VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI.

MODIFIED DRAFT SCHEME

Scheme of Teaching and Examinations and Syllabus
M.Tech. in Tool Engineering (MTE)
(Effective from the Academic year 2022-23)

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VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
Scheme of Teaching and Examinations – 2022
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/Seminar	Tutorial/ Skill Development Activities	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	P	T/SDA					
1	BSC	22MST/MTE/MPD/ MEM/MPM/MPY/ MSE11	Applied Mathematics	03	00	00	03	50	50	100	3
2	IPCC	22MTE12	Finite Element Method	03	02	00	03	50	50	100	4
3	PCC	22MTE13	Press Tool Design	03	00	02	03	50	50	100	4
4	PCC	22MTE14	Jigs and Fixture Design	02	00	02	03	50	50	100	3
5	PCC	22MTE15	Gauges and Measurements	02	00	02	03	50	50	100	3
6	MCC	22RMI16	Research Methodology and IPR	03	00	00	03	50	50	100	3
7	PCCL	22MTEL17	Tool Design Engineering Lab-1	01	02	00	03	50	50	100	2
8	AUD/AEC	22AUD18/ 22AEC18	BOS recommended ONLINE courses	Classes and evaluation procedures are as per the policy of the online course providers.							PP
			TOTAL	**17**	**04**	**06**	**21**	**350**	**350**	**700**	**22**

Note: BSC-Basic Science Courses, PCC: Professional core. IPCC-Integrated Professional Core Courses, MCC- Mandatory Credit Course,
AUD/AEC –Audit Course / Ability Enhancement Course (A pass in AUD/AEC is mandatory for the award of the degree), PCCL-Professional Core Course lab, L-**Lecture, P-Practical, T/SDA-Tutorial / Skill Development Activities** (Hours are for Interaction between faculty and students)

Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with practical of the same course. The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper.

Audit Courses /Ability Enhancement Courses Suggested by BOS (ONLINE courses):

Audit Courses: These are pre-requisite courses suggested by the concerned Board of Studies. Ability Enhancement Courses will be suggested by the BoS if pre-requisite courses are not required for the programs.

Ability Enhancement Courses:

- These courses are prescribed to help students to enhance their skills in the fields connected to the field of specialisation as well allied fields that leads to employable skills. Involving in learning such courses are impetus to lifelong learning.
- The courses under this category are online courses published in advance and approved by the concerned Board of Studies.
- Registration to Audit/Ability Enhancement Course shall be done in consultation with the mentor and is compulsory during the concerned semester.
- In case a candidate fails to appear for the proctored examination or fails to pass the selected online course, he/she can register and appear for the same course if offered during the next session or register for a new course offered during that session, in consultation with the mentor.
- The Audit Ability Enhancement Course carries no credit and is not counted for vertical progression. However, a pass in such a course is mandatory for the award of the degree.

Skill development activities: Under Skill development activities in a concerning course, the students should

1. Interact with industry (small, medium, and large).
2. Involve in research/testing/projects to understand their problems and help creative and innovative methods to solve the problem.
3. Involve in case studies and field visits/ fieldwork.
4. Accustom to the use of standards/codes etc., to narrow the gap between academia and industry.
5. Handle advanced instruments to enhance technical talent.
6. Gain confidence in modelling of systems and algorithms for transient and steady-state operations, thermal study, etc.
7. Work on different software/s (tools) to simulate, analyze and authenticate the output to interpret and conclude.

All activities should enhance student's abilities to employment and/or self-employment opportunities, management skills, Statistical analysis, fiscal expertise, etc.

Students and the course instructor/s to involve either individually or in groups to interact together to enhance the learning and application

skills of the study they have undertaken. The students with the help of the course teacher can take up relevant technical –activities which will enhance their skill. The prepared report shall be evaluated for CIE marks.

APPLIED MATHEMATICS
Common To MST/MTE/MPD/MEM/MPM/MPY/MSE

Course Code	**22MTE11**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	**3:0:0**	SEE Marks	50
Total Hours of Pedagogy	**40**	Total Marks	100
Credits	**03**	Exam Hours	03

Course Learning objectives:

- The course is aimed to develop the basic Mathematical skills of engineering students that are imperative for effective understanding of engineering subjects.
- The topics introduced will serve as basic tools for specialized studies in the fields of engineering and science.
- An understanding of Fourier Series and Laplace Transform to solve real world problems.
- An understanding of Linear Algebra through matrices and understanding of statistical analysis using ANOVA.

Module-1 (08Hrs)

Errors and Simple Mathematical modeling: Error definition, round off errors and truncation errors. Mathematical modeling and Engineering problem solving: Simple mathematical model, Conservation Laws of Engineering.
Engineering Applications on : Deflection of Beams, Whirling of shafts, Terminal velocity of a freely falling body

Teaching-Learning Process	Effective Lecturing, Active Learning, Digital Learning, Case-Based Learning, Effective Class Discussions and Assignments at home/ PPTs.

Module-2 (08Hrs)

System of Linear Algebraic Equations and Eigen Value Problems: Gauss-Jordan Method, Cholesky Method, Partition method, Givens method for symmetric matrices.

Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-3 (08 Hrs)

Roots of Equations: Muller‟s method, Graeffe‟s roots squaring method.

Numerical solutions of ordinary differential equations: Introduction, Picard`s method of successive approximation, first order simultaneous equations by Picard`s & Runge Kutta methods. & Second order equations by Picard`s & Runge Kutta methods.

Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-4 (08Hrs)

Partial Differential Equations: Numerical solution of one dimensional wave equation, Heat equation, (Schmidt`s explicit formula)& Laplace equation(Gauss-Seidel process) by finite difference schemes. Illustrative examples on each method

Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-5 (08Hrs)

Sampling theory: Testing of hypothesis: Chi square test and F-test. Analysis of Variance (ANOVA): One-way classification, Design of experiments, RBD.

Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks.**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs.

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks.**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module.

Course Outcomes:

On completion of this course, students are able to:

1. Acquire the idea of significant figures, types of errors during numerical computation.
2. Implement the statistical and probabilistic concepts required to test the hypothesis and designing the experiments using RBD.
3. Apply various numerical methods to solve system of linear equations.
4. Solve the roots of algebraic/transcendental equations and PDE‟s numerically.
5. Analyze the PDE‟s related to wave equation arising in vibration analysis.

Suggested Learning Resources:

Textbooks:

1. Steven C Chapra and Raymond P Canale, “Numerical Methods for Engineers,” 7th Ed., cGraw-Hill Edition, 2015
2. Theory of ordinary differential equations, Coddington E., Levinson N., McGraw-Hill publishing Company, TMH Edition, 9th Reprint, 1987.
3. M K Jain, S.R.K Iyengar, R K. Jain, Numerical methods for Scientific and engg computation, New Age International, 2003.

Reference books:

1. R.E, Walpole, R.H.Myres, S.L.Myres and Keying Ye, “Probability and Statistics for Engineers and Scientists”, 9th Edition, Pearson, 2012.
2. Dr. B.S. Grewal, “Numerical Methods in Engineering and Science”, Khanna Publishers, 1999.
3. K Shankar Rao, “Introduction to Partial Differential Equations” Prentice - Hall of India Pvt. Lt. , 1995 Edition
4. C. Ray Wylie and Louis C Barrett, “Advanced Engineering Mathematics”. 6th edition, McGraw-Hill, 1995.

Web links and Video Lectures (e-Resources):

- https://archive.nptel.ac.in/courses/

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Acquire the idea of significant figures, types of errors during numerical computation.	L3
CO2	Implement the statistical and probabilistic concepts required to test the hypothesis and designing the experiments using RBD.	L3
CO3	Apply various numerical methods to solve system of linear equations.	L3
CO4	Solve the roots of algebraic/transcendental equations and PDE‟s numerically.	L3
CO5	Analyze the PDE‟s related to wave equation arising in vibration analysis.	L4

Mapping of COS and POs: (Below table is only indicative and hence course teacher can revise it)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	1	1	2	1	1			
CO2	3	2	1	2	2	1	1			
CO3	3	2	1	2	2	1	1			
CO4	3	2	1	2	2	1	1			
CO5	3	2	1	1	2	1	1			

FINITE ELEMENT METHOD			
Course Code	**22MTE12**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	**3:2:0**	SEE Marks	50
Total Hours of Pedagogy	**40**	Total Marks	100
Credits	**04**	Exam Hours	03

Course Learning Objectives:

The student will:

- Study the element properties such as shape function and stiffness matrix for the various elements.
- Learn how to formulate element properties for 1D and 2D elements.
- Develop skill to solve simple beam problems using the steps of FEM.
- Learn the problem solving knowledge on temperature gradient and heat fluxes.
- Understand the numerical solutions of axisymmetric elements.

Module-1 (08 Hrs)

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, Discretization 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.

Teaching-Learning Process	Effective Lecturing, Active Learning, Digital Learning, Case-Based Learning, Effective Class Discussions and Assignments at home/ PPTs.

Module-2 (08 Hrs)

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.

Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-3 (08 Hrs)

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.

Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-4 (08 Hrs)

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.

Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-5 (08 Hrs)

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.

Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

PRACTICAL COMPONENT OF IPCC (May cover all / major modules): Performing a Typical ANSYS Analysis on,

Sl.NO	Experiments
1.	Bars of Constant Cross-section Area
2.	Bars of Tapered Cross section Area
3.	Stepped Bar

4.	Trusses
5.	Simply Supported Beam
6.	Simply Supported Beam with Uniformly varying load
7.	Simply Supported Beam with Uniformly distributed load
8.	Beam with moment and overhung
9.	Cantilever Beam
10.	Beam with angular loads, one end hinged and at other end roller support
11.	Stress analysis of a rectangular plate with a circular hole
12.	Thermal analysis
13.	Modal Analysis of Cantilever beam for natural frequency determination
14.	Fixed- fixed beam subjected to forcing function

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CIE for the theory component of IPCC

1. Two Tests each of **20 Marks.**
2. Two assignments each of **10 Marks/One Skill Development Activity of 20 marks.**
3. Total Marks of two tests and two assignments/one Skill Development Activity added will be CIE for 60 marks, marks scored will be proportionally scaled down to **30 marks**.

CIE for the practical component of IPCC

- On completion of every experiment/program in the laboratory, the students shall be evaluated, and marks shall be awarded on the same day. The **15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test at the end /after completion of all the experiments shall be conducted for 50 marks and scaled down to 05 marks**.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **20 marks**.

SEE for IPCC:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

1. The question paper will be set for 100 marks and marks scored will be scaled down proportionately to 50 marks.
2. The question paper will have ten questions. Each question is set for 20 marks.
3. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
4. The students must answer 5 full questions, selecting one full question from each module.

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper shall include questions from the practical component.

- The minimum marks to be secured in CIE to appear for SEE shall be the 15 (50% of maximum marks-30) in the theory component and 10 (50% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included**.** The maximum of 04/05 questions to be set from the practical component of IPCC, the total marks of all questions should not be more than the 20 marks.
- SEE will be conducted for 100 marks and students shall secure 40% of the maximum marks to qualify in the SEE. Marks secured will be scaled down to 50. (Student must secure an aggregate of 50% of maximum marks of the course (CIE+SEE).

6.

