VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI.

Scheme of Teaching and Examinations and Syllabus

M. Tech Tool Engineering (MTE)

(Effective from Academic year 2020 - 21)

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
Scheme of Teaching and Examinations – 2020 - 21
M. Tech Tool Engineering (MTE)
Choice Based Credit System (CBCS) and Outcome Based Education(OBE)

I SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Hours per Week			Examination				Credits
				Theory	Practical	Skill Development Activities (SDA)	Duration in hours	CIE Marks	SEE Marks	Total Marks	
1	PCC	20MTE11	Applied Mathematics	03	--	02	03	40	60	100	4
2	PCC	20MTE12	Finite Element Method	03	--	02	03	40	60	100	4
3	PCC	20MTE13	Press Tool Design	03	--	02	03	40	60	100	4
4	PCC	20MTE14	Cutting Tool Theory and Design	03	--	02	03	40	60	100	4
5	PCC	20MTE15	Gauges and Measurements	03	--	02	03	40	60	100	4
6	PCC	20MTEL16	Manufacturing Engineering Lab-1	--	04	--	03	40	60	100	2
7	PCC	20RMI17	Research Methodology and IPR	01	--	02	03	40	60	100	2
			TOTAL	**17**	**04**	**12**	**21**	**280**	**420**	**700**	**24**

Note: PCC: Professional core.

Skill development activities:
Students and course instructor/s to involve either individually or in groups to interact together to enhance the learning and application skills.
The students should interact with industry (small, medium and large), understand their problems or foresee what can be undertaken for study in the form of research/ testing / projects, and for creative and innovative methods to solve the identified problem.
The students shall
(1) Gain confidence in modelling of systems and algorithms.
(2) Work on different software/s (tools) to Simulate, analyse and authenticate the output to interpret and conclude. Operate the simulated system under changed parameter conditions to study the system with respect to thermal study, transient and steady state operations, etc.
(3) Handle advanced instruments to enhance technical talent.
(4) Involve in case studies and field visits/ field work.
(5) Accustom with the use of standards/codes etc., to narrow the gap between academia and industry.
All activities should enhance student's abilities to employment and/or self-employment opportunities, management skills, Statistical analysis, fiscal expertise, etc.

Internship: All the students have to undergo mandatory internship of 6 weeks during the vacation of I and II semesters and /or II and III semesters. A University examination shall be conducted during III semester and the prescribed credit shall be counted for the same semester. Internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take-up/complete the internship shall be declared as fail in internship course and have to complete the same during the subsequent University examination after satisfying the internship requirements.

Note: (i) Four credit courses are designed for 50 hours Teaching – Learning process.
(ii) Three credit courses are designed for 40 hours Teaching – Learning process.
(iii) Two credit courses are designed for 25 hours Teaching – Learning process.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
Scheme of Teaching and Examinations – 2020 - 21
M. Tech Tool Engineering (MTE)
Choice Based Credit System (CBCS) and Outcome Based Education(OBE)

II SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Hours /Week			Examination				Credits
				Theory	Practical/ seminar	Skill Development Activities (SDA)	Duration in hours	CIE Marks	SEE Marks	Total Marks	
1	PCC	20MTE21	Plastic Processing	03	--	02	03	40	60	100	4
2	PCC	20MTE22	Jigs and Fixture Design	03	--	02	03	40	60	100	4
3	PCC	20MTE23	Die Casting and Die Design	03	--	02	03	40	60	100	4
4	PEC	20MTE24X	Professional elective 1	04	--	--	03	40	60	100	4
5	PEC	20MTE25X	Professional elective 2	04	--	--	03	40	60	100	4
6	PCC	20MTEL26	Manufacturing Engineering Lab-11	--	04	--	03	40	60	100	2
7	PCC	20MTE27	Technical Seminar	--	02	--	--	100	--	100	2
TOTAL				**17**	**06**	**06**	**18**	**340**	**360**	**700**	**24**

Note: PCC: Professional core, PEC: Professional Elective.

Professional Elective 1		**Professional Elective 2**	
Course Code under 20MTE24X	**Course title**	**Course Code under 20MTE25X**	**Course title**
20MTE241	Advanced Material Technology	20MTE251	Product Design Technology
20MTE242	Tooling for Manufacturing in Automation	20MTE252	Rapid prototyping
20MTE243	Testing of Materials	20MTE253	Non Traditional Machining

Note:

1. Technical Seminar: CIE marks shall be awarded by a committee comprising of HoD as Chairman, Guide/co-guide, if any, and a senior faculty of the department. Participation in the seminar by all postgraduate students of the same and other semesters of the programme shall be mandatory.

The CIE marks awarded for Technical Seminar, shall be based on the evaluation of Seminar Report, Presentation skill and Question and Answer session in the ratio 50:25:25.

2. Internship: All the students shall have to undergo mandatory internship of 6 weeks during the vacation of I and II semesters and /or II and III semesters. A University examination shall be conducted during III semester and the prescribed credit shall be counted in the same semester. Internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take-up/complete the internship shall be declared as fail in internship course and have to complete the same during the subsequent University examination after satisfying the internship requirements.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
Scheme of Teaching and Examinations – 2020 - 21
M. Tech Tool Engineering (MTE)
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)

III SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Hours /Week			Examination				Credits
				Theory	Practical/ Mini –Project/ Internship	Development activities	Duration in hours	CIE Marks	SEE Marks	Total Marks	
1	PCC	20MTE31	Plastic Mould Design	03	--	02	03	40	60	100	4
2	PEC	20MTE32X	Professional elective 3	03	--	--	03	40	60	100	3
3	PEC	20MTE33X	Professional elective 4	03	--	--	03	40	60	100	3
4	Project	20MTE34	Evaluation of Project phase -1	--	02	--	--	100	--	100	2
5	PCC	20MTE35	Mini-Project	--	02	--	--	100	--	100	2
6	Internship	20MTEI36	Internship	(Completed during the intervening vacation of I and II semesters and /or II and III semesters.)			03	40	60	100	6
TOTAL				**09**	**04**	**02**	**12**	**360**	**240**	**600**	**20**

Note: PCC: Professional core, PEC: Professional Elective.

Professional elective 3		**Professional elective 4**	
Course Code under 20MTE32X	**Course title**	**Course Code under 20MTE33X**	**Course title**
20MTE321	Advanced Moulding Techniques	20MTE331	Design for Manufacture
20MTE322	Nano Science and Nano Materials	20MTE332	Non Destructive Testing
20MTE323	Material Flow Analysis	20MTE333	Computer Control of Manufacturing Systems

Note:

1. Project Phase-1: Students in consultation with the guide/co-guide if any, shall pursue literature survey and complete the preliminary requirements of selected Project work. Each student shall prepare relevant introductory project document, and present a seminar.

CIE marks shall be awarded by a committee comprising of HoD as Chairman, Guide/co-guide if any, and a senior faculty of the department. The CIE marks awarded for project work phase -1, shall be based on the evaluation of Project Report, Project Presentation skill and Question and Answer session in the ratio 50:25:25. SEE (University examination) shall be as per the Univeristy norms.

2. Internship: Those, who have not pursued /completed the internship shall be declared as fail in internship course and have to complete the same during subsequent University examinations after satisfying the internship requirements. Internship SEE (University examination) shall be as per the University norms.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
Scheme of Teaching and Examinations – 2020 - 21
M.Tech Tool Engineering (MTE)
Choice Based Credit System (CBCS) and Outcome Based Education(OBE)

IV SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Hours /Week		Examination				Credits
				Theory	Practical/ Field work	Duration in hours	CIE Marks	SEE Marks Viva voce	Total Marks	
1	Project	20MTE41	Project work phase -2	--	04	03	40	60	100	20
			TOTAL	--	**04**	**03**	**40**	**60**	**100**	**20**

Note:

1. **Project Phase-2:**

CIE marks shall be awarded by a committee comprising of HoD as Chairman, Guide/co-guide, if any, and a Senior faculty of the department. The CIE marks awarded for project work phase -2, shall be based on the evaluation of Project Report subjected to plagiarism check, Project Presentation skill and Question and Answer session in the ratio 50:25:25.
SEE shall be at the end of IV semester. Project work evaluation and Viva-Voce examination (SEE), after satisfying the plagiarism check, shall be as per the University norms.

2. Internship: Those, who have not pursued /completed the internship shall be declared as fail in internship course and have to complete the same during subsequent University examinations after satisfying the internship requirements. Internship SEE (University examination) shall be as per the University norms.

APPLIED MATHEMATICS			
Course Code	20MTE11	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Approximations and round off errors: Significant figures, accuracy and precision, error definitions, round off errors and truncation errors.

Solution of Algebraic and Transcendental equations: Bisection method, False position method, Newton-Raphson method, Secant Method, Muller's method, Graeffe's Roots Squaring Method.

Module-2

Solution of System of Linear Equations:
Cramer's Rule, Rank of the matrix, Solutions of linear system of equations: consistency of system of equations, types of solutions, solving by Gauss elimination method, Gauss Jordan method , LU decomposition method, Gauss Seidel method, Relaxation method.

Module-3

Partial Differential Equations: Solution of non-homogeneous PDE by direct integration, Solution of homogeneous PDE involving derivative with respect to one independent variable, Lagrange's linear PDE. Solution of PDE by the method of Separationof variable.

Module-4

Eigen values and Eigen Vectors: Eigen values and Eigen vectors by using characteristic equation. Jacobi method for symmetric matrices, Givens method for symmetric matrices, Householder's method for symmetric matrices, Rutishauser method for arbitrary matrices, Power method, Inverse power method. **10 Hours**

Module-5

Numerical solution for Differential and Integral Equations
Solution of Ordinary differential equations: Euler's modified method, Runga Kutta 4th order method, Taylor‟s series method, Milne‟s Predictor-corrector method.

Solutions for Integral Equations: Trapezoidal rule, Simpson's 1/3rd and 3/8th rule, and Weddle's Rule

Course outcomes:

At the end of the course, students will be able to:
1. Acquire the idea of significant figures, method of approximation of roots of equation.
2. Apply the knowledge of direct methods and iterative methods for solving system of linear equations up to requiredaccuracy.
3. Solve PDE by various methods.
4. Understand direct and numerical methods for finding Eigen values and Eigen vectors.
5. Understand numerical methods for various root finding differential and integral equations.

