive Viva#^	0	0	2
TOTAL			**0**	**0**	**24**

Non University Examination System (NUES).

*****The student will submit a synopsis at the beginning of the semester for approval from the departmental committee in a specified format. The student will have to present the progress of the work through seminars and progress reports. The end semester evaluation shall be on the basis of viva voce and project report.

#A seminar and a project report on a latest topic in the area of Tool Engineering are to be presented by the student which shall be different from the topic of dissertation, before the entire faculty.

#^The director alongwith some faculty should conduct a comprehensive viva voce and a feedback from the student should be collected with regards to the course content and teaching learning process.

Note:

1. The total number of credits of the programme M.Tech (Tool Engg.) = 104.
2. Each student shall be required to appear for examinations in all courses. However, for the award of degree a student shall be required to earn a minimum of 100 credits.

COMPUTER AIDED DESIGN AND MANUFACTURING

	L	T/P	C
Paper Code: ETTE-601			
Paper: Computer Aided Design and Manufacturing	**3**	**0**	**3**

INSTRUCTIONS TO PAPER SETTERS: **MAXIMUM MARKS: 60**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 20 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 10 marks

Objective: To understand the CAD and use the same in manufacturing and introducing latest technology in CAM

UNIT-I

Fundamental of CAD: Design process, application of computers for design, benefits of the computer aided design, Computer graphics software and data base: The software configuration of a graphics system, constructing the geometry, database structure and content, wire frame and solid modeling. CAD/CAM integration.

[T1,T2][No. of Hrs. 09]

UNIT-II

Transformations: 3D transformations, homogenous coordinates, projections: orthographic projection, perspective projection, Axonometric projection, Curves: Space curves- cubic splines, normalized cubic spline, Bezier curve, B- spline introduction, continuity, Surface: surface of revolution, sweep surface, ruled and developable surface.

[T1,T2][No. of Hrs. 13]

UNIT-III

Conventional Numerical Control: NC coordinate systems, NC motion control system, Application of Numerical control, NC part programming, manual part programming, computer assisted part programming. Computer controls in NC: NC controller technology, computer numerical control, Direct Numerical control, combined DNC /CNC systems, Adaptive control machining systems, trends and new developments in NC.

[T1,T2][No. of Hrs. 09]

UNIT-IV

Robot Technology: Introduction, robot physical configuration, basic robot motions, robot applications, Group technology- introduction, part families, and group technologies machine cells. Computer integrated Manufacturing systems- machine tool and related equipment, material handling system, computer control system, Implementing a CAD/CAM.

[T1,T2][No. of Hrs. 10]

Text Books:

[T1] Groover, Mikell and E. W. J. R. Zimmers, "CAD/CAM: Computer-Aided Design and Manufacturing", Pearson Education.

[T2] Rogers, David F., and J. Alan Adams, "Mathematical Elements for Computer Graphics", McGraw-Hill Higher Education.

Reference Books:

[R1] Zeid, I., "Mastering CAD/CAM (Engineering Series"), McGraw-Hill Higher Education.

[R2] P.N. Rao, "CAD/CAM Principles and Applications", Tata McGraw Hill, 2003

DESIGN OF JIGS, FIXTURE & GAUGES

Paper Code: ETTE 603	**L**	**T/P**	**C**
Paper: Design of Jigs, Fixture & Gauges	**4**	**0**	**4**

INSTRUCTIONS TO PAPER SETTERS: **Maximum Marks: 60**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 20 marks.
2. Apart from question no. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 10 marks.

Objective: To understand the theoretical and practical knowledge of design and manufacturing the Jig and fixture for machining, welding, assembly and checking the sheet metal, plastic etc component. Its gigantic application in manufacturing industry.

UNIT-1

Introduction: Definition of Jigs and Fixtures, Difference between jigs and fixtures, Advantages, Steps for design. LOCATION Degree of freedom, 3-2-1 principles, Choice of location, redundant location, Diamond pin calculation, Locating methods and chip control. Locating Devices: Surface location, Rest blocks, pins, V-blocks, N Equalizers, Profile locators. Consideration of Safety factor while designing of Jig Fixture and Gauge, materials used in jigs and fixture, locating principle, locating methods and devices, standard parts

[T1 & T2][No. of Hrs.: 12]

UNIT II

Clamping: Basic principles, cutting forces, Rigid clamping, wedge clamping, Cam clamping, quick action clamps, Toggle clamps, simultaneously acting clamps. Guiding Elements: Jig bushes, Standards, Setting gauges. Indexing Jigs and Fixtures: Indexing methods, Linear, Rotary, Indexing jigs, Indexing fixtures. Assembly and Welding Fixture – Principles

[T1 & T2][No. of Hrs.: 10]

UNIT III

Design of Jigs and Fixture Bodies other Elements Types of Jigs and Fixtures: Plate jigs, Box jigs, Indexing jigs, Milling fixtures, and Indexing-milling fixtures, turning fixtures, Grinding fixtures, Universal jigs and fixtures, welding fixtures, Broaching fixtures, and Assembly Fixtures. Boring fixtures.

T1 & T2 [No. of Hrs.: 10]

UNIT IV

Design of Gauges: Review of tolerance analysis. Taylor's principle, ideal gauge. Design of plain, taper, spline and thread limit gauges. Design of positional gauges, indicator, flush pin, receiver gauges. Gauge manufacturing techniques. Case studies of gauges for selected components.

[T1 & T2][No. of Hrs.: 10]

Text Books:

[T1] P H Joshi, "Jigs and Fixture", Tata McGraw Hill, New Delhi,2006.
[T2] Grant, "Jigs and Fixture: Non Standard Clamping Devices", Mcgraw Hill, 1967.

Reference Books:

[R1] Kempster, "Introduction to Jigs & Tool Design", Viva Books Pvt Ltd,1998.
[R2] Cyryll Donaldson, George H.Lecain, V.C. Goold, "Tool Design", Tata Mcgraw Hill, 2002.
[R3] P H Joshi, "Tooling Data", Wheeler Publication, 2005.
[R4] Calvin, "Jigs and Fixture", MGH Publication, 1948.

TOOL MATERIAL & HEAT TREATMENT

Paper Code: ETTE-605	**L**	**T/P**	**C**
Paper: Tool Material & Heat Treatment	**4**	**0**	**4**

INSTRUCTIONS TO PAPER SETTERS: **MAXIMUM MARKS: 60**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 20 marks.
2. Apart from question no. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 10 marks.

Objective: The objective of the paper is to facilitate the student with the advanced knowledge of Heat treatment and engineering material used in tooling Industries.

UNIT-I

Introduction: Classification of materials, fundamentals of structures of solids, Imperfections in solids, such as point defects, line defects, volume defects etc, Deformation Slip, twinning, effect of cold and hot working on mechanical properties, principles of recovery, re-crystallization and gain growth. Diffusion: Diffusion mechanisms, steady state and non steady state diffusion in polymer materials.

[T1] [No. of Hrs. 10]

UNIT-II

Phase Diagrams & Phase Transformation: Equilibrium Diagrams, Unary, binary, tertiary phase diagram, Gibbs phase rule, Iron-carbon diagram, TTT diagram, various mechanical properties, effects of various alloying elements, failure of metals.

[T1] [No. of Hrs. 10]

UNIT-III

Heat Treatment: Principal of heat treatment, Heat treatment furnaces, control of heat treatment processes, Normalizing, Annealing, Case hardening, Tempering, Gas & Ion Nitriding, Flame Hardening, Cyaniding, Induction Hardening, Sulfinuzing, Heat treatment Defects and remedies.

[T2] [No. of Hrs. 11]

UNIT-IV

Tool Steel Materials: Free cutting steel, carbon tool steel, Hot work Tool steel, Stainless Steel, heat resisting steel, Hot Die steel, Introduction to composite materials. Property, applications, heat treatment of engineering material used in tools manufacturing.

[T1] [No. of Hrs. 11]

Text Books:

[T1] R. Balasubramanian, "Callister's Materials Science and Engineering", 2nd Edition, Wiley.