Suggested Learning Resources:

Textbooks:

1 **Introduction to Finite Elements in Engineering -**Tirupathi R. Chandrupatla, Ashok D Belegundu - Prentice Hall India Pvt. Ltd., New Delhi – Third Edition, 2003.

2 **Concepts and Applications of finite Element Analysis** - Cook R.D, Malkus D.S & Plesha M.E - John Wiley & Sons - 1989.

3 **Applied Finite Element Analysis** - Segerlind L. J - John Wiley & Sons Edition -1984.

4 Textbook of Finite Element Analysis - P. Seshu, PHI, 2004.

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Solve differential equations using weighted residual methods	L3
CO2	Develop the finite element equations to model engineering problems governed by second order differential equations	L4
CO3	Apply the basic finite element formulation techniques to solve engineering problems by using one dimensional elements	L3
CO4	Apply the basic finite element formulation techniques to solve engineering problems by using two dimensional elements	L3
CO5	Apply the basic finite element formulation techniques to find natural frequency of single degree of vibration system	L3

Mapping of COS and POs: (Below table is only indicative and hence course teacher can revise it)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	1	1	2	1	1			
CO2	3	2	1	2	2	1	1			
CO3	3	2	1	2	2	1	1			
CO4	3	2	1	2	2	1	1			
CO5	3	2	1	1	2	1	1			

PRESS TOOL DESIGN			
Course Code	**22MTE13**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	**3:0:2**	SEE Marks	50
Total Hours of Pedagogy	**40**	Total Marks	100
Credits	**04**	Exam Hours	03

Course Learning Objectives:

- Understand press tool types,
- Knowledge of design and press tool operations which makes them aware of type applications,
- To know the force calculations in drawing,
- Awareness' of lubrications in drawing
- Knowledge of typical design of form tools.

Module-1 (08 Hrs)	
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.	
Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-2 (08 Hrs)	
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.	
Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-3 (08 Hrs)	
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.	
Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-4 (08 Hrs)	
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.	
Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-5 (08 Hrs)	
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.	
Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Books

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 Publisher
4. Progressive Dies, Dallas B. Daniel,Springer, publication, 2005.
5. Mining Engineering Handbook, Michigan -SME 3rd Edition by peter darling, 2011.
6. Die Design Hand Book -SMITH A. DAVID.SME 3rd edition, 1990.

Web links and Video Lectures (e-Resources):

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Explain the press tool types,	L2
CO2	Discuss the press tool design and operations which makes them aware of type applications,	L2
CO3	Calculate the force in drawing,	L3
CO4	Describe the awareness of lubrications in drawing	L2
CO5	Exhibit the knowledge of typical design of form tools.	L3

Mapping of COS and POs

(Below table is only indicative and hence course teacher can revise it)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	1	1	1	2	1	1			
CO2	3	1	1	2	2	1	1			
CO3	3	1	1	2	2	1	1			
CO4	3	1	1	2	2	1	1			
CO5	3	1	1	1	2	1	1			

JIGS AND FIXTURES DESIGN			
Course Code	**22MTE14**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	**2:0:2**	SEE Marks	50
Total Hours of Pedagogy	**25**	Total Marks	100
Credits	**03**	Exam Hours	03

Course Learning objectives:

- Acquiring the knowledge on various jigs and fixtures,
- Understand the designs of clamping methods,
- Gaining the knowledge of indexing and methods,
- Study the different applications of fixtures and
- Drawing exercises of different typical jigs and fixtures.

Module-1 (05 Hrs)	
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.	
Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-2 (05 Hrs)	
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.	
Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-3 (05 Hrs)	
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.	
Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-4 (05 Hrs)	
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.	
Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-5 (05 Hrs)	
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.	
Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Tutorial/Activity Sessions:

- 10-12 tutorial/activity sessions need to be planned, which may be distributed among all the modules to cover entire portion of the syllabus within nearly 40 hours.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50 marks.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Books

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.
4. An Introduction to Jig and Tool Design -KEMPSTER M.H.A.- Bristol- ELBS 3rd Ed. 1974.
5. Jigs and Fixture Hand book by A.K. Goroshkin, MIR publications.
6. Jigs and Fixture Hand book by Carr Lane Mfg Com.

Web links and Video Lectures (e-Resources):

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Explain the acquired knowledge on various jigs and fixtures,	L2
CO2	Discuss the designs of clamping methods,	L2
CO3	Apply the knowledge for different indexing methods,	L3
CO4	Illustrate the different applications of fixtures and	L2
CO5	Demonstrate the different typical jigs and fixtures.	L2

Mapping of COS and POs

(Below table is only indicative and hence course teacher can revise it)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1										
CO2										
CO3										
CO4										
CO5										

GAUGES AND MEASUREMENTS			
Course Code	**22MTE15**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	**2:0:2**	SEE Marks	50
Total Hours of Pedagogy	**25**	Total Marks	100
Credits	**03**	Exam Hours	03

Course Learning objectives:

- Understand specification of limits, fits and tolerance,
- Study the design knowledge of different gauges and their uses,
- Understand the Interference of fits and their needs in calculations,
- Know the different types of Geometric dimensioning and tolerance and
- Awareness of design knowledge in different gauges in manufacturing.

Module-1 (05 Hrs)

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).

Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-2 (05 Hrs)

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.

Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-3 (05 Hrs)

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.

Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-4 (05 Hrs)

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.

Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-5 (05 Hrs)

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.

Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Tutorial/Activity Sessions:

- 10-12 tutorial/activity sessions need to be planned, which may be distributed among all the modules to cover entire portion of the syllabus within nearly 40 hours.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50 marks.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Books

1. Engineering Metrology - R.K. Jain
2. Westermann Tables for metal trade – Juts Scharkus, New age international Publishers
3. Engineering Metrology, K. J. Hume.
4. Geometric Dimensioning and Tolerancing -A Self Study Workbook By Alex Krulikowski
5. Fundamentals of Geometric Dimensioning and Tolerancing. ASME Y 14.5 M-1994, By Alex Krulikowski
6. Geometric Dimensioning and Tolerancing for Mechanical Design. McGraw Hill

Web links and Video Lectures (e-Resources):

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Explain the specification of limits, fits and tolerance,	L2
CO2	Discuss the design knowledge of different gauges and their uses,	L2
CO3	Apply the knowledge on the Interference of fits and their needs in calculations,	L3
CO4	Demonstrate the different types of Geometric dimensioning and tolerance	L3
CO5	Explain the design knowledge of different gauges in manufacturing.	L2

Mapping of COS and POs

(Below table is only indicative and hence course teacher can revise it)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1										
CO2										
CO3										
CO4										
CO5										

RESEARCH METHODOLOGY AND IPR			
Course Code	**22RMI16**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	**3:0:0**	SEE Marks	50
Total Hours of Pedagogy	**40**	Total Marks	100
Credits	**03**	Exam Hours	03

Course Learning objectives:

- Identify an appropriate research problem in their interesting domain.
- Understand ethical issues Understand the Preparation of a research project thesis report.
- Understand the Preparation of a research project thesis report
- Understand the law of patent and copyrights.
- Understand the Adequate knowledge on IPR.

Module-1 (08 Hrs)

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.

Teaching-Learning Process	Effective Lecturing, Active Learning, Digital Learning, Case-Based Learning, Effective Class Discussions and Assignments at home.

Module-2 (08 Hrs)

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 Design.

Teaching-Learning Process	Effective Lecturing, Active Learning, Digital Learning, Case-Based Learning, Effective Class Discussions and Assignments at home.

Module-3 (08 Hrs)

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.

Teaching-Learning Process	Effective Lecturing, Active Learning, Digital Learning, Case-Based Learning, Effective Class Discussions and Assignments at home.

Module-4 (08 Hrs)

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.

Teaching-Learning Process	Effective Lecturing, Active Learning, Digital Learning, Case-Based Learning, Effective Class Discussions and Assignments at home.

Module-5 (08 Hrs)

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.

Teaching-Learning Process	Effective Lecturing, Active Learning, Digital Learning, Case-Based Learning, Effective Class Discussions and Assignments at home.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50 marks.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Books

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.
4. Research Methods: the concise knowledge base, Trochim, Atomic Dog Publishing, 2005.
5. Conducting Research Literature Reviews: From the Internet to Paper, Fink A, Sage Publications, 2009.
6. Stuart Melville and Wayne Goddard, " Research methodology: an introduction for science & engineering students"

Web links and Video Lectures (e-Resources):

https://archive.nptel.ac.in/courses/110/105/110105091/
https://archive.nptel.ac.in/courses/127/106/127106227/
https://archive.nptel.ac.in/courses/107/108/107108011/

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Discuss research methodology and the technique of defining a research problem	L2
CO2	Explain the functions of the literature review in research, carrying out a literature search, developing theoretical and conceptual frameworks and writing a review.	L2
CO3	Explain various research designs, sampling designs, measurement and scaling techniques and different methods of data collections.	L2
CO4	Explain several parametric tests of hypotheses, Chi-square test, art of interpretation and writing research reports	L2
CO5	Discuss various forms of the intellectual property, its relevance and business impact in the changing global business environment and leading International Instruments concerning IPR	L2

Mapping of COS and POs

(Below table is only indicative and hence course teacher can revise it)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	1	-	1	1	1			
CO2	3	2	2	-	1	1	1			
CO3	3	2	2	-	1	1	1			
CO4	3	2	1	2	1	1	1			
CO5	3	2	1	-	1	2	1			

TOOL DESIGN ENGINEERING LAB - 1			
Course Code	**22MTEL16**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	**1:2:0**	SEE Marks	50
Credits	**02**	Exam Hours	03

Course objectives:

- Study the design, assemble and drafting of stage and progressive press tool.
- Study on design, assembly and drafting of compound tool and bending tool.
- Study on design, assembly and drafting of combination tool, simple drill jig, leaf Jig
- Study on design, Assembly, drafting and analysis of milling fixture and turning fixture.
- Study on design, Assembly, drafting and analysis of Indexing Jig

Sl.NO	Experiments
	Note: 1. These are independent Tool Design exercises for jigs & Fixture and Press tool designs 2. Student may be given at least five exercises stated below 3. Student must submit a design exercises comprehensive report on the problem solved and give a presentation on the same for the internal evaluation. 4. Any one of the design exercises done (at least five) from the below least has to be asked in the examination for evaluation. 5. Design, drafting and analysis of various Jigs and Fixtures and press tool designs using appropriate software package.
1	Design, assembly and drafting of simple stage tool
2	Design, assembly, drafting and Analysis of progressive press tool
3	Design, assembly and drafting of compound tool
4	Design, assembly, and Drafting of Bending tool
5	Design, assembly and drafting of combination tool
6	Design, Assembly, and detail drawings of simple drill jig
7	Design, Assembly, drafting and analysis of a leaf Jig
8	Design, Assembly, drafting and analysis of milling fixture
9	Design, Assembly, drafting and analysis of Indexing Jig
10	Design, Assembly, drafting and analysis of turning fixture

Course outcomes (Course Skill Set):

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

- Design, assemble and drafting of stage and progressive press tool.
- Design, assembly and drafting of compound tool and bending tool.
- Design, assembly and drafting of combination tool, simple drill jig, leaf Jig
- Design, Assembly, drafting and analysis of milling fixture and turning fixture.
- Design, Assembly, drafting and analysis of Indexing Jig

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 40% of maximum marks in the semester-end examination (SEE). In total of CIE and SEE student has to secure 50% maximum marks of the course.