Question paper pattern:
The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.
- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module. ■

Textbook/ Textbooks

1. Introductory Methods of Numerical Analysis, S.S. Sastry, PHI, 2005.
2. Higher Engineering Mathematics, B.S. Grewal Khanna Publishers, 44th Ed., 2017.
3. Numerical methods for Scientific and Engg computation, M K Jain, S.R.K Iyengar, R K. Jain New Age Int. 2003.
Reference Books
1. Fundamentals of Engineering Numerical Analysis, Pervez Moin, Cambridge, 2010.
2. Linear Algebra and its applications, David. C. Lay, 3rd edition, Pearson Education, 2002
3. Advanced Engineering Mathematics, Erwin Kreyszig 10th Edition , Willely India, 2016.
Note: Weightage may consider in CIE marks for those practicing in the Mat Lab., Scilab, Maxima and Mathematica etc.,

FINITE ELEMENT METHOD

Course Code	20MTE12	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Introduction to Finite Element Method: General description of finite element method. Engineering applications of finite element method. Boundary conditions: homogeneous and non homogeneous. Principle of minimum Potential energy, Rayleigh Ritz method, Galerkin's method, Displacement method of finite element formulation. Convergence criteria, Discretisation process, Types of elements: 1D, 2D and 3D, Node numbering schemes. Strain displacement relations, Stress strain relations, Plain stress and Plain strain conditions, temperature effects.

.

Module-2

Interpolation Models, 1D and 2D elements:
Interpolation Models: Simplex, complex and multiplex elements, Interpolation polynomials in terms of local and global coordinates for 1D elements and CST element, Lagrange interpolation functions.
1D Elements: Solution for displacement, strain and stress for 1D bar and truss elements.
2D Elements: Solution for displacement, strain and stress for CST element.

Module-3

Analysis of Beams and Shafts:
Analysis of Beams: Boundary conditions, Load vectors, Hermite shape functions, stiffness matrix based on Euler-Bernoulli beam theory, Numerical problems.
Analysis of Shafts: Finite element formulation of shafts, determination of stresses and twists in circular shafts.

Module-4

Heat Transfer and Fluid flow:
Heat Transfer: Basic equations of heat transfer: Energy balance equation, Rate equation: conduction, convection, radiation, energy generated in solid, energy stored in solid, 1D finite element formulation using vibrational method, Problems with temperature gradient and heat fluxes, heat transfer in composite sections, straight fins.
Fluid flow: Flow through a porous medium, Flow through pipes of uniform and stepped sections. **10 Hours**

Module-5

Axisymmetric elements and Dynamic considerations:
Axisymmetric solid elements: Derivation of stiffness matrix of axisymmetric bodies with triangular elements, Numerical solution of axisymmetric triangular element(s) subjected to point loads
Dynamic Considerations: Formulation for point mass, Consistent element mass and Lumped mass matrices of one dimensional bar and truss elements.

Course outcomes:
At the end of the course the student will be able to:

1. Define the element properties such as shape function and stiffness matrix for the various elements.
2. Formulate element properties for 1D and 2D elements.
3. Develop skill to solve simple beam problems using the steps of FEM.
4. Problem solving knowledge on temperature gradient and heat fluxes.
5. Understanding the numerical solutions of axisymmetric elements.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module. ■

Textbook/ Textbooks

1. Finite Elements in engineering, Chandrupatla T. R., 2nd Edition, PHI, 2007.
2. Finite Elements Analysis -Procedures in Engineering, Lakshminarayana H. V., Universities Press, 2004.
3. Finite Elements Method in Engineering , Rao S. S. 4th Edition, Elsevier, 2006.

Reference Books

1. Textbook of Finite Element Analysis - P. Seshu, PHI, 2004.
2. Finite Element Method , J.N. Reddy McGraw -Hill International Edition.
3. . Finite Elements Procedures, Bathe K. J PHI.
4. .Concepts and Application of Finite Elements Analysis, Cook R.D. et al 4th Edition, Wiley & Sons, 2003.

PRESS TOOL DESIGN			
Course Code	20MTE13	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Introduction: Elements of press tools, classification of press, High speed presses, press brakes, shearing theory, cutting force, elements of press tool, clearance between punch and die, shut height and daylight, press tonnage calculation.
Strip Layout: Basic rules, economic layout, bridge size, calculation of plug point/center of pressure.
Press Tool Operations: Piercing, blanking, slitting, cropping, trimming, shaving, lancing, bending, curling, calibrating, drawing, embossing, coining, flanging, fine blanking.

Module-2

Design of Press Tool Elements: Die plates, punches, punch holder plates, stripper plates, and calculation of stripping force, bolster plates, pilots, ejectors, shedders, materials ops, pillar, bush, slender punches, stock guides, stock feeding device and die sets.
Types of Press Tools: Progressive tools, stage tools, compound tools, combination tools, cam actuated die, horn dies, sub press dies, inverted dies, bulging dies, levering dies, trimming dies, shaving dies, riveting dies, assembly dies, lamination dies.
Extrusion: Forward, backward, combined extrusion, modem metal forming techniques.

Module-3

Bending and Forming Dies: Theory of bending, development of bend, spring back, correcting spring back, bending tools, U - bending, V -bending, forming tools, bending on press brake, bending force calculation.

Module-4

Drawing: Theory of drawing, blank development, strain factor, calculation of number of stages of drawing, circular draw, rectangular draw, draw force calculation, lubrication. Defects and remedies, ironing.

Module-5

Preparation and Presentation of Typical Designs in the Form of Drawings for the Following

1. Piercing & blanking tool.
2. Progressive tool
3. Stage tool
4. Bending tool
5. Compound tool.

Course outcomes:
At the end of the course the student will be able to:

1. Students will be in a position to understand press tool types,
2. Knowledge of design and press tool operations which makes them aware of type applications,
3. To know the force calculations in drawing,
4. Awareness' of lubrications in drawing and
5. Knowledge of typical design of form tools.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module. ■

Textbook/ Textbooks

1. Basic die design, D. Eugene Ostergaard,McGraw Hill, 1963
2. Die Design Fundaments, J. R. Paquin, R.E Crowley Industrial Press Inc. 2nd edition
3. Press Tools, Prakash. H Joshi Wheeler Publilisher
Reference Books
1. Progressive Dies, Dallas B. Daniel,Springer, publication, 2005.
2. Mining Engineering Handbook, Michigan -SME 3rd Edition by peter darling, 2011.
3. Die Design Hand Book -SMITH A. DAVID.SME 3rd edition, 1990.

CUTTING TOOL THEORY AND DESIGN			
Course Code	20MTE14	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Mechanism of chip formation: Review of deformation mechanism, Fracture, Mechanism of yielding, overview of chip formation, concept of shearing strain. Mechanism of Metal Cutting, Force system during turning - velocity relationships – Force analysis in turning, milling, drilling etc.

Module-2

Measurement of cutting forces: Dynamometers Tool wears mechanisms, types and causes of wear.
Turning Tools: Indexable Inserts, Chip breakers, ISO classification of inserts and tool holders

Module-3

Milling Cutters: Standardization, Geometry, Face Mills, Shoulder Mills, End Mills, Deep shoulder Mills, T-Slot cutters.

Module-4

Boring: Types of boring tool, Boring heads, Cartridges. Reamer, types of reamers, Geometry of flutes. Tools for CNC.
Drilling: Drills with indexable inserts, Deep hole drills, carbide tipped drills, Core drills, Counter pores, and Counter sinks.

Module-5

Design Exercise: Design of Single point tool, Drill, Form tools, Reamer

Course outcomes:
At the end of the course the student will be able to:
1. Students will be able to understand mechanism of chip formation,
2. Understanding the measurement of cutting forces and its importance in cutting tool design,
3. Knowledge design of various cutting tools,
4. Awareness of tolls for CNC and
5. Design knowledge of single and multipoint cutting tools.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.
- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module. ■

Textbook/ Textbooks

1. Metal Cutting and Tool Design, Dr. B. J. Ranganath, Vikas Publishing House Pvt. Ltd., New Delhi, 2nd Revised Edition, 2009.
2. Metal Cutting Theory and Cutting Tool Design, Arshinov, M I R Publications.
3. Tool Design by Cyril Donaldson, George H LeGain,V.G. Good, TATA Mc GRAW HILL.

Reference Books

1. All about Machine Tools, Heinrich Gerling, New Age Int. (P) Ltd, 2007, Production Technology, HMT.
2. Tool Design, Herman W. Pollack, Prentice Hall PTR, 1988.
3. Modeling of Metal Forming and Machining Processes- Prakash M Dixit, Uday S dixit, Springer and verlag publication,2008.
4. Machining Technology, Machine Tools and operations- Helmi A. Youssef, Hassan El Hofy, Taylor and Francis group,2008.

GAUGES AND MEASUREMENTS			
Course Code	20MTE15	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Introduction: Definition and objectives of metrology, Linear measurement: neutral axis significance, imperial standard yard, international standard meter, airy points, Basel points, Line, End & Wave length standards, Slip Gages.

Angular Measurement: introduction, comparisons with linear measurement, sine bar: principle, types, advantages & limitations, uses, problems on sine bar, practical uses, material, construction, limitations problems on angle blocks (angle gauges.

Module-2

Limits, Fits and Tolerance: Definitions, need of tolerance, types of tolerance, tolerance analysis (addition & subtraction of tolerances) interchangeability & selective assembly, representation of holes & shaft as per I.S. class & grade of tolerance,-difference between allowance & tolerance.

Module-3

Fits: Definition, types of fits, (clearance, interference & transition), tolerance disposition chart, problems (calculation of fits) hole base system & shaft base system, procedure for solving on finding the hole & shaft tolerance upper & lower limits.

Module-4

Design Of Gauges: Taylor's principle, MMC & LMC of hole & shaft types of gauges (plain, threaded, limit, single end , double end, progressive, position, etc.,) important points for gauge design, limitations of gauges, - problems on gauge design.

Module-5

Geometric Dimensioning & Tolerancing (Gd&T) Introduction, ANSI, ASME & ISO systems of Gd&T, functional dimensioning, feature & feature of size, advantages & limitations, feature control frame, fourteen characteristic symbols, form controls, profile controls, orientation controls, location controls, run-out controls, datum.

Design Exercise: Design of Plug Gauge, Ring Gauge, Snap Gauge, Indicator Gauge, Taper plate Gauge, Taper Plug Gauge, Thread Gauge and Position Gauge.