[T2] K. H. Prabhudev, "Handbook of Heat Treatment of Steels", Tata McGraw-Hill Education

Reference Books:

[R1] American Society for Metals, "Metals Handbook Vol.4", ASM Metals Parks. Ohio,USA, 1991

[R2] Thelning K.E., "Steel and its heat treatment", Bofors Handbook, 1975.

INTRODUCTION TO FINITE ELEMENT METHODS

Paper Code: ETTE 607	**L**	**T/P**	**C**
Paper: Introduction to Finite Element Methods	**3**	**0**	**3**

INSTRUCTIONS TO PAPER SETTERS : MAXIMUM MARKS: 60

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 20 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be 10 marks.

Objective: To introduce the knowledge of Finite element method for using it in engineering problems and to give the base for its use in industries.

UNIT-I

Introduction to FEM, boundary conditions, stress strain relations, Potential energy and rayleigh ritz method, galerkin's method, von mises stress. Finite element modeling, coordinates and shape functions, element stiffness matrix, assembly of global stiffness matrix and load vector, The finite element equation, treatment of boundary conditions, quadratic shape functions, temperature effects, stress related problems.

[T1][No. of hrs.11]

UNIT-II

Trusses: Plane truss, three dimensional truss, constant strain triangle, Problem modeling and boundary condition, axis symmetric formulation, finite element modeling triangular element, problem modeling and boundary condition.

[T1,T2][No. of hrs. 11]

UNIT-III

Four node quadrilateral element, Numerical integration, higher order elements, beams and frames: finite element formulation, load vector, boundary consideration, shear stress and bending moment, beams on elastic supports, plane frames.

[T1,T2][No. of hrs. 10]

UNIT-IV

Steady state heat transfer: One dimensional heat conduction, one dimensional heat transfer in thin fins, two dimensional steady state heat conduction, two dimensional fins, torsion, Computer procedures for Finite element analysis, fluid flow, related problems.

[T1][No. of hrs.11]

Text Books:

[T1] Chandrupatla T.R., and Belegundu A.D., "Introduction to Finite Elements in Engineering", Pearson Education.

[T2] Rao S.S.,"The Finite Element Method in Engineering", Pergammon Press.

Reference Books:

[R1] Reddy J.N, An Introduction to Finite Element Method, McGraw-Hill International Student Edition.

[R2] O.C.Zienkiewicz and R.L.Taylor, "The Finite Element Methods", Vol.1. The basic formulation and linear problems, Vol.1, Butterworth Heineman.

PRODUCT DESIGN AND DEVELOPMENT

Paper Code: ETTE -609	**L**	**T/P**	**C**
Paper: Product Design and Development	**4**	**0**	**4**

INSTRUCTIONS TO PAPER SETTERS: **MAXIMUM MARKS: 60**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 20marks.
2. Apart from question no. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 10 marks.

Objective: The objective of the paper is to facilitate the student with the basics of Product design and Development and its application in different type of Industries.

UNIT-I

Introduction to Product Design: Characteristics of product design and development, Cost estimation, Challenges of product design and development.

[T1][No. of Hrs. 08]

UNIT-II

Development Processes and Organisations: A generic development process, concept development; the front-end process, adapting the generic product development process, the AMF development process, product development organizations, the AMF organization. Product Planning: The product planning process, identify opportunities, Evaluate and prioritize projects, allocate resources and plan timing, complete pre project planning, reflect all the results and the process.

[T1][No. of Hrs. 12]

UNIT-III

Identifying Customer Needs: Raw data collection and interpretation, Organization of the needs, Establishment of the relative importance: effect on the results and the process.
Product Specifications: Introduction, establishment, setting target and final specifications.

[T1][T2][No. of Hrs. 12]

UNIT-IV

Concept Selection: Overview of methodology, concept screening, concept scoring, caveats.
Concept Testing: Define the purpose of concept test, choose a survey population, choose a survey format, communicate the concept, measure customer response, interpret the result, reflect on the results and the process Product Architecture: What is product architecture, implications of the architecture, establishing the architecture, Design for Manufacturing

[T1] [No. of Hrs. 12]

Text Books:

[T1] Karl. T. Ulrich, Steven D.Eppinger, Anita Goyal "Product Design and Development",Tata McGraw Hill, 2009.

[T2] A.C. Chitale and R. C. Gupta "Product Design and Manufacturing" 3rd Ed. 2005, PHI Learning.

Reference Books:

[R1] Geoffery Boothroyd, Peter Dewhurst and Winston Anthony Knight "Product Design for Manufacture and Assembly"3rd Ed. 2010, CRC Press.

[R2] Timjones Butterworth Heinmann "New Product Development" Oxford, UCI.1997.

MACHINING PROCESS & ANALYSIS

Paper Code: ETTE-611	**L**	**T/P**	**C**
Paper: Machining Process & Analysis	**4**	**0**	**4**

INSTRUCTIONS TO PAPER SETTERS: **MAXIMUM MARKS: 60**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 20 marks.
2. Apart from question no. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 10 marks.

Objective: The objective of the paper is to facilitate the student with good knowledge of metal cutting mechanism and how it can effected by the various parameters.

UNIT-I

Introduction to Machining: Need of manufacturing and its definition, classification of Engineering manufacturing Processes, various process parameters for machining, Geometry of single point tools such as Machine Reference System or ASA system, Orthogonal Rake System and their conversion to each other.

[T1 & T2][No. of Hrs. 08]

UNIT- II

Mechanics of Machining: Mechanism of Chip formations in ductile & brittle materials, Chip reduction coefficient or cutting ratio, Shear Angle, Cutting strain, Built-up-Edge (BUE) formation, Characteristics of BUE**,** Classification of machining chips, Orthogonal cutting and oblique cutting , cause of chip flow deviations, Need and purpose of chip breakers, various types of chip breakers, cutting forces components and their significance, cutting forces in drilling, Merchant's Circle Diagram and its use , Dynamometer: it principal of measurement, Design requirements for Tool – force Dynamometers

[T1 & T2][No. of Hrs. 13]

UNIT-III

Heat Generation & Cutting Temperature: Introduction, Zone, cause, effect of heat generation, Measurement of cutting temperature, Effects of machining parameters on cutting temperature, Controlling of cutting temperature, Cutting Fluids: principal, types, properties, and method of applications.

[T1 & T2][No. of Hrs. 10]

UNIT-IV

Machinability: Machinability and its criteria, Mechanism of cutting tool wear, forms of tool-wear in metal cutting, Tool Life, Taylor's Tool life equation, Modified & its modified equation, Effects of machining parameters on Tool Life, Conventional & Advanced Cutting Tool Materials.

Grinding: Principal & Mechanism of material removal in grinding, Specifications of grinding wheel, Mechanics of grinding, Grinding Forces: Causes, Effects and control.

[**T1 & T2][No. of Hrs. 11]**

Text Books:

[T1] A.B. Chattopadhyay "Machining and Machine Tools" Wiley India

[T2] Milton C. Shaw, "Metal Cutting Principal", Oxford University Press.

Reference Books:

[R1] Bhattacharyya A "Metal cutting theory and practice", New Central Book Agency –Kolkatta

[R2] Geoffrey Boothroyd, "Fundamentals of Metal Machining & Machine Tools", Tata McGraw Hill Kogakusha Ltd.

COMPUTER AIDED DESIGN AND MANUFACTURING LAB

Paper Code: ETTE-651	**L**	**T/P**	**C**
Paper: Computer Aided Design and Manufacturing Lab	**0**	**2**	**1**

List of Experiments:

1. To study sketcher mode and make the related exercise.
2. To study extrude feature and its exercises.
3. To study revolve feature and its exercises
4. To study sweep feature and its exercises.
5. To study blend feature and its exercises.
6. To study hole feature and its exercises.
7. To study pattern feature and its exercises.
8. To study the sectioning feature and its exercises.
9. To study the advanced feature in part mode and its exercises.
10. To study assembly mode and its exercises.
11. To study the drawing mode and its exercises.
12. To study and practise manufacturing module and its exercise.
13. To study and practice manufacturing module using fixed/c cycle.
14. To study and practice manufacturing module using macro programming.