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of **scaled-down** marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University.

All laboratory experiments are to be included for practical examination. (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.
- General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
- Change of experiment is allowed only once and 10% Marks allotted to the procedure part to be made zero.

The duration of SEE is 03 hours

Suggested Learning Resources:

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***** END OF I SEMESTER *****

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI.

MODIFIED DRAFT SCHEME

Scheme of Teaching and Examinations and Syllabus
M.Tech. in Tool Engineering (MTE)
(Effective from the Academic year 2022-23)

Registrar,
Visvesvaraya Technological University
JnanaSangam, Machhe, Belagavi-590018
eMail: registrar@vtu.ac.in
contact: 0831-2498112

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	Tutorial/ Skill Development Activities	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	P	SDA					
1	PCC	22MTE31	Cutting Tool Theory and Design	03	00	02	03	50	50	100	4
2	PEC	22MTE32X	Professional Elective-3	03	00	00	03	50	50	100	3
3	OEC	22MTE33X	**Professional Elective 4**	03	00	00	03	50	50	100	3
4	PROJ	22MTE34	Project Work Phase -1	00	06	00	--	100	--	100	3
5	SP	22MTE35	Societal Project	00	06	00	--	100	--	100	3
6	INT	22MSEI36	Internship	(06 weeks Internship Completed during the intervening vacation of II and III semesters.)			03	50	50	100	6
TOTAL				**09**	**12**	**03**	**12**	**400**	**200**	**600**	**22**

Note: PCC: Professional core courses, PEC: Professional Elective Courses, IPCC-Integrated Professional Core Courses. MPS-Mini Project With Seminar; AUD/AEC; Audit Courses / Ability Enhancement Courses (Mandatory), PCCL-Professional Core Course lab, **L-Lecture, P-Practical, T/SDA-Tutorial / Skill Development Activities** (Hours are for Interaction between faculty and students)

Professional Elective-3		**Professional Elective 4**	
Course Code under 22MTE32X	**Course title**	**Course Code under 22MTE33X**	**Course title**
22MTE321	Advanced Moulding Techniques	22MTE/MST/MSE/ MAU/MPE/MPD/M PT/MPY331	Non Destructive Testing
22MTE/MPY/MPM/ MSE/MMD/MEA/ MSE/MPE/MAU/ MPD322	Rapid prototyping	22MTE/MST/MAU/ MPD/MPE/MPE332	Hydraulics & Pneumatics Controls
22MTE323	Material Flow Analysis	22MSE333	Networking and IOT
22MTE324	Computer Control of Manufacturing Systems	22MTE334	Advanced Material Technology
22MTE325	Industrial Robotics	22MTE335	Product Design Technology

Note:

1. Project Work Phase-1: The project work shall be carried out individually. However, in case a disciplinary or interdisciplinary project requires more participants, then a group consisting of not more than three shall be permitted.

Students in consultation with the guide/co-guide (if any) in disciplinary project or guides/co-guides (if any) of all departments in case of multidisciplinary projects, shall pursue a literature survey and complete the preliminary requirements of the selected Project work. Each student shall prepare a relevant introductory project document, and present a seminar.

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

2. Societal Project: Students in consultation with the internal guide as well as with external guide (much preferable) shall involve in applying technology to workout/proposing viable solutions for societal problems.

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, shall be based on the evaluation of Project Report, Project Presentation skill, and performance in the Question-and-Answer session in the ratio of 50:25:25.

Those, who have not pursued /completed the Societal Project, shall be declared as fail in the course and have to complete the same during subsequent semester/s after satisfying the Societal Project requirements. There is no SEE (University examination) for this course.

3. Internship: Those, who have not pursued /completed the internship, shall be declared as fail in the 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.

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 performance in the Question-and-Answer session in the ratio of 50:25:25.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
Scheme of Teaching and Examinations – 2022 - 23
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	
				L	P					
1	Project	22MTE41	Project work phase -2	--	08	03	100	100	200	18
			TOTAL	--	**08**	**03**	**100**	**100**	**200**	**18**

Note:

1. Project Work Phase-2:

Students in consultation with the guide/co-guide (if any) in disciplinary project or guides/co-guides (if any) of all departments in case of multidisciplinary projects, shall continue to work of Project Work phase -1 to complete the Project work. Each student / batch of students shall prepare project document, and present a seminar.

CIE marks shall be awarded by a committee comprising of HoD as Chairman, all Guide/s and co-guide/s (if any) and a senior faculty of the concerned departments. The CIE marks awarded for project work phase -2, shall be based on the evaluation of Project Report, Project Presentation skill, and performance in the Question-and-Answer session in the ratio of 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.

Total Credits 22+18+22+18 =**80**

III Semester

CUTTING TOOL THEORY AND DESIGN			
Course Code	**22MTE31**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	**3:0:2**	SEE Marks	50
Total Hours of Pedagogy	**40**	Total Marks	100
Credits	**04**	Exam Hours	03

Course Learning Objectives:

- Understand mechanism of chip information,
- Understand the measurement of cutting forces and its importance in cutting tool design,
- Gain knowledge on design of various cutting tools,
- Awareness of tolls for CNC
- Learn on design knowledge of single and multipoint cutting tools.