Course outcomes:

At the end of the course the student will be able to:

1. Students will be able to understand specification of limits, fits and tolerance,
2. Design knowledge of different gauges and their uses,
3. Understanding the Interference of fits and their needs in calculations,
4. To know the different types of Geometric dimensioning and tolerance and
5. Awareness of design knowledge in different gauges in manufacturing.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Textbook/ Textbooks

1. Engineering Metrology - R.K. Jain
2. Westermann Tables for metal trade – Juts Scharkus, New age international Publishers.
3. Engineering Metrology, K. J. Hume.

Reference Books

1. Geometric Dimensioning and Tolerancing -A Self Study Workbook By Alex Krulikowski.
2. Fundamentals of Geometric Dimensioning and Tolerancing. ASME Y 14.5 M-1994, By Alex Krulikowski.
3. Geometric Dimensioning and Tolerancing for Mechanical Design. McGraw Hill.

MANUFACTURING ENINGEERING LAB. – 1			
Course Code	20MTEL16	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	0:4:0	SEE Marks	60
Credits	02	Exam Hours	03

Note:

1. These are independent laboratory exercises.
2. A student may be given at least five exercises stated below.
3. Student must submit a comprehensive report on the problem solved & give a Presentation on the same for Internal Evaluation.
4. Any one of the exercises done (at least five) from the below list has to be asked in the Examination for evaluation.

Sl. NO	Experiments
1	Optimizing machining time to produce mild steel components on a CNC turning Centre.
2	Characterize surface roughness of High carbon steel using a grinding machine.
3	To determine power required to machine a chosen component and evaluate suitability of the machine to manufacture the same.
4	To compare surface characteristics produced by conventional and CNC turning machines.
5	To Estimate the accuracy of taper produced on a shaft by grinding.
6	To measure cutting forces during machining of High carbon steel and optimize machining parameters.
7	To optimize a single point cutting tool for machining HC steel and to arrive at parameters like rake angle, relief angle, nose radius etc.
8	To study type of chips produced in machining Al/ Composites materials/ HC alloy steels and to characterize chip thickness.
9	Construction of Merchant circle diagram for turning operation of mild steel and to compute power requirement for turning operation.
10	Perform cutting/ drilling/ turning operations on mild steel/ high carbon steel/ composite material components and estimate power required for cutting/ drilling/ turning. (Ex: values are provided, Student has to find the volume of metal removed and energy consumed)
11	Determine the true taper and actual taper mathematically and perform turning operations (roughing cuts) on lathe and estimate the tool life of tool on similar cuts at different speeds.

RESEARCH METHODOLOGY AND IPR			
Course Code	20RMI17	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	1:0:2	SEE Marks	60
Credits	02	Exam Hours	03

Module-1

Research Methodology: Introduction, Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Importance of Knowing How Research is Done, Research Process, Criteria of Good Research, and Problems Encountered by Researchers in India.

Defining the Research Problem: Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, An Illustration. ■

Module-2

Reviewing the literature: Place of the literature review in research, Bringing clarity and focus to your research problem, Improving research methodology, Broadening knowledge base in research area, Enabling contextual findings, How to review the literature, searching the existing literature, reviewing the selected literature, Developing a theoretical framework, Developing a conceptual framework, Writing about the literature reviewed.

Research Design: Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs, Important Experimental Designs. ■

Module-3

Design of Sampling: Introduction, Sample Design, Sampling and Non-sampling Errors, Sample Survey versus Census Survey, Types of Sampling Designs.

Measurement and Scaling: Qualitative and Quantitative Data, Classifications of Measurement Scales, Goodness of Measurement Scales, Sources of Error in Measurement Tools, Scaling, Scale Classification Bases, Scaling Technics, Multidimensional Scaling, Deciding the Scale.

Data Collection: Experimental and Surveys, Collection of Primary Data, Collection of Secondary Data, Selection of Appropriate Method for Data Collection, Case Study Method. ■

Module-4

Testing of Hypotheses: Hypothesis, Basic Concepts Concerning Testing of Hypotheses, Testing of Hypothesis, Test Statistics and Critical Region, Critical Value and Decision Rule, Procedure for Hypothesis Testing, Hypothesis Testing for Mean, Proportion, Variance, for Difference of Two Mean, for Difference of Two Proportions, for Difference of Two Variances, P-Value approach, Power of Test, Limitations of the Tests of Hypothesis.

Chi-square Test: Test of Difference of more than Two Proportions, Test of Independence of Attributes, Test of Goodness of Fit, Cautions in Using Chi Square Tests. ■

Module-5

Interpretation and Report Writing: Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports.

Intellectual Property: The Concept, Intellectual Property System in India, Development of TRIPS Complied Regime in India, Patents Act, 1970, Trade Mark Act, 1999,The Designs Act, 2000, The Geographical Indications of Goods (Registration and Protection) Act1999, Copyright Act,1957,The Protection of Plant Varieties and Farmers' Rights Act, 2001,The Semi-Conductor Integrated Circuits Layout Design Act, 2000, Trade Secrets, Utility Models, IPR and Biodiversity, The Convention on Biological Diversity (CBD) 1992, Competing Rationales for Protection of IPRs, Leading International Instruments Concerning IPR, World Intellectual Property Organisation (WIPO),WIPO and WTO, Paris Convention for the Protection of Industrial Property, National Treatment, Right of Priority, Common Rules, Patents, Marks, Industrial Designs, Trade Names, Indications of Source, Unfair Competition, Patent Cooperation Treaty (PCT), Advantages of PCT Filing, Berne Convention for the Protection of Literary and Artistic Works, Basic Principles, Duration of Protection, Trade Related Aspects of Intellectual Property Rights(TRIPS) Agreement, Covered under TRIPS Agreement, Features of the Agreement, Protection of Intellectual Property under TRIPS, Copyright and Related Rights, Trademarks, Geographical indications, Industrial Designs, Patents, Patentable Subject Matter, Rights Conferred, Exceptions, Term of protection, Conditions on Patent Applicants, Process Patents, Other Use without Authorization of the Right Holder, Layout-Designs of Integrated Circuits, Protection of Undisclosed Information, Enforcement of Intellectual Property Rights, UNSECO. ■

Course outcomes:

At the end of the course the student will be able to:

- Discuss research methodology and the technique of defining a research problem
- Explain the functions of the literature review in research, carrying out a literature search, developing theoretical and conceptual frameworks and writing a review.
- Explain various research designs, sampling designs, measurement and scaling techniques and also different methods of data collections.
- Explain several parametric tests of hypotheses, Chi-square test, art of interpretation and writing research reports
- Discuss various forms of the intellectual property, its relevance and business impact in the changing global business environment and leading International Instruments concerning IPR. ■

Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module. ■

Textbooks

(1) Research Methodology: Methods and Techniques, C.R. Kothari, Gaurav Garg, New Age International, 4th Edition, 2018.

(2) Research Methodology a step-by-step guide for beginners. (For the topic Reviewing the literature under module 2), Ranjit Kumar, SAGE Publications,3rd Edition, 2011.

(3) Study Material (For the topic Intellectual Property under module 5),Professional Programme Intellectual Property Rights, Law and Practice, The Institute of Company Secretaries of India, Statutory Body Under an Act of Parliament, September 2013.

Reference Books

(1) Research Methods: the concise knowledge base, Trochim, Atomic Dog Publishing, 2005.

(2) Conducting Research Literature Reviews: From the Internet to Paper, Fink A, Sage Publications, 2009.

*** END OF I SEMESTER ***

PLASTIC PROCESSING			
Course Code	20MTE21	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Plastic Processing: Basic principle of processing, shape and size, processing parameters, their effect and behavior, Rheology ideal fluids, and real polymers, Effects of melt behavior on processing and product performance.

Injection Moulding: Principles, process variables, moulding cycle, machinery used, parts and function, specification, construction and maintenance of injection moulding machine, start up and shut down procedure, cylinder, nozzles, interaction of moulding variables, press capacity, projected area, shot weight, concepts and their relationship to processing, trouble shooting in injection moulding, microprocessors controlled injection moulding machines

Module-2

Extrusion: Basic principles of extruders, and extrusion process, different types of extrudes i.e. barrel, screw, drive mechanics, head, constructional features of dies, sizing and haul-off equipment for extruders of mono filaments and tubes, blown film lines, wire and cable covering system, pipe profile extrusion, co-extrusion, process variables in extrusion like heating, temperature control, dies well, and melt fracture, spacing and orientation, treating, printing and sealing, quality of extruder products, fault, causes and remedy

Module-3

Rotational Moulding: Basic principle, charge size, wall thickness, temperature control, fault causes.

Blow Moulding: Blow moulding process, processing parameter, materials used, hand operated and automatic blow moulding machine, extrusion blow moulding, moulding cycle, faults and remedies**.**

Thermo Forming: Basic principles, types of thermoforming, thermoforming moulds, processing parameters faults and remedies

Module-4

Calendaring: Basic principle, process variable, end product properties and applications, secondary processing techniques like powder coating, casting, machining, and joining of plastics, metalizing, printing.

Compression and Transfer Moulding: Techniques, various types of compression moulds, machinery used, and common moulding faults and remedies. Transfer moulding, its advantage over compression moulding, equipment used, press Capacity ,integral mold and auxiliary mould, moulding cycle, ram pressure, clamping pressure, faults andremedies

Module-5

Processing of Engineering Plastics: precautions, and start up procedure, preheating, shutdown procedure, quality control, and waste management. Ram Extrusion of PTFE, Processing of reinforced plastics, like filament winding, Hand-lay-up, spray moulding, SMC, DMC, Centrifugal casting, pultrusion, resin transfer moulding.

Course outcomes:

At the end of the course the student will be able to:

1. Students will understanding the basics of plastic processing,
2. Knowledge of injection moulding, extrusion and thermo forming,
3. Understanding the powder coating, casting, machining and joints of plastics,
4. Knowledge of plastic metalizing and printing and
5. Understand the different processing techniques of engineering plastics.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.

The students will have to answer five full questions, selecting one full question from each module. ■
Textbook/ Textbooks
1. Plastic Processing Data Hand Book – Dominic V Rosato P.E.
2. Modern Plastics Hand Book – Charles A Harper.
3. Injection Mould Design, Pye R.G. W. - New York-John Wiley & Sons, 12th Ed. 1989.
Reference Books
1. Injection Moulding Theory & Practice, Rubin. J. Irvin, New York John Wiley & Sons.
2. Blow Moulding Hand Book, Rosato, New York-Oxford University- Hanser Publishers.
3. Principles of Rotational Moulding Process, Bruins.