Software Used: Creo, CATIA, NX-7 should be used for performing the experiments.

Atleast 8-10 experiments are mandatory to conduct in semester.

DESIGN OF JIGS, FIXTURE & GAUGES LAB

	L	T/P	C
Paper Code: ETTE 653			
Paper: Design of Jigs, Fixture & Gauges Lab	**0**	**4**	**2**

List of Experiments:

1. Design of drill jigs & fixture for milling operation.
2. Design of drill jigs & fixture for turning operation.
3. Design of drill jigs & fixture for Broaching operation.
4. Design of drill jigs & fixture for grinding operation.
5. Design of Plug and Ring Gauges.
6. Design of positional fixture to hold the component 1
7. Design of grinding fixture given component.
8. Design of various types of clamps.
9. Design of progressive type of plug gauge.
10. Design of taper gauges of given components
11. Design of jigs & Fixture for turning operation for given component
12. Design of jig pate.

Atleast 8-10 experiments are mandatory to conduct in semester.

INTRODUCTION TO FINITE ELEMENT METHODS LAB

Paper Code: ETTE-655	**L**	**T/P**	**C**
Paper: Introduction to Finite Element Methods Lab	**0**	**2**	**1**

(EXPERIMENTS TO BE DONE IN ANY FEM BASED ANALYSIS SOFTWARE)

1. Stress Analysis of cantilever beam
2. 2-D truss stress analysis
3. Stress Analysis of wall bracket
4. Heat conduction analysis in cylinder
5. Plane frame analysis.
6. Thermal stress analysis in a bar.
7. Stress due to gravity analysis.
8. Bending of curved beam analysis.
9. Stress analysis in bar of variable cross- section.
10. Modal Analysis.

Atleast 8-10 experiments are mandatory to conduct in semester.

METROLOGY

Paper Code: ETTE-602	L	T/P	C
Paper: Metrology	3	0	3

INSTRUCTIONS TO PAPER SETTERS: **MAXIMUM MARKS: 60**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 20 marks.
2. Apart from question no. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 10 marks.

Objective: The objective of the paper is to facilitate the student with the good knowledge of measurement with help of various advanced measuring instruments.

UNIT - I

Principles of measurement:- definition of metrology, measuring error, precision and accuracy, Sub division of standards , Line, End Standards, & Wavelength standard , Transfer of line standard into end standard, Effects of Environment Temperature and support , Limits, Fits & Tolerances, Interchangeability & Selective assembly, Standard Specifications, Application of Tolerances, Gauge Design – Taylor's Principle, wear allowance on gauges.

[T1,T2][No. of Hrs. 10]

UNIT-II

Types of Inspection:-Inspection by Gauging: limit gauging, plug gauges, Ring gauges, position gauges Inspection by Measurement: Direct measurement such as Vernier Caliper, Vernier Height gauge, Vernier Depth gauge Outside Micrometer, Inside Micrometer, Depth Micrometer, Slip gauges (gauge blocks), length bars , Bevel protractor etc. Indirect Measurement such as Mechanical, optical, & pneumatic comparators, Angular Measurements- Sine bar, angle gauges, precision levels, autocollimator, interferometers, NPL Flatness Interferometer etc.

[T1,T2][No. of Hrs. 12]

UNIT-III

Measurement of Screw threads & Gears:- Measurement of elements of screw threads such as major diameter, minor diameter , pitch, flank angle and effective diameter, Threads gauges, Gear terminology and standard proportions, Spur gear measurement, Tooth thickness measurement, Parkinson Gear Tester.

[T1,T2][No. of Hrs. 10]

UNIT-IV

Surface texture, Geometric Features & CMM:- Introduction to surface finish, Nomenclature of surface finish, various roughness parameters and their significance, Measurement of surface roughness, Tomlinson Surface meter, Taylor – Hobson Talysurf, measurement of geometric feature inspection such as straightness, Flatness, Squareness Roundness, etc. Introduction to Coordinate Measuring Machine (**CMM**), Types of CMM, Probes, and accessories, In-Process gauging, Post Process Inspection, etc.

[T1,T2][No. of Hrs. 12]

Text Books:

[T1] R.K. Jain, "Engineering Metrology", Khanna Publishers, Delhi
[T2] I.C. Gupta, "Engineering Metrology", Dhanpat Rai Publications, Delhi

Reference Books:

[R1] Francis T. Farago & Mark A. Curtis, "Hand Book of Dimensional Measurement", 1994, Industrial Press Inc., New York.
[R2] Clifford W. Kennedy, Edward G. Hoffman & Steven D.Bond, "Inspection and Gaging", 1987, Industrial Press Inc., New York.

INTRODUCTION TO METAL FORMING & PRESS TOOL DESIGN

Paper Code	**: ETTE-604**	**L**	**T/P**	**C**
Paper	**: Introduction to Metal forming & Press Tool Design**	**3**	**0**	**3**

INSTRUCTIONS TO PAPER SETTERS: **MAXIMUM MARKS: 60**

Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 20 marks.

Apart from question no. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 10 marks.

Objective: To understand the theoretical and practical knowledge of metal forming process and its used in sheet metal industries.

UNIT I

INTRODUCTION TO METAL FORMING:

Classification of various Forming Process, Cold, Hot, and warm Forming, Component of Stresses, Principal Stresses, Stress Invariants, Mean stress, Stress Deviator, Mohr's Stress circles, Shear strain theory, strain measure, Elastic Stress-Strain Laws, Von-Mises Stress-strain rate law, Tresca yield criterion, Von-Mises yield criterion.

Forging: Introduction, forging machines, open-die forging, closed-die forging, Impression Die forging, Forging defects, calculation of forging loads in closed-die forging.

Rolling: Introduction, Hot and Cold Rolling, Evaluation of Roll force, Roll torque, mill horsepower, Limiting thickness and limiting reduction, cambering of rolls, In-Process changing of roll camber.

Extrusion: Introduction, Direct Extrusion, Indirect Extrusion, Impact Extrusion, Hydrostatic Extrusion, Continuous Extrusion, Lubrication in Extrusion, Extrusion through curved Dies, Lubrication.

[T1,T2][No. of Hrs. 12]

UNIT II

Principles of Blanking and Piercing Dies: Basic Blanking or piercing operation, Shearing Theory, calculation of cutting force and stripping force, importance of cutting force, calculation of press tonnage, calculation of cutting clearance, importance of cutting clearance. Method of reducing the cutting force, Calculation of die size and punch size for blanking and piercing operation. Function of screw hole and dowel holes, Effects of Die and Punch life. **[T1,T2][No. of Hrs. 10]**

UNIT III

Introduction to various parts of Blanking and Piercing Dies: Function, types and construction of Punches, Punch Plate, Die Plate, stripper plate, Top Plate, Shank, Guide pillar, Guide Bushes, gages, Stock guides ,Die stops, Nest Gages and Pushers, Stock material utilization and strip layouts. Materials selection and used for above referred parts. Types of Die Sets, Spring selection process. Design of blanking, Piercing Dies, Types and function of Pilots. [**T1,T2][No. of Hrs. 10]**

UNIT IV

Introduction and Design of Bending Dies: Basic of Bending, bending stress, bend allowance curve, estimating Flat Blank lengths, Introduction to Bending Dies to produce V,L and U shaped Bend components, Grain direction, Spring back effect, calculation of bending force and pad force, Design of Bending Dies.

[T1,T2][No. of Hrs. 10]

Text Books:

[T1] B.L.Junejha, Fundamental of Metal Forming Process, New age international publishers, 2nd edition 2010.

[T2] Ostergaard, "Basic Die Making", MGH, New York, 1993.