Module-1 **(08 Hrs)**	
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.	
Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-2 **(08 Hrs)**	
Measurement of cutting forces: Dynamometers Tool wears mechanisms, types and causes of wear. **Turning Tools: I**ndexable inserts, Chips breakers, ISO classification of inserts and tool holders	
Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-3 **(08 Hrs)**	
Milling cutters: Standardization, Geometry, Face Mills, Shoulder Mills, End Mills, Deep shoulder Mills, T- Slot cutters.	
Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-4 **(08 Hrs)**	
Boring: Types of boring tool, Boring heads, Cartridges. Reamers, types of reamers, Geometry of flutes. Tool for CNC. **Drilling:** Drills with indexable inserts, Deep hole drills, carbide tipped drills, Core drills, Counter pores, and Counter sinks	
Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-5 **(08 Hrs)**	
Design Exercise: Design of single point tool, Drill, Form tools, Reamer	
Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Tutorial/Activity Sessions:

- 10-12 tutorial/activity sessions need to be planned, which may be distributed among all the modules to cover entire portion of the syllabus.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50 marks. The question paper will have ten full questions carrying equal marks.
2. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
3. Each full question will have a sub-question covering all the topics under a module.
4. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Books

1. Metal cutting and Tool Design, Dr. B.J. Ranganth, Vikas Publishing House Pvt. Ltd., New Delhi, 2nd Revised Edition, 2009.
2. Metal cutting and Cutting Tool Design, Arshinov, MIR Publications
3. Tool Design, by Cyril Donaldson, George H LeGain, V.G. Good, TATA Mc GRAY HILL
4. Tool Design, Herman W. Pollack, Prentice Hall PTR, 1988.
5. Modelling of Metal Forming and Machining Processes-Prakash M Dixit, Uday S Dixit, Springer and verlag publications, 2008.

Web links and Video Lectures (e-Resources):

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Explain the mechanism of chip information,	L2
CO2	Apply the knowledge on the measurement of cutting forces and its importance in cutting tool design,	L3
CO3	Discuss on the design of various cutting tools,	L2
CO4	Analyse the tolls for CNC	L4
CO5	Design the single and multipoint cutting tools.	L4

Mapping of COS and POs

(Below table is only indicative and hence course teacher can revise it)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1										
CO2										
CO3										
CO4										
CO5										

Professional Electives-3 (22MTE32X):

ADVANCED MOULDING TECHNIQUES			
Course Code	**22MTE321**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	**3:0:0**	SEE Marks	50
Total Hours of Pedagogy	**40**	Total Marks	100
Credits	**03**	Exam Hours	03

Course Learning Objectives:

- Learn on how to demonstrate their knowledge in the field of advanced moulding methods.
- Understand the process and consideration in extrusion process.
- Learning the techniques in PTEF moulding.
- Learning the advanced Reaction Injection Moulding
- Knowledge of advance techniques like, Resin transfer mould, electro plating etc.

Module-1 (08 Hrs)

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.

Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-2 (08 Hrs)

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.

Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-3 (08 Hrs)

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.

Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-4 (08 Hrs)

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**.**

Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-5 (08 Hrs)

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.

Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50 marks. The question paper will have ten full questions carrying equal marks.
2. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
3. Each full question will have a sub-question covering all the topics under a module.
4. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Books

1. Injection Moulding, by Rubin.
2. Extrusion –Berln.
3. Injection Mold by Glavin & Denton
4. Extrusion Die Design, M. V. Joshi.
5. Polymer Chemistry, Gowriker.

Web links and Video Lectures (e-Resources):

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Demonstrate their knowledge in the field of advanced moulding methods.	L2
CO2	Explain the process and consideration in extrusion process.	L2
CO3	Describe the techniques in PTEF moulding.	L2
CO4	Apply the advanced Reaction Injection Moulding technics	L3
CO5	Apply the advance techniques like, Resin transfer mould, electro plating etc.	L3

Mapping of COS and POs

(Below table is only indicative and hence course teacher can revise it)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1										
CO2										
CO3										
CO4										
CO5										

RAPID PROTOTYPING			
Course Code	**22MTE/MPY/MPM/MSE/MMD/ MEA/MSE/MPE/MAU/MPD322**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	**2:0:2**	SEE Marks	50
Total Hours of Pedagogy	**25**	Total Marks	100
Credits	**03**	Exam Hours	03

Course Learning Objectives:

- Study the concept of product design stages and methods, thereby making him a better product designer.
- Learn on how to assess and implement RP techniques for specific application leading to better ROI.
- Understand the concept and principles of prototype printers,
- Knowledge of software for RP
- Understanding the RP Process and its optimization.

Module-1 (05 Hrs)	
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	
Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-2 (05 Hrs)	
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	
Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-3 (05 Hrs)	
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).**	
Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-4 (05 Hrs)	
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.	
Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-5 (05 Hrs)	
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.	
Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Tutorial/Activity Sessions:

- 10-12 tutorial/activity sessions need to be planned, which may be distributed among all the modules to cover entire portion of the syllabus within nearly 40 hours.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50 marks. The question paper will have ten full questions carrying equal marks.
2. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
3. Each full question will have a sub-question covering all the topics under a module.
4. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Books

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

Web links and Video Lectures (e-Resources):

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Explain the concept of product design stages and methods, thereby making him abetter product designer.	L2
CO2	Discuss on how to assess and implement RP techniques for specific application leading to better ROI.	L2
CO3	Demonstrate the concept and principles of prototype printers,	L2
CO4	Apply the knowledge of software for RP	L3
CO5	Analyse the RP Process and its optimization.	L4

Mapping of COS and POs

(Below table is only indicative and hence course teacher can revise it)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1										
CO2										
CO3										
CO4										
CO5										

MATERIAL FLOW ANALYSIS			
Course Code	**22MTE323**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	**3:0:0**	SEE Marks	50
Total Hours of Pedagogy	**40**	Total Marks	100
Credits	**03**	Exam Hours	03

Course Learning Objectives:

- Learn how to make analysis of material flow, shrinkage, wrappage and microstructure analysis.
- Knowledge of Residual stress, static analysis, contact analysis, buckling analysis and bending analysis.
- Knowledge of Die casting analysis like, mesh generation, heat flow, stress, strain and micro structure modeling.
- Study of die life estimation.
- Software knowledge about mold flow and pro-cast.