JIGS AND FIXTURES DESIGN			
Course Code	20MTE22	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Module-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.

Module-2

Locating Devices: Surface location, Rest blocks, pins, V-blocks, Equalizers, Profile locators, Vee locaters, Nesting locaters, Diamond Pins, adjustable Locaters.
Clamping Devices: Basic principles, cutting forces, Rigid clamping, wedge clamping, cam clamping, quick action clamps, strap clamps, screw clamps, swing clamps, Toggle clamps, simultaneously acting clamps.

Module-3

Guiding Elements, Drill Bushings: Standard Drill Bushing types**,** Jig bushes Installation, Standards, Tool Setting gauges.
Indexing Jigs and Fixtures: Indexing methods, Linear, Rotary, Indexing jigs, Indexing fixtures. Assembly and Welding Fixture – Principles.

Module-4

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 & Fixtures, Welding fixtures, Broaching fixtures and assembly fixtures, Modular Fixturing.

Module-5

Preparation and Presentation of typical designs in the form of drawings for the following

1. Drill Jig
2. Drilling and Reaming Jigs
3. Milling Fixtures
4. Indexing Jigs
5. Indexing Milling Fixtures.
6. Turning Fixtures.

Course outcomes:

1. Students understand their knowledge in various jigs and fixtures,
2. Understand the designs of clamping methods,
3. Knowledge of indexing and methods,
4. Knowledge of different applications of fixtures and
5. Drawing exercises of different typical jigs and fixtures.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.■

Textbook/ Textbooks

1. Jigs & Fixtures - JOSHI P .H.- New Delhi -Tata McGraw Hill Pub. Co. Ltd., 11th print 1999.
2. Jigs. & Fixtures & Gauges -BOYES E. WILLIAM-Michigan -SME 1st Ed. 1986.
3. Jigs and Fixture Design Manual- by Erik k Henriksen, Industrial Press Inc.

Reference Books
1. An Introduction to Jig and Tool Design -KEMPSTER M.H.A.- Bristol- ELBS 3rd Ed. 1974.
2. Jigs and Fixture Hand book by A.K. Goroshkin, MIR pub.
3. Jigs and Fixture Hand book by Carr Lane Mfg Com.

Course Code	20MTE23	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Introduction: Classification of Castings, Sand casting, Metal mould castings, Plastic moulds casting, Investment casting, Gravity die casting, Pressure die casting, Advantages of Die casting, Die casting process, Vacuum casting. Die Casting Alloys Low fusion alloys, High fusion alloys, Properties.

Module-2

Die Casting Machines: History of die casting machines, Hot chamber machine, Cold chamber machine, Horizontal machine, Vertical machine, Die locking, Toggle locking, Hydraulic locking, Injection systems, knock out pins and plates, ejector system furnaces, loading of metal into hot chamber.

Module-3

Feed System Gates, Runners, Taper tangent runner system, Precession layout, Spreader, shot sleeve, shot weight, PQ2 Diagram and calculations etc.
Die Construction: Cores, Cavities, pillars and bushes, ejectors, bolster plates.
Cooling System: Core cooling, Cavity cooling, cooling of shot sleeve, cooling of spreader, baffles, cooling calculations.

Module-4

Types of Dies: Single cavity and Multi cavity dies, combination dies, unit dies, trimming and finishing of components, Inspection of components, safety, SPC & visual control techniques.
Dies with side Cores: Construction, Actuation of side cores. Die casting, defects and remedies.

Module-5

Preparation and Presentation of typical Designs in the Form of Drawings of the Following:

1. Cold chamber die casting dies
2. Cold chamber die casting dies
3. Single cavity die casting dies
4. Multi cavity die casting dies
5. Dies with side cores and splits

Course outcomes:
At the end of the course the student will be able to:

1. Students will get an understanding of various types of dies for castings,
2. Understanding the construction and design of dies,
3. Knowledge of die casting machine and mechanism of different productions,
4. Understand the concept of die constructions with specific cooling systems and
5. Students able to prepare drawings of various dies and demonstrate its design

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.

The students will have to answer five full questions, selecting one full question from each module. ■

Textbook/ Textbook

1. Die Casting, Do Ehler H.A. New York -McGraw Hill Book Co-Inc. International Student Ed. 1951.
2. The Die Casting Book, Street. C. Arthur, Surrey, England –Portcullis Press Ltd., 2nd Edition 1986.

3. Die Casting Dies Designing , E.A Herman, Society of Die Casting Engineers
Reference Books
1. Die Casting Process Control By EA Herman NADCA.
2. High Pressure Die casting: by H. L. Harvill, Paul Roe Jordan

ADVANCED MATERIALS TECHNOLOGY			
Course Code	20MTE241	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Structure-Property Relations: Introduction, Atomic structure, atomic bonds, secondary bonds, crystal structure, Miller indices, packing efficiency, crystal defects, grain structure, elastic and plastic deformation in single crystals, dislocation theory, strain/ work hardening, plastic deformation in polycrystalline metals, fracture of metals, cold working, re-crystallization and hot working, grain growth.

Newer Materials: Introduction, plastics, molecular structure, isomers, polymerization, thermosetting and thermoplastic materials, properties and applications of plastics. Ceramics, nature and structure, fine ceramics, properties and applications of ceramics. Composite materials – classification, matrix and reinforcement materials, properties, rule of mixtures, longitudinal strength and modulus (iso strain model), transverse strength and modulus (iso stress model), applicationsof composites.

Module-2

Processing of Composites: Liquid-state process, solid state process and in situ processes of MMC's. Slurry infiltration process, combined hot pressing and reaction bonding method, melt infiltration process, direct oxidation, isothermal chemical impregnation process and Sol-Gel and polymer pyrolysis of CMC's. Hand layup process, filament winding process, pultrusion process, pressure bag moulding, vacuum-bag moulding, autoclave moulding, injection moulding process and thermoforming process of PMC's.

Methods of Analysis of Composites: Micromechanics -Mechanics of material approach, elasticity approach to determine material properties. Macro mechanics- Stress-strain relations with respect to natural axis, arbitrary axis and determination of material properties. Experimental characterization of laminates and particulate composites.

Module-3

Failure Analysis and Design of Composites: Failure criterion for particulate and laminate composites. Design of laminated and particulate composites. Other mechanical design issues-Long term environmental effects, inter laminar stresses, impact resistance, fracture resistance and fatigue resistance.

Nano Technology: Introduction, concept of nanotechnology, nano science, nanomaterials (one, two and three dimensional), top down and bottom up constructions, fabrication of carbon nano tubes (CNT), nano material characterization – scanning probe microscopy, atomic force microscopy, scanning tunnelling microscopy, applications of nano technology.

Module-4

SURFACE TREATMENT: Introduction, Surface Engineering, Surface quality & integrity concepts, Mechanical treatment, Thermal spraying processes and applications, Vapour depositions processes and applications, Ion-treatment.

Module-5

Powder Metallurgy: Introduction, Steps in powder metallurgy, Production of Powder, Characterization & Testing of Powders, Powder Conditioning, Powder Compaction, Sintering, Finishing operations, Applications of PM components.

Course outcomes:

At the end of the course the student will be able to:

1. Students will understand the basic structure properties of newer materisals,
2. Students able to decide the application of various newer materials to engineering applications,
3. Awareness of composites and their manufacturing,
4. Understanding the concept of Nano technology and
5. Knowledge of surface engineering and powder metallurgy.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module. ■

Textbook/ Textbooks

1. Materials and Processing in Manufacturing , E. Paul Degarmo, J.T. Black, Ronald A Kohser, 8th Edition – Prentice Hall India.
2. Composite materials – Science & Engineering, K.K. Chawla, Springer.
3. Powder Metallurgy A.K. Sinha, 2nd Edition – DhanpatRai Publications.
4. Composite Materials Dr. H.K. Shivanand, Asian Publication.
5. Mechanics of composite materials, AUTAR K. KAW Taylor and Francis group

Reference Books

1. ASM Handbook on Metal Casting - Vol.15, 9th Edition, ASM publication.
2. ASM Handbook on Powder Metallurgy -Vol 17, ASM publications.
3. Nanotechnology – Basic Science & Emerging Technologies, -Mick Wilson, Kamali Kannangara, Overseas Press India.
4. Structure and Properties of Engineering Materials, V.S.R Murthy, A.K. Jena, K.P. Gupta, G.S. Murthy, Tata McGraw Hill.
5. Composite Materials Hand Book, M M Schwartz Mc Graw Hill.
6. Nanotechnology, Rakesh Rath, S Chand & Co.

TOOLING FOR MANUFACTURING IN AUTOMATION			
Course Code	20MTE242	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Mechanics of metal cutting: Introduction, measurement of cutting forces and chip thickness, force components, chip formation and primary plastic deformation, shear plane and slip line theories for continuous chip formation.
Modern Cutting tool materials: Material properties, HSS related materials, sintered tungsten carbide, cermets, ceramics, polycrystalline tools, tool coatings, coating methods, conventional coating materials, diamonds and CBN
Cutting tools: Basic types of cutting tools, turning tools, indexable inserts, groove geometry, edge preparation, wiper geometry, insert clamping methods, tool angles, threading tools, grooving and cut off tools, milling tools, types of milling cutters, milling inserts and edge clamping methods. Selection and application of Single point cutting tool and multipoint cutting tools.

Module-2

Optimization: Machining cost and production rate verses cutting speed, role of computerized optimization system, economic considerations, optimization of machining system, machining conditions, constraints, depth of cut feed and speed.
Tooling Requirements for CNC Machines: Tool holding systems modular and quick change tool holding system, tool holder spindle connection, cutting tool clamping systems, milling cutter driver, side lock type chuck, collet chucks, hydraulic chucks, milling chucks. Tool magazines, Automatic Tool Changers, robotized tool assembly, tool management system. Tool monitoring, presetting and offsets, wear and radius compensation.

Module-3

Location and Clamping Methods: Basic principles of locating, locating methods & devices, Basic principles of clamping, clamping methods.
Fixtures: Definitions, General considerations, Machine considerations, Process considerations, Product considerations, Types of fixtures, Milling fixtures, Boring fixtures, Broaching fixtures, Lathe fixtures, Grinding fixtures, Steps involved in designing a fixture.