Reference Books:

[R1] Joshi, "Machine Tools Handbook : Design and Operation", McGraw Hill, 2008

[R2] J.R.Paquin, Die Design Fundamental", Industrial Press, Inc. New York, NY, USA, 2005

[R3] Vukota Boljanovic,"Sheet Metal Stamping Dies: Die Design and Die-Making Practice", Industrial Press, Inc. New York, NY, USA

[R4] Surender Kumar, Technology of Metal Forming Process, PHI Learning Private Limited@2008

[R5] Eary Reed, "Technique of Press Working Sheet Metal", Prentice Hall, 1974

[R6] Ivana Suchy, Handbook of Die Design, Design Engineer Fair Lawn, New Jersey, Second Edition, Mcgraw-Hill

[R7] Design Data Hand Book, Delhi Institute of Tool Engineering, Delhi

THEORY OF DIE CASTING AND DIE DESIGN

Paper Code: ETTE 606	**L**	**T/P**	**C**
Paper: Theory of Die Casting and Die Design	**4**	**0**	**4**

INSTRUCTIONS TO PAPER SETTERS: **MAXIMUM MARKS: 60**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 20 marks.
2. Apart from question no. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 10 marks.

Objective: The objective of the paper is to facilitate the student with the basics of Die Casting and Die Design and it's application in different type of Industries.

UNIT I

Introduction: Die casting process , Advantages, Applications, Classification of Castings, Sand casting, Metal mould Castings (Aluminium, Zinc), Plastic moulds casting, Investment casting, Gravity die casting, Pressure die casting.

Die Casting Alloys: Different alloys, properties and application.

[T1] [No. of Hrs. 10]

UNIT II

Die Casting Machines: History of die casting machines, Hot chamber machine, cold chamber machine, Horizontal machine, Vertical machine.

Die locking methods: Hydraulic with toggles, straight hydraulic, Mechanical.

Injection systems, knock out pins and plates, Feed System Gates, Runners, Taper tangent runner system, Spreader, PQ2 Diagram and calculations etc.

[T1, T2][No. of Hrs. 12]

UNIT III

Die Construction: Cores, Cavities, pillars and bushes, ejectors, bolster plates. Cooling

System: Core cooling, Cavity cooling, cooling of shot sleeve, cooling of spreader, baffles. Preparation and Presentation of Typical Designs in the Form of Drawings.

Types of Dies: Single cavity dies, Multi cavity dies, combination dies, unit dies, trimming and finishing of components, Metal melting and handling.

[T1, T2] [No. of Hrs. 10]

UNIT IV

Inspection: Inspection, Die casting, defects and remedies.

Cost Estimation : Estimating the cost of die castings.

Safety : Safety-Melting and Alloying Department, Casting Department, Machining and Trimming and Maintenance Department.

Recent developments in the field of Die Casting.

[T1,T2] [No. of Hrs. 12]

Text Books:

[T1] H.H.Doehler, "Die Casting", Mc Graw Hill Co.,New York, 1951.

[T2] Street A.C., "The Die Casting Book", Surrey Portcullis, 1986.

Reference books:

[R1] Wilson Frank W., "Die Design Handbook", Mcgraw Hill, 1965.

[R2] SME, "Die Design Handbook", MGH Publication, 1990.

[R3] Jones, "Die Design & Die Making Practice", Industrial Press, 1951

INTRODUCTION TO PLASTIC & PLASTIC PROCESSING

Paper Code: ETTE - 608	**L**	**T/P**	**C**
Paper: Introduction to Plastic & Plastic Processing	**4**	**0**	**4**

INSTRUCTIONS TO PAPER SETTERS: **MAXIMUM MARKS: 60**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 20 marks.
2. Apart from question no. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 10 marks.

Objective: The objective of the paper is to facilitate the student with the processing techniques in detail and also to make them understandable with the behavior of plastics while processing with different processing techniques.

UNIT-I

Introduction : Concept of Monomer, Polymer, Degree of Polymerization, Classification of Polymer, Molecular Weight Distribution, Types of Polymerization: chain polymerization and step polymerization, Polymerization techniques: Bulk, Solution, Suspension and Emulsion techniques, Concept of Copolymer, Glass Transition and Melting Transition Temperature, General review of Properties and Application of various plastics:- PE, PP, PS, PVC, PMMA, ABS, NYLON, Polyacetal, Polycarbonate, PTFE, PF, UF & MF. Biodegradable and conducting plastics.

[T1][No. of Hrs. 12]

UNIT-II

Additives for plastics:- fillers, antioxidants, thermal stabilizers, lubricants, plasticizers, fire retardants, blowing agents, Impact Modifier, mixing and compounding equipment.

Introduction to plastics processing, Injection Moulding: Principles, moulding cycle, Types of machinery used, specification machines specifications - projected area, plasticizing capacity, shot weight, Day light, mould clamping system – toggle and hydraulic system. Faults and remedies, Injection moulding of thermosets.

[T1, T2] [No. of Hrs. 10]

UNIT-III

Compression and Transfer Moulding: Techniques, machinery used, Compression moulding cycle, common moulding faults and remedies. Transfer moulding, Technique, types of transfer moulding, its advantage over compression moulding, equipment used, faults and Blow Moulding remedies.

Extrusion: General description of extrusion processes, type of extruders, screw and their output in terms of drag, leakage and pressure flow, L/D ratio, compression ratio, back pressure, influence of screw dimensions and output, extrusion screw design features, extruder faults - causes and remedies. Film extrusion, sheet extrusion, Pipe extrusion, coating extrusion.

[T2] [No. of Hrs. 10]

UNIT-IV

Blow moulding process: materials used, Extrusion blow moulding, Injection blow moulding, Stretch blow moulding. Faults and remedies.

Rotational moulding: Description and features of rotational moulding process.

Thermo Forming: Basic principles, Description of various thermoforming processes.

Miscellaneous Process: Casting and Calendaring.

[T2] [No. of Hrs. 10]

Text Books:

[T1] Premamoy Ghosh," Polymer Science and Technology, Plastics, Rubbers, Blends and Composites", McGraw Hill Education (India) Private Limited, 2013.

[T2] M. Berins, "Plastics Engineering Handbook of the Society of the Plastics Industry", Springer, 1991.

Reference books:

[R1] Irvin I. Rubin," Handbook of plastic materials and technology" New York : Wiley, 1990.

[R2] Harper, "Handbook of Plastic Processes", MGH Publication, 2006.

[R3] J.P. Beaumont, R. Nagel, R. Sherman, "Successful Injection Molding: Process, Design, and Simulation", Hanser Gardner Publications, 2002 .

[R4] Schwartz & good man "Plastics materials and processing" Van Nostrand Reinhold, New York, 1982.

CNC TECHNOLOGY & PROGRAMMING

Paper Code: ETTE-610	**L**	**T/P**	**C**
Paper: CNC Technology & Programming	**3**	**0**	**3**

INSTRUCTION TO PAPER SETTER: **MAXIMUM MARKS:60**

1. Question no. 1 should be compulsory & cover the entire syllabus. This question should have objective or short answer type questions. It should be of 20 marks.
2. Apart from question no. 1, rest of the paper shall consist of four units as per syllabus. Every unit should have two questions. However, student may be asked to attempt only one question from each unit. Each question should be of 10 marks.

Objective: The objective of the paper is to facilitate the student with the good knowledge of CNC Programming & Technology and latest development in the field.

UNIT I

Introduction to NC/CNC/DNC, overview of CNC machines- need, benefits & limitations, classification of CNC machines, Constructional features of CNC machines, Design considerations of CNC machine tools, elements of CNC machine & systems, precision measuring & positioning of CNC, Function of MCU, Machining centre, Turning centre, CNC EDM, Ball screw, Bearings, Centralised lubrication systems, its role in FMS and CIMS.

[T1,T2][No. of Hrs. 10]

UNIT II

Manual part programming - preparatory, miscellaneous functions- Fanuc, Sinumeric, Hass controls. Linear interpolation, circular interpolation, canned cycles, cycles of threading & grooving operations, tool compensation, sub-program, main program, part programming structure, work co-ordinate system, absolute & incremental commands, feed, program zero point , co-ordinate system, process planning & flow chart for part programming, scaling, rotating, mirroring, copy & special cycles for CNC lathe and milling, radius & length compensation, advance programming features.