Module-4

Fixtures for Automation: Work holders for CNC, Fixturing in FMS: Part holding on Pallets, standard fixtures, pallet changers, pallet pool, flexible fixturing – principles and methodologies, modular fixturing system: T-slot based, dowel pin based, fixturing components, computer aided fixture design – locating and clamping, use of Gd & T in fixture design, fixture database.

Module-5

Plastics for Tooling materials: Introduction, Commonly used plastics for tooling, Epoxy plastics tools, Construction methods, Urethane dies Force calculation for Urethane pressure pads.

Course outcomes:

1. Students are able to decide a type of tool appropriate for machining a material,
2. Student decide on nomenclature parameters and tool optimize,
3. Understand the tooling for CNC machine,
4. To know the general knowledge of location and design a clamping method and
5. Knowledge about the plastic tools.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module. ■

Textbook/ Textbooks
1. Tool Design, Cyrol Donaldson, Tata McGraw Hill, India.
2. Fundamentals of Tool Design, Edward G Hoffman, SME, USA.
3. Jigs & Fixtures, Joshi P.H, 2nd Edition, Tata McGraw-Hill Publishing Co. Limited, New Delhi, 2004.
4. Jigs and Fixture Hiram E Grant, Tata McGraw-Hill, New Delhi,
Reference Books.
1. Handbook of Jigs & Fixtures Design, William E Boyes,SME, USA..
2. Tool Engineering & Design, G.R. Nagpal, Khanna publications
3. Metal cutting theory and practice, David A. Stephenson, John S. Agapiou, 2nd Ed. CRC Taylor and Francis publishers.
4. Metal cutting and tool design, Dr. B.J. Ranganath, Vikas publishing house.
5. ASTME; Die Design Hand book; McGraw Hill.
6. Metal cutting applications engineering course material – by Kennametal

TESTING OF MATERIALS			
Course Code	20MTE243	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Testing machines and sensors: types of Universal Testing machines and principles of operations, Machine stiffness, load and strain measurement. Calibration and verification of UTM.

Friction, wear and surface testing: Testing of sliding contact, damage, abrasive wear, adhesive wear, erosive wear. Testing and determination of surface characteristics of solid materials. (Surface roughness measurements.

Module-2

Importance of calibration of Testing Instruments: Calibration methods and standards. Tests/ experiments based on methods with active reference to various codes and standard for each test.

Failure Analysis: Principles and Approaches of Failure analysis, objectives, scope, planning, preparation. Failure Analysis, procedures, examination of damages and materials evaluation. Tools and Techniques in FA – An overview. Appearances of fracture in common conditions like uni axial loads, tensional and shear loads, fatigue and creep loading.

Module-3

Microscopy: Optical microscope, scanning electron microscope. Preparation of Specimens for microscopic study**.**

Speed & Control of Testing: Background, Developments in testing Machine Technology, Effects of testing rates on properties, Results before servo control, Results from servo controlled machines.

Module-4

Strain Rate Testing: Aim of Recommendations, Abbreviations and Symbols, Test Machine Requirements. Specimens Measurements, Data Processing, General Definitions Strength Hardening Constitutive Relations to Model Material Strain Rate Dependency.

Module-5

Lubrication & Determination of characteristics of lubricants: Introduction, Types of lubricants, characteristics of lubricants Methods of lubrication, four ball testing.

Course outcomes:

At the end of the course the student will be able to:

1. Students will be able to understand and correlate various materials testing methods used in industries.
2. Understanding the concept of importance of calibration in testing instruments.
3. Knowledge of materials testing microscopes,
4. Understanding the strain rate testing knowledge and
5. Knowledge of lubrication and method of testing the lubrications.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module. ■

Textbook/ Textbooks

1. Testing of Metallic Materials – A.V.K. Suryanarayan, Prentice Hall of India.
2. Inspection of Materials, Vol. II – Destructive Methods, R.C. Andersen, ASM 1988.

Reference Books
1. ASM - Testing of materials.
2. Workability Testing Techniques, G.E. Dieter, ASM 1984.
3. Relevant Codes and Standards.

PRODUCT DESIGN TECHNOLOGY

Course Code	20MTE251	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Introduction: Characteristics of successful product development who Designs and develops products, duration and cost of product development, the challenges of product development.
Development Processes and Organizations: 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.

Module-2

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.
Identifying Customer Needs: Gather raw data from customers, interpret raw data in terms of customer needs, organize the needs into a hierarchy, establish the relative importance of needs and reflect on the results and the process.
Product Specifications: What are specifications, when are specifications established, establishing target specifications setting the final specifications.
Concept Selection: Overview of methodology, concept screening, concept scoring, caveats.

Module-3

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 and reflect on the results and the process.

Product Architecture: What is product architecture, implications of the architecture, establishing the architecture, variety and supply chain considerations, platform planning, related system level design issues

Module-4

Industrial Design: Assessing the need for industrial design, the impact of industrial design, industrial design process, managing the industrial design process, assessing the quality of industrial design.
Design for Manufacturing: Definition, estimation of manufacturing cost, reducing the cost of components, assembly, supporting production, impact the DFM on other factors .

Module-5

Course outcomes:

At the end of the course the student will be able to:

1. Students will be able to demonstrate their knowledge in various aspects of product development.
2. Knowledge of identifying the customer needs and aspects,
3. To have idea of product specifications,
4. Knowledge of product survey and methods of surveys and
5. Awareness of ergonomics and aesthetics designs with customer needs.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module. ■

Textbook/ Textbooks

1. Product Design and Development, Karl,. T. Ulrich, Steven D. Eppinger, Irwin McGraw Hill.
2. Product Design for Manufacture and Assembly, Geoffery Boothroyd, Peter Dewhurst and Winston Knight.
Reference Books
1. Product Design and Manufacturing, A C Chitale and R C Gupta, PH1.
2. New Product Development, Timjones Butterworth Heinmann, Oxford, UCI.1997.

RAPID PROTOTYPING			
Course Code	20MTE252	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Introduction: Definition of Prototype, Types of prototype, 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

Module-2

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

Module-3

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.
Laser Engineering Net Shaping (LENS).

Module-4

Rapid Tooling : Indirect Rapid tooling -Silicon rubber tooling -Aluminum filled epoxy tooling, Spray metal tooling, Cast kirksite, 3D keltool etc, Direct Rapid Tooling — Direct AI M, Quick cast process, Copper polyamide, Rapid Tool, DMILS, Pro Metal, Sand casting tooling, Laminate tooling soft Tooling vs. hard tooling.

Module-5

Software For Rp: Stl files, Overview of Solid view, magics, imics, magic communicator, etc. Internet based software, Collaboration tools.
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.

Course outcomes:

At the end of the course the student will be able to:

1. Students can express the concept of product design stages and methods, thereby making him a better product designer.
2. Student can assess and implement RP techniques for specific application leading to better ROI.
3. Understanding the concept and principles of prototype printers,
4. Knowledge of software for RP
5. Understanding the RP Process and its optimization.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module. ■

Textbook/ Textbooks

1. : Stereo 1ithography and other RP & M Technologies- Paul F. Jacobs, SME NY, 1996.
2. Rapid Manufacturing -,Flham D.T & Dinjoy S.S, Verlog London 2001.

Reference Books

1. **Wohler's Report 2000** , Terry Wohler's Wohler's Association 2000

NON-TRADITIONAL MACHINING			
Course Code	20MTE253	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Introduction: Need for non-traditional machining processes, Process selection, classification, comparative study of different processes.

Abrasive Jet Machining: Principle, Process parameters, Influence of process parameters on MRR, applications, advantages and disadvantages.

Water Jet Machining: Principle, Equipment, Operation, Application, Advantages and limitations**.**

Module-2

Thermal Metal Removal Processes: Electric discharge machining, Principle of operation, mechanism of metal removal, basic EDM circuitry, spark erosion generators, Analysis of relaxation type of circuit, material removal rate in relaxation circuits, critical resistance parameters in Ro Circuit, Die electric fluids, Electrodes for spark erosion- surface finish, applications.

Electro Chemical machining (ECM): Classification of ECM process, Principle of ECM, Chemistry of the ECM process, parameters of the process, Determination of the metal removal rate, dynamics of ECM process, Hydrodynamics of ECM process, polarization, Tool Design, advantages and disadvantages-applications. Electro Chemical grinding, Electro Chemical honning, Electrochemical deburring.

Module-3

Chemical Machining: Introduction, fundamental principle types of chemical machining, Maskants, Etchants, Advantages and disadvantages, applications, chemical blanking, chemical milling (contour machining), Hydrogen embrittlement

Plasma arc Machining: Introduction, Plasma, Generation of Plasma and equipment, Mechanism of metals removal, PAM parameters, process characteristics, types of torches, applications.

Electron beam machining (EBM): Introduction, Equipment for production of Electron beam, Theory of electron beam machining, Thermal & Non thermal type, Process characteristics, applications.

Module-4

Laser Beam Machining: Introduction, principles of generation of lasers, Equipment and Machining Procedure, Types of Lasers, Process characteristics, advantages and limitations, applications. CO_2 Laser: Principle, Equipment, Applications.

Ion Beam Machining: principle, equipment, working, sputtering rate, applications.

Module-5

High Velocity forming processes: Introduction, development of specific process, selection, comparison of conventional and high velocity forming methods.

Types of high velocity forming methods: explosion forming process, electro-hydraulics forming, magnetic pulse forming. Applications, Advantages and limitations.

Ultra Sonic Machining: Definition, Mechanism of metal removal, elements of the process, Tool feed mechanisms, Theories of mechanics, effect of parameters, Different types of concentrators, horn design, applications, Limitations.

Course outcomes:

At the end of the course the student will be able to:

1. Student will be in a position to appreciate the merits of nontraditional machining and its application in Industries.
2. Justify and demonstrate the benefits of non-traditional machining processes over traditional machining processes.
3. Students will be able to decide a process suitable for a particular material based on the availability of the sources.
4. Understanding the advanced techniques in manufacturing and
5. Students can expose for the marching of all tough materials.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module. ■

Textbook/ Textbooks

1. Modern Machining Process - P.C Pandy & H.S Shan Tata McGraw Hill.
2. Modern Machining Processes - P.K Mishra
3. Thermal Metal Cutting Processes- Dr. B.J. Ranganath, I K International, New Delhi.

Reference Books

1. New technology - Bhattacharya, Institution of Engineers, India
2. Production technology - HMT Tata McGraw Hill.
3. Metals hand book - ASM Vol-3
4. High velocity forming of metals - F.M Wilson ASTME Pretice Hall.
5. Modern Manufacturing Methods – Adithan.