[T1,T2][No. of Hrs. 12]

UNIT III

Tooling for CNC machine: introduction, cutting tool materials, types of cutting tools for NC machines, tool selection, ISO specification of cutting tools, different clamping system in tool holders, tooling for milling, angle plates, CNC vices, work holding devices, clamps, rotary tables.

[T1,T2][No. of Hrs. 10]

UNIT IV

CNC Program generation from CAD models, geometric modelling for NC machining & machining of free-form surfaces, CNC controller & motion control in CNC system. Application of CNC and recent advances in CNC machines, maintenance of CNC machine tools, CNC trainer, CNC hardware elements including drives actuators sensors, construction of modern CNC machine tool controller, NC program verification & virtual NC.

[T1,T2][No. of Hrs. 10]

Text Books:

[T1] T. K. Kundra, P. N. Rao and N. K. Tiwari, "Numerical Control and Computer Aided Manufacturing", Tata McGraw-Hill Publishing company, New Delhi.

[T2] Tilak Raj, "CNC technology & programming", Dhanpat Rai publishing company(p) ltd., N Delhi

Reference Books:

[R1] P. Radhakrishnan, "Computer Numerical Control Machine & Computer Aided Manufacturing", New Academic Science Limited.

[R2] M. Adithan & B. S. Pabla, "CNC Machines", New Age International Publishers , N Delhi

[R3] Binit Kumar Jha, "CNC Programming Made Easy", UBS Publisher's distributors limited, N Delhi

[R4] Krak S. & Gill A.,"CNC Technology & Programming", Tata McGraw-Hill Publishing Co., N Delhi

[R5] M. Lynch, "Computer Numerical Control for Machining", McGraw Hill.

GENERATIVE MANUFACTURING

Paper Code: ETTE-612	**L**	**T/P**	**C**
Paper: Generative Manufacturing	**4**	**0**	**4**

INSTRUCTIONS TO PAPER SETTERS: **MAXIMUM MARKS: 60**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 20 marks.
2. Apart from question no. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 10 marks.

Objective: To learn the material additive process for rapid manufacturing and utilize this knowledge in the industries.

UNIT-I

Introduction: Classification of RP system Need for the compression in product development, history of RP systems, Survey of applications, Growth of RP industry, and classification of RP systems. Stereo Lithography Systems: Principle, Process parameter, Process details, Data preparation, data files and machine details, Application. Selective Laser Sintering: Selective Laser Sintering: Type of machine, Principle of operation, process parameters, Data preparation for SLS, Applications. Fusion Deposition Modelling: Principle, Process parameter, Path generation, Applications.

[T1][No. of Hrs. 11]

UNIT-II

Solid Ground Curing: Principle of operation, Machine details, Applications. Laminated Object Manufacturing: Principle, of operation, LOM materials. Process details, application. Concepts Modelers: Principle, Thermal jet printer, Sander's model market, 3-D printer. Genisys Xs printer HP system 5, object Quadra Systems.

[T1][No. of Hrs. 09]

UNIT-III

Laser Engineering Net Shaping (LENS) : Rapid Tooling: Indirect Rapid tooling –Silicone rubber tooling – Aluminum filled epoxy tooling, Spray metal tooling, Cast kirksite, 3Q keltool, etc,Direct Rapid Tooling Direct. AIM, Quick cast process, Copper polyamide, Rapid Tool, DMILS, Prometal, Sand casting tooling, Laminate tooling soft Tooling vs. hard tooling. Software for RP: STL files, Overview of Solid view, magics, imics, magic communicator, etc. Internet based software, Collaboration tools.

[T1][No. of Hrs. 10]

UNIT-IV

Rapid Manufacturing Process Optimization: factors influencing accuracy. Data preparation errors, Part building errors, Error in finishing, influence of build orientation. Allied Processes: vacuum casting, surface digitizing, surface generation from point cloud, surface modification-data transfer to solid models.

[T1][No. of Hrs. 10]

Text Books:

[T1] Paul F.Jacobs “Stereo lithography and other RP & M Technologies” SME NewYork, 1996.

Reference Books:

[R1] Flham D.T & Dinjoy S.S Verlog “Rapid Manufacturing” London press 2001.
[R2] Patri K. Venuvinod and Weiyin Ma, “Rapid Prototyping : Laser based and other Technology”, Kluwer, Boston, 2004.

METROLOGY LAB

Paper Code: ETTE-652	**L**	**T/P**	**C**
Paper: Metrology Lab	**0**	**2**	**1**

List of Experiments:

1. Measure the given threads elements on the profile projector.
2. Cup Drawing Test for the Sheet Metal.
3. Study of Coordinate Measuring machine.
4. Use of Slip Gauges in measurement of the component
5. To find the hardness of the given component
6. To inspect the given component with respect to the component drawing
7. Angle measurement by the use of sine bar.
8. To find the effective tooth thickness with the help of Gear tooth Vernier Caliper.
9. To find the flatness of the given component with the help of Sine bar and Dial indicator.
10. To find the straightness of the given component with the help of autocollimator.
11. Measurement of screw thread measurement with the help of floating carriage micrometer.
12. Inspect the given component under the Tool microscope.

Atleast 8-10 experiments are mandatory to conduct in semester.

INTRODUCTION TO METAL FORMING & PRESS TOOL DESIGN LAB

Paper Code	**: ETTE-654**	**L**	**T/P**	**C**
Paper	**: Introduction to Metal forming & Press Tool Design Lab**	**0**	**4**	**2**

LIST OF EXPERIMENT:

(1) Design of Blanking Die with fixed stripper having lower plan view, upper plan view given any blank shape.
(2) Sections of assembly Dies of the same Blanking given in Sr. No Die.-1.
(3) Detailing,Balloning and BOM of the same Blanking given in Sr. No Die.-1.
(4) Design of Blanking Die with moving stripper having lower plan view, upper plan view given any blank shape.
(5) Sections of assembly Dies of the same Blanking given in Sr. No Die.-4.
(6) Detailing,Balloning and BOM of the same Blanking Die given in Sr.No.-4.
(7) Design of Piercing Die having lower plan view, upper plan view given any piercing shape component.
(8) Sections of assembly Dies of the same Piercing given in Sr. No Die.-7.
(9) Detailing,Balloning and BOM of the same Piercing Die given in Sr.No.-7.
(10) Design of 'V' Bending Die having lower plan view, upper plan view given any V shape bend component .
(11) Sections ,Detailing,Balloning and BOM of the same V Bending Die given in Sr.No.-10.
(12) Design of 'U' Bending Die having lower plan view, upper plan view, section given any U shape bend component BOM of the parts.

Atleast 8-10 experiments are mandatory to conduct in semester.

CNC TECHNOLOGY & PROGRAMMING LAB

Paper Code: ETTE-658	**L**	**T/P**	**C**
Paper: CNC Technology & Programming Lab	**0**	**2**	**1**

List of Experiments:

1. Study of Graziano CNC lathe- programming codes – programs for simple components using linear interpolation, circular interpolation ; study of tools & zero offsets.
2. Study of Duplostandard CNC lathe – programming codes- programs for simple components using linear interpolation, circular interpolation ; study of tools & zero offsets.
3. Create a part program for component using canned cycles on Graziano or Duplostandard CNC lathe for internal drill, boring & simulate in the software.
4. Create a part program for component using cycles of thread cutting and grooving operation on Graziano or Duplostandard CNC lathe & simulate in the software.
5. Absolute programming – Incremental programming – mixed programming for component on Graziano or Duplostandard CNC lathe & simulate in the software.
6. Create a part program for step turning & simulate in the software using G90 cycle of FANUC control.
7. Create a part program for multiple turning operations & simulate in the software using stock removal cycle and finishing cycle G71, G70 of FANUC control.
8. NC program generation practice from CAD models.
9. Study of NOVAR CNC milling machine with Heidenhain control – programming method.
10. Study of MCM horizontal machining center – programming codes – programs for simple profiles using linear interpolation, circular interpolation – simulation – Absolute & Incremental programming – machining.
11. Create a part program on MCM HMC for mirroring, Scaling, Rotation & simulate in software using sub-program & main program.
12. Create a part program on MCM HMC using Parametric programming method for engraving a profile on the top of a surface.
    Software Used: Creo, CATIA, NX-7 should be used for performing the experiments.

Atleast 8-10 experiments are mandatory to conduct in semester.

INDUSTRIAL AUTOMATION & PROCESS CONTROL

Paper Code: ETTE-701	**L**	**T/P**	**C**
Paper: Industrial Automation & Process Control	**3**	**0**	**3**

INSTRUCTION TO PAPER SETTER **MAXIMUM MARKS:60**

1. Question no. 1 should be compulsory & cover the entire syllabus. This question should have objective or short answer type questions. It should be of 20 marks.
2. Apart from question no. 1, rest of the paper shall consist of four units as per syllabus. Every unit should have two questions. However, student may be asked to attempt only one question from each unit. Each question should be of 10 marks.

Objective: After going through this course, the student should be able to identify the Automation Control problems in any existing process control setup and also can define and assist a Designer in various stages of developing the viable solutions to industrial process control problems/relevant Greenfield projects.

UNIT I

Introduction, Definition and Basic concepts of Control Engg., Classifications of controls. Control chain breakup. Types of automation, Degree of automation, Technical, Economic and human factors in automation. Review of material handling systems using in – line transfer, rotary transfer by Geneva mechanism, electro-hydraulic or pneumatic systems as applied in Product Lifecycle & Manufacturing functions,

[T2][No. of Hrs. 12]

UNIT II

Comparative study of Technologies used in automation - Mechanical, Electrical, Hydraulic, Pneumatic, Electronic, Hybrid systems. Different classes of valves and elements used in pneumatics, hydraulic systems. ISO/DIN symbology. Logical approach for Development of small automation systems using different form of control and operative media.

[T1][No. of Hrs. 11]

UNIT III

Industrial logic control systems, PLC's, Logic diagramming & Elements used for automation circuits, Circuit optimization techniques. Illustrative examples of the above types of systems as well as hybrid systems used for Tooling and supporting applications in industry.

[T2][No. of Hrs. 09]

UNIT IV

Recent trends in Industrial logic control systems, Programmable controllers, Designing for automation in Tool design and manufacturing, Cost-benefit analysis.

[T2][No. of Hrs. 08]

Text Books:

[T1] Joji, P., "Pneumatic Controls", Wiley India.

[T2] Groover, Mikell P., "Automation, Production Systems and Computer Integrated Manufacturing", Prentice Hall 2007.

Reference Books:

[R1] Hasebrink, J P & Kobler, R, "Fundamentals of Pneumatic Control Engineering", Festo Didactic, 2nd Ed. 1978.

[R2] Meixner, H & Kobler, R, "Introduction to Pneumatics", Festo Didactic, 3rd Ed.

[R3] Boothroyd, G. and Poli, C., "Automatic Assembly", Marcel Dekkar, New York 1982.

[R4] John W. Webb "Programmable Controllers: Principles and Applications" Merrill Publishing Company 2007.

ADVANCED PRESS TOOL DESIGN

Paper Code ETTE-703	**L**	**T/P**	**C**
Paper: Advanced Press Tool Design	**3**	**0**	**3**

INSTRUCTIONS TO PAPER SETTERS: **Maximum Marks: 60**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 20 marks.
2. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 10 marks.

Objective: The objective of this paper is to introduce the various dies used in Tool Engineering.

UNIT I

Presses, Compound Dies & Inverted Dies: Introduction to Press Working, Types of presses, mechanical and automatic feed, Introduction to Inverted Dies, function of various parts of Inverted dies, Compound dies, function of various parts of Compound dies. Design of compound and Inverted Dies.

[T1,T2][No. of Hrs.: 08]

UNIT II

Progressive Dies and Secondary Operation: Definition of Progressive dies, introduction to the progressive dies, Progressive Dies using Blank-Through, Chop off, Parting principle , Progressive strip layouts, Secondary operations-Trimming Dies, shear form operation, Notching, Side action Dies, combination Dies, Flanging Dies, Burring operation, Restrike operation, concept of Design of progressive Dies

[T1,T2][No. of Hrs.: 12]

UNIT III

Drawing Dies and Forming Dies: Difference between Drawing and Forming operation, Introduction to Draw Dies, Inverted Draw Dies, Deep drawing process, Redraw dies deformation, blank development range of draw, draw ability, strain factor, Draw force calculation, wrinkling Erickson test, defects in drawing. Forming theory. Flow limit diagram. Failures in forming and drawing, Displacement of metal in forming. Selection of material for Draw Dies. Designing Die for automation. Basic of Casting Dies.

[T1,T2][No. of Hrs.: 12]

UNIT IV

Fine Blanking and Advanced forming process: Fine blanking process techniques and application. Reconditioning and repair of tools. Importance of safety. Cost analysis with a view on the quantity of production. Use of CAD for design of Press Tools: Work Piece checks, Find developed Length/Blank Size, Nesting. Basics of Advanced forming process-Hydro forming process and Micro forming Dies.

[T1,T2][No. of Hrs.: 10]

Text Books:

[T1] Ostergaard, “Advance Die Making”, MGH, New York, 1993.

[T2] P.H. Joshi, “Press Tool Design and Construction”, Wheeler Publishing, Delhi, 2000.

Reference Books:

[R1] Vukota Boljanovic,"Sheet Metal Stamping Dies: Die Design and Die-Making Practice", Industrial Press, Inc. New York, NY, USA

[R2] Oehler, “Hydrualic Presses”, Arnold Press, 1968.

[R3] Makelt, “Mechanical Presses”, Arnold Press, 1968.

[R4] Eary Reed, “Technique of Press Working Sheet Metal”, Prentice Hall, 1974

[R5] Ivana Suchy, Handbook Of Die Design, Design Engineer Fair Lawn, New Jersey, Second Edition, McGraw-HILL

[R6] Design Data Hand Book, Delhi Institute of Tool Engineering, Delhi

INJECTION MOULD DESIGN AND ANALYSIS

Paper Code: ETTE -705	**L**	**T/P**	**C**
Paper: Injection Mould Design and Analysis	**4**	**0**	**4**

INSTRUCTIONS TO PAPER SETTERS: **MAXIMUM MARKS: 60**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 20 marks.
2. Apart from question no. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 10 marks.

Objective: The objective of the paper is to facilitate the student with the basics of injection mold and Design and its application in different type of Industries.

UNIT I

Introduction to injection mould and its construction: Methodical Mould Design – Number of Cavities, Selection of Injection Moulding Machine, clamping force calculations, Mould materials and their selection criteria, Design of various Injection mould elements, cores, cavities, and Inserts, fitting core and cavity inserts, mould plate fastening, tapered locations, attachment of mould to platen, pillars and bushes.

[T1][No. of Hrs. 12]

UNIT-2

Feed and Ejector System: Design of optimum Gates, Runners, Impressions, Layout, Sprue, sprue pullers, mould shrinkage. Types of ejection, Ejector grids, ejection methods, Ejector Pin, Sleeve ejection, plate ejection, Blade ejection, Air ejection, Ejection from fixed half, Double ejection, Delayed ejection.

Cooling System: Need for cooling, cooling solid cores and cavities, insert cooling, cooling long cores, cooling elements, baffles etc., Heat rod/pipe and cooling calculation.

[T1][No. of Hrs. 10]

UNIT-3

Parting Surfaces: Straight, stepped, curved parting Surface.

Design of Moulds with External under Cuts: Split moulds, Actuation of splits, Guiding of splits, side cores. Angled lifted splits, side core and side cavity. Design of externally Threaded moulds.

Defects in moulding and its remedies.case studies

[T1][No. of Hrs. 10]

UNIT-4

Moulds with internal under cuts: Form pins, split cores,side cores, stripping internal undercut.

Design of mould for internally threaded component.