MANUFACTURING ENGINEERING LAB- 2			
Course Code	20MTEL26	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	0:4:0	SEE Marks	60
Credits	02	Exam Hours	03

Note:

5. These are independent laboratory exercises.
6. A student may be given at least five exercises stated below.
7. Student must submit a comprehensive report on the problem solved & give a Presentation on the same for Internal Evaluation.
8. Any one of the exercises done (at least five) from the below list has to be asked in the Examination for evaluation.

Sl. NO	Experiments
1	Study waviness produced by grinding process and characterize the resulting surface.
2	Develop and implement a program for pick and place of an object by a robot.
3	Modeling and simulation using MATLAB of a vibration control system and to draw time response/ frequency response curves.
4	Kinematic analysis of forward/ reverse linkages of robots using MATLAB (Denavit-Hartenberg convention).
5	Trajectory planning of robots using MATLAB.
6	Design and analysis of PID controller for mechanical engineering applications using MATLAB.
7	Reduce MLT using Lean principles that are followed in major industries (using case studies and data from industries and make a proposal for redesigning existing machine shop).
8	To develop a CIM Layout consisting of 3 machining centers, one AGV and 3 material handling robots. Layout developed must indicate complete CIM environment consisting of tool crib, raw material storage and finished product storage area. (using solid edge, Autocad or any other available software).
9	Monitoring of vibrations/noise of a machine tool and to compare it with industry standards. List the causes of variation and suggest remedial measures.
10	Detection, location and characterization of defects in castings/ welds/ adhesive bonds.

TECHNICAL SEMINAR			
Course Code	20MTE27	CIE Marks	100
Number of contact Hours/week (L:P:SDA)	0:2:0	SEE Marks	--
Credits	02	Exam Hours	--

Course objectives:

The objective of the seminar is to inculcate self-learning, face audience confidently, enhance communication skill, involve in group discussion and present and exchange ideas.

Each student, under the guidance of a Faculty, is required to

- Choose, preferably through peer reviewed journals, a recent topic of his/her interest relevant to the Course of Specialization.
- Carryout literature survey, organize the Course topics in a systematic order.
- Prepare the report with own sentences.
- Type the matter to acquaint with the use of Micro-soft equation and drawing tools or any such facilities.
- Present the seminar topic orally and/or through power point slides.
- Answer the queries and involve in debate/discussion.
- Submit two copies of the typed report with a list of references.

The participants shall take part in discussion to foster friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident.

The CIE marks for the seminar shall be awarded (based on the relevance of the topic, presentation skill, participation in the question and answer session and quality of report) by the committee constituted for the purpose by the Head of the Department. The committee shall consist of three faculties from the department with the senior most acting as the Chairperson.

Marks distribution for CIE of the course 20MTE27 seminar:

Seminar Report: 30 marks

Presentation skill:50 marks

Question and Answer:20 marks

*** END OF II SEMESTER***

PLASTIC MOULD DESIGN			
Course Code	20MTE31	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Introduction to Plastics: Monomer, Polymer, Degree of Polymerisation, Classification of Plastics, General review of Properties, Application and Processing, Behaviors of various plastics PE, PP, PYC, PMMA, ABS, NYLON, Polyacetal, Polycarbonate, PTFE, PF, UF & MF.
Mould Construction: Parting Surfaces: Straight, stepped, curved parting surface. Design of various Injection mould elements, cores, cavities, and inserts, fitting core and cavity inserts, pillars and bushes.

Module-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.

Module-3

Cooling System: Need for cooling, cooling solid cores and cavities, insert cooling, cooling long cores, cooling elements, baffles, bubblers etc., and cooling calculation.
Parting Surfaces: Straight, stepped, curved parting surface.

Module-4

Moulds with External Under Cuts: Split moulds, Actuation of splits, Guiding of splits, side cores.
Special Moulds: Form pins Moulds for threaded components: External threads, internal threads, Moulds with loose cores, Automatic unscrewing type of moulds, Under feed moulds, 3 Plate moulds, hot runner moulds (Runner less moulds), Multi color moulding tools, Defects in moulding and its remedies, Compression moulding tools, transfer moulding tools .
Moulds with internal under cuts : Form pins
Moulds for threaded components: External threads, internal threads, Moulds with loose cores, Automatic unscrewing type of moulds.
Under feed moulds : 3 Plate moulds, hot runner moulds (Runner less moulds)
Multi color moulding tools: Defects in moulding and its remedies, Compression moulding tools, transfer moulding tools.

Module-5

Design of the following types of moulds:

1. Two plate moulds with pin ejection and edge gate.
2. Two plate moulds with sleeve ejection and submarine gate
3. Two plate moulds with stripper plate ejection.
4. Two plate moulds with internal undercut
5. Two plate moulds with spilt mould and mould with side core.
6. Two plate moulds for threaded parts (loose core and automatic rack & pinion design).
7. Three plate moulds with multi impressions.
8. Compression moulds.
9. Transfer moulds.

NOTE: Draw proportionate sketches of the designed moulds on graph sheets or plain sheets.

Course outcomes:
At the end of the course the student will be able to:

1. Students will be able to understand various concepts of molds and mold design.
2. Understand the various behavior of plastic used for moulds
3. Expose to manufacturing concepts of plastics in moulds.
4. Understanding the special moulds especially used in thread components.
5. Expose to exercise of mould designs with working drawings.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module. ■

Textbook/ Textbooks

1. Injection Mould Design, Pye. R. G. W., New York – John Wiley & Sons.
2. Hand book of Plastic Processes, Charles A. Harper.
3. Injection Mould Design, Pye R.G.W., New-York -John Wiley &. Sons 12th Ed. 1989.

Reference Books

1. Injection Moulding Theory & Practice, Rubin. J. Irvin, New York-John Wiley & Sons 1976.
2. Injection Mould 108 Proven Design, Gastro, London -Applied Science Pub. 9th Ed. 1982.
3. 101 Proven Design by RGW Pye.

ADVANCED MOULDING TECHNIQUES			
Course Code	20MTE321	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Module-1

Injection Moulding Technology : Microprocessor control injection moulding machine, close loop control, open loop control, CNC control, multi color injection moulding, rotary injection moulding, structural foam moulding, sandwich injection moulding**.**

Metal injection moulding: contact injection moulding, moulding of cellular product like EPS, steam chest moulding, future trends in injection moulding like external & internal inter locking alignment of large moulds, processing of specialty polymers.

Module-2

Extrusion: General consideration during extrusion process like specific heat, latent heat, internal conductivity, shape & size of granular hygroscopic nature over temperature, effect of flow property like relaxation time & defects like shark skin, elastic turbulence, influence of TG, TM & crystal growth rate, cooling rate, impact strength, manufacturing of woven sacks etc. co extrusion, co extruded pipe, muilt layer pipe, foam pipe, biaxial oriented pipe.

Module-3

Lamination : Lamination by extrusion coating, twin screw extrusion, co-rotating & counter rotating, feeding mechanism in twin screw extruder, roll of side feede injection feeder, principles of compounding, mixing mechanism etc**.**

PTFE Moulding: Processing techniques used for PTFE, Material consideration, sintering, Ram extrusion, and Paste extrusion, lso statistic. Moulding and skewing technique for PTFE processing.

Module-4

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

Reaction Injection Moulding (RIM): RIM of Polyurethane, material for RIM, liquid RIM & its advantages over conventional injection moulding, RRIM**.**

Module-5

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.

Course outcomes:

At the end of the course the student will be able to:

1. Students will be able to demonstrate their knowledge in the field of advanced moulding methods.
2. Understanding the process and consideration in extrusion process.
3. Learning the techniques in PTEF moulding.
4. Learning the advanced Reaction Injection Moulding
5. Knowledge of advance techniques like, Resin transfer mould, electro plating etc.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module. ■

Textbook/ Textbooks

1. Injection Moulding, by Rubin.

2. Extrusion –Berln.
3. Injection Mold by Glavin & Denton
Reference Books
1. Extrusion Die Design, M. V. Joshi.
2. Polymer Chemistry, Gowriker.

NANO SCIENCE AND NANOMATERIALS			
Course Code	20MTE322	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Module-1

Introduction to Nano science and Nano tehnology: History, background scope and interdisciplinary nature of nano science and nanotechnology, scientific revolutions, nano sized effects surface to volume ratio, atomic structure, molecules and phases, energy at the nano scale molecular and atomic size, quantumeffects,types of nanotechnology and nano machines.

Classification of Nano structures: Zero dimensional, one-dimensional and two dimensional nanostructure materials-clusters of metals, semiconductors, ceramics and nano composites, size dependent phenomena, quantum dots nano wires, tubes, nanosheets, nano and mespores, top down and bottom ups approachs, misnomers and misconception of nano techonology, importance of nano scale materials and their devices.

Module-2

Properties of Nano materials: Mechanical properties- Thermo physical properties - Electrical properties – Electro chemical properties Magnetic p properties - optical properties -Catalytic property – properties of gas permeation and separation membranes.

Nanostructure Design: Functionality of nanostructures and their characteristics evaluation, size effect in semiconductor nano particles – particle size, shape density – Melting point, surface tension, wettability – specific surface area and pore – Assembly of nano particles and fictionalization – nano particles arranged structure s as nani pores and nano composites – Structure control of nano particle collectives by sintering and bounding – Self – assembly. Nano particle dispersion and aggression behaviour – Single nano particle motion in fluid – Brownian diffusion – Adsorption properties – interactions between particles – Aggregation and dispersion, characterization and control– Rheology of slurry – Simlation of colloidal dispersion system.

Module-3

Melting Point and Phase Transition Processes : quantum-size-effect (QSE) Size-induced metal-insulator-transition (SIMIT) nano-scale magnets, transparent magnetic materials and ultrahigh-density magnetic recording materials – chemical physical of atomic and molecular clusters. Surface energy – chemical potential as a function of surface curvature – Electrostatic stabilization – surface charge density-electric potential at the proximity of solid surface-vander Waals attraction potential. Photochemistry, Photoconductivity, Electrochemistry of nano materials – Diffusion in Nano materials, Nano scale Heat transfer, Catalysis by Gold Nano particles, Transport in semiconductor Nanostructures, Transition Metal Atoms on Nano carbon Surfaces, Nano deposition of soft materials, Nano catalysis.