Multi day light moulds: Introduction, underfeed mould,triple day light mould Hot Runner mould, Stacked mould.

[T1][No. of Hrs. 10]

Text Books:

[T1] Pye R.G.W "Injection Mould Design,New-York -John Wiley &. Sons 12th Ed. 1989.

Reference Books:

[R1] Rubin. J. Irvin "Injection Moulding Theory & Practice" John Wiley & Sons New York, 1976.
[R2] Rosato, "Injection Molding HandBook", CBS Publishers, Delhi, 1987.

INDUSTRIAL MANAGEMENT

Paper Code: ETTE-707	**L**	**T/P**	**C**
Paper: Industrial Management	**3**	**0**	**3**

INSTRUCTIONS TO PAPER SETTERS: **MAXIMUM MARKS: 60**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 20 marks.
2. Apart from question no. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 10 marks.

Objective: The objective of this paper is to define the functions of management in achieving quality of design and maintenance of quality management standards.

UNIT – I

Introduction, Definition of management, characteristics of management, functions of management - Planning, Organising, Staffing, Directing, Co-ordination, Controlling, Motivating, Communication, Decision Making, Principles of management – F.W.Taylor, Henry Fayol, Elton Mayo, Administration and management, Nature of management, levels of management, managerial skills, managerial roles.

[T1,T2][No. of Hrs. 10]

UNIT-II

Plant Location:- Introduction, theories of industrial location, factors affecting for location, facility location Models ,Plant layout:- objective & principal of plant layout, Types of layouts, factors affecting layout, Group technology layout, Method study, principal and procedure, flow process charts, micro motion study, Work measurement, principal of time study, Method-Time-Measurement, motion economy.

[T1,T2][No. of Hrs. 12]

UNIT – III

Definition of quality, goalpost view of quality, continuous improvement definition of quality, types of quality – quality of design, conformance and performance, phases of quality management, Juran's and Demings view of quality, TQM, Kaizen, Five S (5S), Six sigma Quality Management Standards (Introductory aspects only)- The ISO 9001:2000 Quality Management System Standard- The ISO 14001:2004 Environmental Management System Standard- ISO 27001:2005, case study.

[T1,T2][No. of Hrs. 12]

UNIT-IV

PERT/CPM, Network Analysis, Programme Evaluation and Review Technique (PERT), Critical Path Method (CPM), Identifying critical path, Probability of Completing the project within given time, Project Cost Analysis, Project Crashing. (Simple problems).

[T1,T2][No. of Hrs. 10]

Text Books:

[T1] Production planning control & Industrial management by K.C jain & L.N.Aggarwal, Khanna publishers

[T2] Industrial Engineering & management Systems by Dr S.Dalela & Dr mansoor Ali, Standard publishers distributors.

References Books:

[R1] Dinesh Seth and Subhash C. Rastogi, "Global Management Solutions", Cengage Learning, Second Edition, USA.

[R2] B. Davis and Margrethe H. Olson, "Management Information Systems", Mc-Graw-Hill International Editions.

[R3] Azar Kazmi , "Strategic Management & Business Policy ", Tata McGraw Hill, New Delhi.

[R4] Ravi Shankar, "Industrial management" Galgotia , New Delhi .

PRODUCT RELIABILITY AND MAINTENANCE

Paper Code: ETTE-709	**L**	**T/P**	**C**
Paper: Product Reliability and Maintenance	**3**	**0**	**3**

INSTRUCTIONS TO PAPER SETTERS: **MAXIMUM MARKS: 60**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 20 marks.
2. Apart from question no. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 10 marks.

Objective: The objective of the paper is to facilitate the student with the basics of Product Reliability and Maintenance and its application in different type of Industries

UNIT I

Introduction : Definition of reliability, Reliability Measures, product pathology, reliability evaluation criteria, Static Reliability Models, Probabilistic Engineering Design.

[T1,T2][No. of Hrs. 08]

UNIT II

Design of variables : Combination of Random Variable's in Design, Interference Theory and Reliability Computation, Reliability Design Examples.

Failure: Product failure theories, reliability of parallel, standby and series products, reliability of non maintained and maintained products.

[T1][No. of Hrs. 12]

UNIT III

Reliability models: Time Dependent Stress-Strength Models, Dynamic Reliability Models. **Reliability Estimation**: Weibull Distribution, Sequential Life Testing, Use of signal flow graph theory for evaluating reliability.

[T1][No. of Hrs. 10]

UNIT IV

Design and Testing: Bayesian Reliability in Design and Testing, Reliability Optimization, Reliability and reward. Making of more reliable products using less reliable components: "Good as New" and "Bad as Old" concepts. Maintenance policies. Information theoretic approach to reliability. Examples

[T1,T2][No. of Hrs. 12]

Text Books:

[T1] K C Kapur, L.R Lamberson "Reliability in engineering Design" Wiley

[T2] D. N. Prabhakar Murthy**,** Rausand**,** Marvin, Østerås "Product Reliability" Trond-Springer publishing house, 2008

Reference Books:

[R1] Marvin Rausand, Arnljot Høyland "System Reliability Theory" John wiley & sons, 2nd Edition, 2003.

INTRODUCTION OF COMPOSITE MATERIALS AND ITS PROCESSING

Paper Code: ETTE-711	**L**	**T/P**	**C**
Paper title: Introduction of Composite Materials and its Processing	**3**	**0**	**3**

INSTRUCTIONS TO PAPER SETTERS: **MAXIMUM MARKS: 60**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 20 marks.
2. Apart from question no. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 10 marks.

Objective: The objective of the paper is to facilitate the student with the basics of the properties of various polymer matrixes, reinforcement used for the composites and to learn various processing techniques and applications of composite materials

UNIT-I

Introduction of Composites, Resins for composites, Reinforcements for composites, Fibrous and particulate composites, Composite based on inorganic matrix, Additives for composites, Macro and micromechanical behaviour of laminae and laminated composites. Failure criteria of composites.

[T1, T2] [No. of Hrs. 10]

UNIT-II

Primary Processing techniques –Hand layup, Spray layup, prepreg layup, Resin Tranfer Moulding(RTM), Reaction injection moulding (RIM), Reinforced reaction injection moulding (RRIM), Structural reaction injection moulding (SRIM), Filament winding, Pultrusion, Compression moulding. Moulding compounds – SMC, DMC.

[T1, T2] [No. of Hrs. 12]

UNIT-III

Secondary Processing techniques: Machining of composite-Drilling ,Sawing, Edge trimming, Water jet Machining, Laser Machining, Electro-discharge Machining, Electro-Chemical Machining, Joining of Composite- adhesive Bonding, Cocuring and lamination, Solvent Bonding, Mechanical joining.

[T1, T2] [No. of Hrs. 10]

UNIT-IV

Composite Characterization-Physical and Mechanical properties, Composite application-Transportation, Marine, Aerospace, construction, Electrical, Sports and others.

[T1, T2] [No. of Hrs. 10]

Text Books:

[T1] T. G .Gutowski, "Advanced Composites manufacturing", John Wiley and Sons, New York (1997).

[T2] B.T.Astrom, "Manufacturing of polymer Composites", Chapman and Hall, London (1995).

Reference Books:

[R1] Lawrence E.Nielsen and Robert F. Landel, " Mechanical Properties of Polymers and Composites", 2nd Ed., Marcel Dekker, New York (1994).

[R2] S.M. Lee, Reference Book for Composite Technology I, II & III, Technomic 1989

[R3] P.K. Mallic, Fiber Reinforced composites, Morcal Dekker Inc. 1988.

[R4] J.N. Reddy "Mechanics of Composite Materials: Selected Works of Nicholas J.Pagano" Kluwer publishers, 1994.

ADVANCES IN MACHINING TECHNOLOGY

Paper Code: ETTE-713	**L**	**T/P**	**C**
Paper: Advances in Machining Technology	**3**	**0**	**3**

INSTRUCTIONS TO PAPER SETTERS: **MAXIMUM MARKS: 60**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 20 marks.
2. Apart from question no. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 10 marks.

Objective The objective of the paper is to facilitate the student with the basics of Non-Conventional or Modern Manufacturing Methods and it's application in different type of Industries.

UNIT-I

Mechanical Processes: Ultrasonic Machining- Elements of process, cutting tool system design, effect of parameters, economic considerations, applications, limitations of the process, advantages and disadvantages. Abrasive Jet Machining- Variables in AJM, metal removal rate in AJM. Water Jet Machining- Jet cutting equipments, process details, advantages and applications.

[T1,T2][No. of Hrs. 08]

UNIT- II

Electrochemical and Chemical Metal Removal Processes: Electrochemical Machining- Elements of ECM process, tool work gap, chemistry of the process, metal removal rate, accuracy, surface finish and other work material characteristics, economics, advantages, applications, limitations. Electrochemical Grinding – Material removal, surface finish, accuracy, advantages, applications.

[T1,T2][No. of Hrs. 13]

UNIT-III

Thermal Metal Removal Processes: Electric Discharge Machining (EDM) or spark erosion machining processes, mechanism of metal removal, spark erosion generators, electrode feed control, dielectric fluids, flushing, electrodes for spark erosion, selection of electrode material, tool electrode design, surface finish, machining accuracy, machine tool selection, applications. Wire cut EDM. Laser beam machining (LBM)- Apparatus, material removal, cutting speed and accuracy of cut, metallurgical effects, advantages and limitations.

[T1,T2][No. of Hrs. 10]

UNIT- IV

Plasma Arc Machining (PAM): Plasma, non thermal generation of plasma, mechanism of metal removal, PAM parameters, equipments for D.C. plasma torch unit, safety precautions, economics, other applications of plasma jets. Electron Beam Machining (EBM) – Generation and control of electron beam, theory of electron beam machining, process capabilities and limitations.

[T1,T2][No. of Hrs. 11]

Text Books:

[T1] P.C.Pandey, H.S.Shan, "Modern Machining Processes", Tata McGraw Hill
[T2] Ghosh and Malik, "Machining Science", Affiliated East-West Press

Reference Books:

[R1] Non Traditional Manufacturing Processes- Benedict G.F, Marcel Dekker
[R2] Advanced Methods of Machining- Mc Geongh J.A, Chapman and Hall

ADVANCED MOULD TECHNIQUES

Paper Code: ETTE-715	**L**	**T/P**	**C**
Paper: Advanced Mould Techniques	**3**	**0**	**3**

INSTRUCTIONS TO PAPER SETTERS: **MAXIMUM MARKS: 60**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 20 marks.
2. Apart from question no. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 10 marks.

Objective: The objective of the paper is to facilitate the student with the basics of advanced moulding techniques its application in different type of Industries.

UNIT-I

Microcellular injection molding: Basics of microcellular injection molding, Morphology of Microcellular Materials, Materials for microcellular injection molding, Design and process for Microcellular injection moulding, equipment and machine for microcellular injection molding, Market and applications of micro cellular injection molding.

[T1][No. of Hrs. 12]

UNIT-II

Gas Assisted molding: Basic Principle, Control of gas Delivery, Lower Pressure Moulding, full short moulding, benefits and limitation of GAM, Equipments for GSM, Injected gas into plastic, Thick section or Rod like moulding, External Gas Moulding, Application and future of GAM.

[T2,R3][No. of Hrs. 10]

UNIT-III

Blow Moulding : Micro processor / CNC controlled blow moulding machine, injection stretch blow moulding of PET, precut moulding, multi layer blow moulding, Parission programming.

[T2][No. of Hrs. 08]

UNIT-IV

PTFE Moulding : Processing techniques used for PTFE, Material consideration, sintering, Ram extrusion, and Paste extrusion, lso statistic. Moulding and skewing technique for PTFE processing. Advancement in Other Processing Technique : New techniques like Resin transfer moulding, Pultrusion. Filament winding, multi layer rotation moulding, Electro plating and printings, Centrifugal casting, Shrink film, Clink film.

[T2][No. of Hrs. 12]

Text Books:

[T1] Jingyi Xu, "Microcellular Injection Moulding", Wiley Publications

[T2] Charles A. Harper, "Handbook of Plastic Processes", Wiley Publications

Reference Books:

[R1] John Wiley, "Plastic Extrusion Technology", Hanser Publications New York, 1997.

[R2] T. Kruckenberg, R. Paton "Resin Transfer Moulding for Aerospace Structures" Springer Netherlands, 2012

[R3] T. C. Pearson "Gas Assisted Moulding" Sithers Rapra Technology ltd.

INDUSTRIAL AUTOMATION & PROCESS CONTROL LAB

Paper Code: ETTE-751	**L**	**T/P**	**C**
Paper: Industrial Automation & Process Control Lab	**0**	**2**	**1**

List of Experiments:

1. Open and closed loop exercises with linear drive for A-stable Memory controls.
2. Open and closed loop exercises with linear drive for Bi stable Memory controls
3. Co-ordinated motion control using A or B stable Linear drives
4. Time dependent sequence control Ex.with single and double actuator
5. Pressure dependent sequence control Ex. with double actuators
6. Metering/Throttling in and metering/throttling out control exercises on speed regulation of actuators
7. Practicals showing Application of transducers: PE and EP type
8. Forward/ Reverse, Start/Stop control of a 3-Ø Induction Motor using Programmable Logic Controller (PLC)
9. Square wave generation with duty cycle of 5 Secs ON & Off Time using timers
10. Generating RTC using timer and counter
11. Generating Square Cycle using Bi-Stable Electro-Pneumatic Valve
12. Lift Controller using PLC

Atleast 8-10 experiments are mandatory to conduct in semester.

ADVANCE PRESS TOOL DESIGN LAB

Paper Code ETTE-753	**L**	**T/P**	**C**
Paper: Advance Press Tool Design Lab	**0**	**4**	**2**

LIST OF EXPERIMENT:

(1) Design of INVERTED DIE with knockout arrangement for any shape.
(2) Sections of assembly Dies of the same Die given in Sr. No Die.-1.
(3) Detailing,Balloning and BOM of the same Die given in Sr. No Die.-1.
(4) Design of COMPOUND DIE with shedder-knockout and shedder -spring arrangement given any shape component .
(5) Sections of assembly Dies of the same Die given in Sr. No Die.-4.
(6) Detailing,Balloning and BOM of the same Die given in Sr. No Die.-4.
(7) Design of PROGRESSIVE DIE having lower plan view, upper plan view given any shape of the parts.
(8) Sections of assembly Dies of the same Die given in Sr. No Die.-7.
(9) Detailing,Balloning and BOM of the same Die given in Sr. No Die.-7.
(10) Design of PROGRESSIVE DIE given bending shape of the component having three or more stations.
(11) Design of DRAWING DIE using simple Drawing shape component.
(12) Design of Lancing ,Combination,restrike tool(any one) given shape component.

Atleast 8-10 experiments are mandatory to conduct in semester.

INJECTION MOULD DESIGN AND ANALYSIS LAB

Paper Code: ETTE -755	**L**	**T/P**	**C**
Paper: Injection Mould Design and Analysis Lab	**0**	**4**	**2**

Design and analysis of the following types of moulds:

1. Two plate moulds with pin ejection and edge gate.
2. Mold flow analysis Warpage analysis of two plate moulds with pin ejection and edge gate.
3. Multi-impression moulds with sleeve ejection and submarine gate
4. Mold flow analysis Flow analysis Multi-impression moulds with sleeve ejection and submarine gate
5. Multi-impression moulds with stripper plate ejection
6. Mold flow analysis Multi-impression moulds with stripper plate ejection
7. Multi-impression moulds with internal undercut
8. Mold flow analysis Multi-impression moulds with internal undercut
9. Two plate moulds with spilt and side core
10. Mold flow analysis two plate moulds with spilt design and side core
11. Two plate moulds for threaded parts (loose core and automatic rack & pinion design).
12. Three plate moulds with multi impressions

Atleast 8-10 experiments are mandatory to conduct in semester.