Module-4

Application of Quantum Dots for Bio-Medical Engineering: Bio- imaging with quantum dots – Pinpoint drug and gene delivery- delivery to the brain – Development of the thermo responsive magnetic nano particle and its deployment in the biotechnology field, Addressing of nano particles by using DNA molecules, Nano particle formation of DNA (globule transformation) – Development and multi-functionalization of high – functional separation membranes – Design of nano particles for oral delivery of peptide drugs.

Module-5

Smart Materials And Systems : Thermo responsive materials, piezoelectric materials, electro strictive and magneto strictive materials, ferro fluids, ER and MR fluids, biomimetic materials, smart gel, shape memory alloys and polymers, actuation methods, measurements.

Nanoparticles: Surface modification of inorganic nano particles by organic functional groups Instantaneous nano foaming method for fabrication of closed –porosity silica particle- Development of photo catalyst inserted into surface of porous alumina silicate- Fabrication technique of organic nano crystals and their optical properties and matetialization, Dispersion control of nano particles in solvents – Development of new cosmetics based on nano particles – Development of functional skincare cosmetics using biodegradable PLGA nano spheres.

Course outcomes:
At the end of the course the student will be able to:

1. Students will be able to understand the importance of nanoscience and nanomaterials in industrial applications.
2. Understanding the basic properties and designs of nano structures.
3. Understanding the phase transition process.
4. Knowledge of Nano materials in Bio-Medical engineering.
5. Knowledge of Smart materials and its systems.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module. ■

Textbook/ Textbooks

1. Nanophysics and Nanotechnology" – An Introduction to Modern Concepts in Nanoscience, Edward L. Wolf. 2nd Edition, John Wiley & Sons, 2006.
2. Surface Science Foundation of Catalysis and Nano science, K.W. Kolasinski, Wiley, 2002
3. Nano chemistry:- A chemical approach to Nano materials, G.A. Ozin and A.C. Arsenault 2005.
4. Nano structures & Nano materials Synthesis, Properties & applications, G. Cao Imperial Collage 2004.

Reference Books

1. Nano particulates as Drug Carriers imperial college Valdimir P, Torchilin (2006).
2. Nano materials and Nano systems for Bio-Medical Applications, M Reza Mozafari (2007), springer.
3. Nanotechnology – Basic science and emerging technologies Chapman and Hall/CRC(2002).
4. Nanomaterials and Nanotechnologies and design on introduction for engineers and architects, Micheal F. Ashby, P.J. Ferreria, D.L. Sehodek.

MATERIAL FLOW ANALYSIS			
Course Code	20MTE323	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Module-1

Introduction: Modeling, meshing, Boundary conditions, Loads, Optimization..

Module-2

Sheet Metal Analysis I: Metal Flow Analysis, Heat analysis, Micro structure analysis, Stress analysis, Thermo mechanic processing, Heat transfer analysis.
Sheet Metal Analysis II: Residual stress analysis, Static analysis, Contact analysis, Buckling analysis, Bending analysis, Natural frequency.

Module-3

Mold Analysis: Shrinkage analysis, Warpage analysis, Flow analysis.
Die Casting Analysis I: 3D -mesh generation, Heat flow, fluid flow, Stress and Strain.

Die Casting Analysis II: Microstructure modeling, inverse modeling, die life estimation.

Module-4

Software I: Mold flow, Pro-cast; Pro-Mechanica, De-form.

Module-5

Software II: Mold flow, Pro-cast; Pro-Mechanica, De-form.

Course outcomes:
At the end of the course the student will be able to:

1. Students will be able to make analysis of material flow, shrinkage, wrappage and microstructure analysis.
2. Knowledge of Residual stress, static analysis, contact analysis, buckling analysis and bending analysis.
3. Knowledge of Die casting analysis like, mesh generation, heat flow, stress, strain and micro structure modeling.
4. Study of die life estimation.
5. Software knowledge about mold flow and pro-cast.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module. ■

Reference Books

1. Operating Manuals of Mold Flow, PSG-cast, PSG Mechanica, Deform.

DESIGN FOR MANUFACTURE			
Course Code	20MTE331	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Module-1

Effect of Materials and Manufacturing Process on Design: Major phases of design. Effect of material properties on design Effect of manufacturing processes on design. Material selection process- cost per unit property, Weighted properties and limits on properties methods.

Tolerance Analysis: Process capability, mean, variance, skewness, kurtosis, Process capability metrics, Cp, Cpk, Cost aspects, Feature tolerances, Geometries tolerances, Geometric tolerances, Surface finish, Review of relationship between attainable tolerance grades and different machining process. Cumulative effect of tolerance- Sure fit law and truncated normal law.

Module-2

Selective Assembly: Interchangeable part manufacture and selective assembly, Deciding the number of groups - Model-1: Group tolerance of mating parts equal, Model total and group tolerances of shaft equal. Control of axial play -Introducing secondary machining operations, Laminated shims, examples.

Datum Features: Functional datum, Datum for manufacturing, Changing the datum. Examples.

Module-3

Design Considerations: Design of components with casting consideration. Pattern, Mould, and Parting line. Cored holes and Machined holes. Identifying the possible and probable parting line. Casting requiring special sand cores. Designing to obviate sand cores.

Component Design: Component design with machining considerations link design for turning components - milling, Drilling and other related processes including finish- machining operations.

Module-4

True positional theory: Comparison between co-ordinate and convention method of feature location. Tolerance & true position tolerancing virtual size concept, Floating and fixed fasteners. Projected tolerance zone. Assembly with gasket, zero position tolerance. Functional gauges, Paper layout gauging.

Module-5

Design of Gauges: Design of gauges for checking components in assemble with emphasis on various types of limit gauges for both hole and shaft.

Course outcomes:

At the end of the course the student will be able to:

1. Students will be able to demonstrate their understanding of tolerance specification and considerations to be given importance in design for manufacture.
2. Knowledge of Process capability in manufacturing.
3. Understanding the concept of Interchangeability and Selective assembly.
4. Awareness of the Component design.
5. Understanding the designs of gauges in checking the hole and shaft components..

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module. ■

Textbook/ Textbooks

1. Designing for Manufacturing - Harry Peck, Pitman Publications, 1983.

2.	Machine Design - Dieter McGraw hill Publications for topic 1
3.	Metrology - R.K. Jain Khanna Publication for topic 6.
4.	Product design for manufacture and assembly - Geoffrey Boothroyd, peter dewhurst, Winston Knight, Merceldekker. Inc. New york.
5.	Material selection and Design, Vol. 20 - ASM Hand book.

NON DESTRUCTIVE TESTING			
Course Code	20MTE332	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Module-1

Introduction to ND Testing: Selection of ND methods, visual inspection, leak testing, Liquid penetration inspection, its advantages and limitation.
Magnetic Particle Inspection: Methods of generating magnetic field, types of magnetic particles and suspension liquids, steps in inspection application and limitations.

Module-2

Eddy Current Inspection: principles, operation variables, procedure, inspection coils, and detectable discounts by the method.
Ultrasonic Inspection: Basic equipment characteristics of ultrasonic waves, variables inspection, inspection methods pulse echo A,B,C scans transmission, resonance techniques, transducer elements couplets, search units, contact types and immersion types inspection standards-standard reference blocks.

Module-3

Radiography Inspection: principles, radiation source X-rays and gamma rays, X-ray-tube, radio graphic films, neutron radiography, Thermal inspection principles, equipment inspection methods applications.
Microwave Inspection: Microwave holography, applications and limitations

Module-4

Optical Holography: Basics of Holography, recording and reconstruction -Acoustical Holography: systems and techniques applications. Indian standards for NDT

Module-5

Visual Inspection and Thermographic methods: **Acoustic emission, Total acoustic emission, felicity ratio, Generation of Acoustic Emission.**

Course outcomes:
At the end of the course the student will be able to:

1. Students will be able to understand significance and suitability of various non destructive testing methods in industrial applications.
2. Knowledge of Magnetic particle, Eddy current and Ultrasonic inspections.
3. Knowledge of Radiography and Microwave inspection.
4. Understanding the concept of Holography.
5. Knowledge of Thermographics.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module. ■

Textbook/ Textbooks

1. The Testing Instruction of Engineering Materials - Davis H.E Troxel G.E Wiskovil C.T - McGraw Hill.

Reference Books

1. Non Destructive Testing – Mc Gonnagle JJ – Garden and Reach New York.
2. Non Destructive Evolution and Quality Control – Vol. 17 of metals hand book 9th Edition Asia Int. 1989.

COMPUTER CONTROL OF MANUFACTURING SYSTEMS			
Course Code	20MTE333	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Module-1

Introduction to Computer integrated Manufacturing Systems: Manufacturing Systems, Types of Manufacturing Systems, Machine Tools and related equipment's, Material Handling Systems, Computer monitoring and control, Manufacturing support systems, The Product Cycle and CAD/ CAM, Functions of computers in CIMS: CIMS Data Files, System Reports, Benefits of Computer integrated Manufacturing Systems,

NC/ CNC Machine Tools: General architecture of CNC Machine, Components of the CNC Systems: Machine Control Unit, CNC Driving system components: Hydraulic, Servo Motors, Stepper Motors, Feed back Devices: Encoder, Resolver, Inductosyn, Tachometers, Counting devices, Digital to analog converters.

Module-2

Interpolations: DDA integrators, simple and symmetrical DD reference word CNC interpolators. **Control loops for N C Systems:** Introduction-control loops for point and counting systems.

Constructional Features of CNC Machines: Design considerations of CNC machines for improving machining accuracy, Structural Members, Slide ways, bearings, Re-circulating ball Screws, Spindle drives, Work holding devices and tool holding devices, Automatic tool changers: Principles of Operation, Machining Centers, Tooling for CNC machines.

Module-3

N.C part programming: Introduction, NC/ CNC programming methods: Manual part programming for turning and milling centers, G codes, M codes, canned cycles, Programming with CAD/CAM integration, CAM packages for CNC part program generation, Practical Exercises on CNC part programming.

Computer Controls in NC: CNC Technology: Functions of CNC Control in Machine Tools, Advantages of CNC, Direct Numerical Control(DNC Systems): Configuration of DNC system, , Functions of DNC, Communication between DNC computer & MCU, Advantages of DNC, Adaptive control machining systems. Adaptive control optimization system, adaptive control constraint system, applications to machining processes, Benefits of Adaptive control machining

Module-4

Industrial Robotics : Robotics technology : Types of Robots, Robot Technology Levels, Robot geometric configurations and Technical Features, basic robot motions, Robot control systems, robot drive systems, Work-cell control and Interlocks, robot sensors, robot safety, robot-computer interface, industrial robot applications and benefits, robot programming and programming languages

Module-5

Computerized Manufacturing Planning and Control Systems: Computer aided process planning, Variant and Generative approaches, Computer integrated production planning and control systems, Typical production planning and control system, Material planning systems, Capacity planning, Shop Floor Control, Automatic identification, Automated data collection systems.

Course outcomes:

At the end of the course the student will be able to:

1. Students will get clear understanding of NC/CNC machines, Various elements of CNC machines and its uses.
2. Understanding the Constructional features of CNC machine Tools
3. Knowledge of CNC programming and its implementation.
4. Knowledge of Robotic technology.
5. Awareness of Computerized manufacturing planning and Control systems.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- The question paper will have ten full questions carrying equal marks.
- Each full question is for 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module. ■

Textbook/ Textbooks

1. Automation, Production Systems and Computer Integrated Manufacturing, GROOVER M P, Prentice Hall India (P) Ltd, 1989.
2. CAD/CAM Computer Aided Designand Manufacturing, Mikell P. Groover and Emory W. Zimmer Jr, Prentice Hall India (P) Ltd, 1992. (unit 1).
3. Computer Controls of Manufacturing Systems, M. Koren, Mc GrawHill, 1983.

Reference Books

1. Numerical control of machine tools". Martin J.
2. CAD/CAM Principles and Applications P.N. Rao, Mc Grawhill 200.2
3. Numerical control of machine tools - Y. Koren & J. Benuri, Khanna, 1992.
4. Numerical control in manufacturing- Wilson, F.M Mc Graw Hill Newyork.
5. Theory and Design of CNC Systems, Suk-Hwan Suh, Seong-Kyoon Kang, Dea-Hyuk Chung and Ian Stroud, Springer, 2008.

PROJECT WORK PHASE – 1			
Course Code	20MTE34	CIE Marks	100
Number of contact Hours/Week	0:2:0	SEE Marks	--
Credits	02	Exam Hours	--

Course objectives:

- Support independent learning.
- Guide to select and utilize adequate information from varied resources maintaining ethics.
- Guide to organize the work in the appropriate manner and present information (acknowledging the sources) clearly.
- Develop interactive, communication, organisation, time management, and presentation skills.
- Impart flexibility and adaptability.
- Inspire independent and team working.
- Expand intellectual capacity, credibility, judgement, intuition.
- Adhere to punctuality, setting and meeting deadlines.
- Instil responsibilities to oneself and others.
- Train students to present the topic of project work in a seminar without any fear, face audience confidently, enhance communication skill, involve in group discussion to present and exchange ideas.

Project Phase-1 Students in consultation with the guide/s shall carry out literature survey/ visit industries to finalize the topic of the Project. Subsequently, the students shall collect the material required for the selected project, prepare synopsis and narrate the methodology to carry out the project work.

Seminar: Each student, under the guidance of a Faculty, is required to

- Present the seminar on the selected project orally and/or through power point slides.
- Answer the queries and involve in debate/discussion.
- Submit two copies of the typed report with a list of references.

The participants shall take part in discussion to foster friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident.

Course outcomes:

At the end of the course the student will be able to:

- Demonstrate a sound technical knowledge of their selected project topic.
- Undertake problem identification, formulation, and solution.
- Design engineering solutions to complex problems utilising a systems approach.
- Communicate with engineers and the community at large in written an oral forms.
- Demonstrate the knowledge, skills and attitudes of a professional engineer.

Continuous Internal Evaluation

CIE marks for the project report (50 marks), seminar (30 marks) and question and answer (20 marks) shall be awarded (based on the quality of report and presentation skill, participation in the question and answer session by the student) by the committee constituted for the purpose by the Head of the Department. The committee shall consist of three faculty from the department with the senior most acting as the Chairperson.

MINI PROJECT			
Course Code	20MTE35	CIE Marks	100
Number of contact Hours/Week	0:2:0	SEE Marks	--
Credits	02	Exam Hours/Batch	--

Course objectives:

- To support independent learning and innovative attitude.
- To guide to select and utilize adequate information from varied resources upholding ethics.
- To guide to organize the work in the appropriate manner and present information (acknowledging the sources) clearly.
- To develop interactive, communication, organisation, time management, and presentation skills.
- To impart flexibility and adaptability.
- To inspire independent and team working.
- To expand intellectual capacity, credibility, judgement, intuition.
- To adhere to punctuality, setting and meeting deadlines.
- To instil responsibilities to oneself and others.
- To train students to present the topic of project work in a seminar without any fear, face audience confidently, enhance communication skill, involve in group discussion to present and exchange ideas.

Mini-Project: Each student of the project batch shall involve in carrying out the project work jointly in constant consultation with internal guide, co-guide, and external guide and prepare the project report as per the norms avoiding plagiarism.

Course outcomes:

At the end of the course the student will be able to:

- Present the mini-project and be able to defend it.
- Make links across different areas of knowledge and to generate, develop and evaluate ideas and information so as to apply these skills to the project task.
- Habituated to critical thinking and use problem solving skills.
- Communicate effectively and to present ideas clearly and coherently in both the written and oral forms.
- Work in a team to achieve common goal.
- Learn on their own, reflect on their learning and take appropriate actions to improve it.

CIE procedure for Mini - Project:

The CIE marks awarded for Mini - Project, shall be based on the evaluation of Mini - Project Report, Project Presentation skill and Question and Answer session in the ratio 50:25:25.The marks awarded for Mini - Project report shall be the same for all the batch mates.

Semester End Examination

SEE marks for the mini-project shall be awarded based on the evaluation of Mini-Project Report, Presentation skill and Question and Answer session in the ratio 50:25:25 by the examiners appointed by the University.

INTERNSHIP / PROFESSIONAL PRACTICE			
Course Code	20MTEI36	CIE Marks	40
Number of contact Hours/Week		SEE Marks	60
Credits	06	Exam Hours	03

Course objectives:

Internship/Professional practice provide students the opportunity of hands-on experience that include personal training, time and stress management, interactive skills, presentations, budgeting, marketing, liability and risk management, paperwork, equipment ordering, maintenance, responding to emergencies etc. The objective are further,

To put theory into practice.

To expand thinking and broaden the knowledge and skills acquired through course work in the field.

To relate to, interact with, and learn from current professionals in the field.

To gain a greater understanding of the duties and responsibilities of a professional.

To understand and adhere to professional standards in the field.

To gain insight to professional communication including meetings, memos, reading, writing, public speaking, research, client interaction, input of ideas, and confidentiality.

To identify personal strengths and weaknesses.

To develop the initiative and motivation to be a self-starter and work independently.■

Internship/Professional practice: Students under the guidance of internal guide/s and external guide shall take part in all the activities regularly to acquire as much knowledge as possible without causing any inconvenience at the place of internship.

Seminar: Each student, is required to

- Present the seminar on the internship orally and/or through power point slides.
- Answer the queries and involve in debate/discussion.
- Submit the report duly certified by the external guide.
- The participants shall take part in discussion to foster friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident. ■

Course outcomes:

At the end of the course the student will be able to:

- Gain practical experience within industry in which the internship is done.
- Acquire knowledge of the industry in which the internship is done.
- Apply knowledge and skills learned to classroom work.
- Develop a greater understanding about career options while more clearly defining personal career goals.
- Experience the activities and functions of professionals.
- Develop and refine oral and written communication skills.
- Identify areas for future knowledge and skill development.
- Expand intellectual capacity, credibility, judgment, intuition.
- Acquire the knowledge of administration, marketing, finance and economics.

Continuous Internal Evaluation

CIE marks for the Internship/Professional practice report (20 marks), seminar (10 marks) and question and answer session (10 marks) shall be awarded (based on the quality of report and presentation skill, participation in the question and answer session by the student) by the committee constituted for the purpose by the Head of the Department. The committee shall consist of three faculty from the department with the senior most acting as the Chairperson. ■

Semester End Examination

SEE marks for the internship report (30 marks), seminar (20 marks) and question and answer session (10 marks) shall be awarded (based on the quality of report and presentation skill, participation in the question and answer session) by the examiners appointed by the University. ■

PROJECT WORK PHASE -2			
Course Code	20MTE41	CIE Marks	40
Number of contact Hours/Week	4	SEE Marks	60
Credits	20	Exam Hours	03

Course objectives:

- To support independent learning.
- To guide to select and utilize adequate information from varied resources maintaining ethics.
- To guide to organize the work in the appropriate manner and present information (acknowledging the sources) clearly.
- To develop interactive, communication, organisation, time management, and presentation skills.
- To impart flexibility and adaptability.
- To inspire independent and team working.
- To expand intellectual capacity, credibility, judgement, intuition.
- To adhere to punctuality, setting and meeting deadlines.
- To instil responsibilities to oneself and others.
- To train students to present the topic of project work in a seminar without any fear, face audience confidently, enhance communication skill, involve in group discussion to present and exchange ideas. ■

Project Work Phase - 2: Each student of the project batch shall involve in carrying out the project work jointly in constant consultation with internal guide, co-guide, and external guide and prepare the project report as per the norms avoiding plagiarism. ■

Course outcomes:

At the end of the course the student will be able to:

- Present the project and be able to defend it.
- Make links across different areas of knowledge and to generate, develop and evaluate ideas and information so as to apply these skills to the project task.
- Habituated to critical thinking and use problem solving skills
- Communicate effectively and to present ideas clearly and coherently in both the written and oral forms.
- Work in a team to achieve common goal.
- Learn on their own, reflect on their learning and take appropriate actions to improve it. ■

Continuous Internal Evaluation:

Project Report: 20 marks. The basis for awarding the marks shall be the involvement of the student in the project and in the preparation of project report. To be awarded by the internal guide in consultation with external guide if any.

Project Presentation: 10 marks.

The Project Presentation marks of the Project Work Phase -II shall be awarded by the committee constituted for the purpose by the Head of the Department. The committee shall consist of three faculty from the department with the senior most acting as the Chairperson.

Question and Answer: 10 marks.

The student shall be evaluated based on the ability in the Question and Answer session for 10 marks.

Semester End Examination

SEE marks for the project report (30 marks), seminar (20 marks) and question and answer session (10 marks) shall be awarded (based on the quality of report and presentation skill, participation in the question and answer session) by the examiners appointed by the University. ■