Module-1 (08 Hrs)	
Introduction: Modeling, meshing, Boundary conditions, Loads, Optimization.	
Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-2 (08 Hrs)	
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.	
Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-3 (08 Hrs)	
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.	
Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-4 (08 Hrs)	
Software I: Mold flow, Pro-cast; Pro-Mechanica, De-form.	
Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-5 (08 Hrs)	
Software II: Mold flow, Pro-cast; Pro-Mechanica, De-form.	
Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50 marks. The question paper will have ten full questions carrying equal marks.
2. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
3. Each full question will have a sub-question covering all the topics under a module.
4. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Books

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

Web links and Video Lectures (e-Resources):

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Analyze of material flow, shrinkage, wrappage and microstructure analysis.	L4
CO2	Explain the Residual stress, static analysis, contact analysis, buckling analysis and bending analysis.	L2
CO3	Analyse the die casting analysis like, mesh generation, heat flow, stress, strain and micro structure modeling.	L4
CO4	Estimate the die life.	L3
CO5	Use of software about mold flow and pro-cast.	L4

Mapping of COS and POs

(Below table is only indicative and hence course teacher can revise it)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1										
CO2										
CO3										
CO4										
CO5										

Computer Control of Manufacturing Systems			
Course Code	**22MTE324**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	**3:0:0**	SEE Marks	50
Total Hours of Pedagogy	**40**	Total Marks	100
Credits	**03**	Exam Hours	03

Course Learning Objectives:

- Understand of NC/CNC machines, Various elements of CNC machines andits uses.
- Understand of the Constructional features of CNC machine Tools
- Knowledge of CNC programming and its implementation.
- Knowledge of Robotic technology.
- Awareness of Computerized manufacturing planning and Control systems.

Module-1 **(08 Hrs)**

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, Feedback Devices: Encoder, Resolver, Inductosyn, Tachometers, Counting devices, Digital to analog converters.

Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-2 **(08 Hrs)**

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.

Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-3 **(08 Hrs)**

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

Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-4 **(08 Hrs)**

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

Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-5 **(08 Hrs)**

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.

Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50 marks. The question paper will have ten full questions carrying equal marks.
2. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
3. Each full question will have a sub-question covering all the topics under a module.
4. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Books

1. Automation, Production Systems and Computer Integrated Manufacturing, GROOVER M P, Prentice Hall India (P) Ltd, 1989.
2. CAD/CAM Computer Aided Design and Manufacturing, Mikell P. Groover and Emory W. Zimmer Jr, Prentice Hall India (P) Ltd, 1992.
3. Computer Controls of Manufacturing Systems, M. Koren, Mc GrawHill, 1983.
4. CAD/CAM Principles and Applications P.N. Rao, Mc Grawhill 2002
5. Numerical control of machine tools - Y. Koren & J. Benuri, Khanna, 1992.
6. Theory and Design of CNC Systems, Suk-Hwan Suh, Seong-Kyoon Kang, Dea-Hyuk Chung and Ian Stroud, Springer, 2008.

Web links and Video Lectures (e-Resources):

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Explain the NC/CNC machines, Various elements of CNC machines and its uses.	L2
CO2	Describe the Constructional features of CNC machine Tools	L2
CO3	Apply the knowledge of CNC programming and its implementation.	L3
CO4	Discuss the Robotic technology.	L2
CO5	Generate the Computerized manufacturing planning and Control systems.	L3

Mapping of COS and POs

(Below table is only indicative and hence course teacher can revise it)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1										
CO2										
CO3										
CO4										
CO5										

INDUSTRIAL ROBOTICS			
Course Code	**22MTE325**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	**3:0:0**	SEE Marks	50
Total Hours of Pedagogy	**40**	Total Marks	100
Credits	**03**	Exam Hours	03

Course Learning Objectives:

- Understand the concept of robotics and its drives.
- Understand the sensors applications and images recognition mechanism.
- Study to program robot and analyse the computational element ofrobot computer system.
- Learn how to transform robot manipulator using knowledge kinematics and mathematical methods.
- Study the design and control robot cells and understand the application of robots.

Module-1 (08 Hrs)

FUNDAMENTAL CONCEPTS OF ROBOTICS: History, present status and future trends, Robotics. Robot – Definition, Robotics Systems and Robot Anatomy, Specification of Robotics. Resolution, Repeatability and Accuracy of a Manipulator.
ROBOT DRIVES: Power transmission systems and control Robot drive mechanisms, hydraulic electropneumatic drives. Mechanical transmission method – Rotary-to-Rotary motion conversion. Rotary-to- linear motion conversion end effectors – types-grip pind problem Remote-Centered Compliance Devices-Control of Actuators in Robotic Mechanisms.

Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-2 (08 Hrs)

SENSORS AND INTELLIGENT ROBOTS: Sensory devices – Non-optical-Position sensors – Optical position sensors – velocity sensors – proximity sensors: Contact and noncontact type-Touch and slip sensors – Force and Torque Sensors – AI and Robotics

Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-3 (08 Hrs)

COMPUTER VISION FOR ROBOTICS SYSTEMS: Robot vision systems – Imaging components – Image representation – Hardware Aspects-Picture coding – Object Recognition and Categorization- Visual inspection – software considerations – applications – commercial– Robotics vision systems.
COMPUTER CONSIDERATIONS FOR ROBOTIC SYSTEMS:
Computer architecture for robts, hardware, Computational elements in robotic applications – Robot programming – sample programspath planning – Robot"s computer system.

Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-4 (08 Hrs)

TRANSFORMATIONS AND KINEMATICS: Homogeneous Co-ordinates – Co-ordinate Reference Frames – Homogeneous Transformations for the manipulator – the forward and inverse problem of manipulator kinematics – Motion generation – Manipulator dynamics – Jacobian in terms of D.H.Matrices controller architecture.

Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-5 (08 Hrs)

ROBOT CELL DESIGN AND CONTROL: Specifications of Commercial Robots – Robot Design and Process specifications – motor selection in the design of a robotic joint – Robot Cell layouts – Economic and Social aspects of robotics.
APPLICATIONS OF ROBOTS: Capabilities of Robots – Robotics Applications – Obstacle avoidance – Robotics in India – The future of Robotics.

Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

3. Three Unit Tests each of **20 Marks**
4. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

5. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50 marks. The question paper will have ten full questions carrying equal marks.
6. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
7. Each full question will have a sub-question covering all the topics under a module.
8. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Books

2. **Robotics Engineering An integrated approach -** Richard D Klafter, Thomas AChmielewski, Michael Negin – Prentice Hall of India Pvt. Ltd. - Eastern Economy Edition, 1989.
3. **Robotics: Control Sensing, Vision, intelligence** - Fu KS Gomaler R C, Lee C S G -McGraw Hill Book Co. - 1987.
4. **Handbook of Industrial Robotics** - Shuman Y. Nof - John Wiley & Sons, New York- 1985.
5. **Robotics Technology and Flexible Automation** - Deb SR - McGraw Hill BookCo. -1994

Web links and Video Lectures (e-Resources):

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Explain the concept of robotics and its drives.	L2
CO2	Describe the sensors applications and images recognition mechanism.	L2
CO3	Program robot and analyse the computational element of robot computer system.	L4
CO4	Transform robot manipulator using knowledge kinematics and mathematical methods.	L3
CO5	Design and control robot cells and understand the application of robots.	L4

Mapping of COS and POs

(Below table is only indicative and hence course teacher can revise it)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1										
CO2										
CO3										
CO4										
CO5										

NON-DESTRUCTIVE TESTING			
Course Code	**22MTE/MST/MSE/MAU/MPE/MPD/MPT/MPY331**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	**3:0:0**	SEE Marks	50
Total Hours of Pedagogy	**40**	Total Marks	100
Credits	**03**	Exam Hours	03

Course Learning Objectives:

- Study to distinguish the destructive and non-destructive testing and find effectiveness.
- Learn to find the surface defect using liquid penetrant and magnetic particle test and eddy current test.
- Learn the mechanism of flaw detection using ultrasonic wave system.
- Understand the operations of microwave and radiography inspection system.
- Understand the basics of holography and interferometry and its application in defect detection.

Module-1 (08 Hrs)	
Introduction to ND Testing: Selection of ND methods, visual inspection, leak testing, Liquid penetration inspection, its advantages and limitation.	
Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-2 (08 Hrs)	
Magnetic Particle Inspection: Methods of generating magnetic field, types of magnetic particles and suspension liquids steps in inspection – application and limitations. **Eddy Current Inspection:** principles, operation variables, procedure, inspection coils, and detectable discounts by the method.	
Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-3 (08 Hrs)	
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.	
Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-4 (08 Hrs)	
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.	
Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-5 (08 Hrs)	
Optical Holography: Basics of Holography, recording and reconstruction – Acoustical Holography: systems and techniques applications. Indian standards for NDT. **Microwave Inspection:** Microwave holography, applications and limitations.	
Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50 marks. The question paper will have ten full questions carrying equal marks.
2. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
3. Each full question will have a sub-question covering all the topics under a module.
4. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Books

1. **Non Destructive Testing** - McGonnagle JJ – Garden and reach New York.
2. **Non Destructive Evolution and Quality Control -** volume 17 of metals hand book, 9th edition Asia internal 1989.
3. **The Testing instruction of Engineering materials** - Davis H.E Troxel G.E wiskovilC.T - McGraw hill

Web links and Video Lectures (e-Resources):

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Distinguish the destructive and non-destructive testing and find effectiveness.	L2
CO2	Find the surface defect using liquid penetrant and magnetic particle test and eddy current test.	L3
CO3	Explain the mechanism of flaw detection using ultrasonic wave system.	L2
CO4	Describe the operations of microwave and radiography inspection system.	L2
CO5	Explore the basics of holography and interferometry and its application in defect detection.	L4

Mapping of COS and POs

(Below table is only indicative and hence course teacher can revise it)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1										
CO2										
CO3										
CO4										
CO5										

Hydraulics & Pneumatics Controls			
Course Code	**22MTE/MST/MAU/MPD/MPE/ MPE332**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	**3:0:0**	SEE Marks	50
Total Hours of Pedagogy	**40**	Total Marks	100
Credits	**03**	Exam Hours	03

Course Learning Objectives:

- Learn how to correlate the basics of hydraulics to the performance of fluid power systems.
- Study the working principle of hydraulic systems including pumps and controllers.
- Correlate the basics of pneumatics to the performance of pneumatic systems.
- Design and analyse problems relating to Pneumatic and Hydraulic control systems and components.
- Design hydraulic and pneumatic power circuits.

Module-1 (08 Hrs)	
Introduction to control system, Types of control system and their utility.	
Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-2 (08 Hrs)	
Hydraulic power generation and transmission, valve control pressure flow relationship for hydraulic valves, valve configurations and constructions, steady state operating forces, transient forces and valve instability. Circuit design.	
Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-3 (08 Hrs)	
Pneumatic valves, Hydraulic and pneumatic drives.	
Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-4 (08 Hrs)	
Fluidics: Introduction to fluidic devices and sensors lumped and distributed parameter fluid systems. Fluid mechanics of jets, wall attachment and vortex devices. Pure fluidic analog amplifiers. Analog signal control techniques. Design of pure fluid digital elements	
Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-5 (08 Hrs)	
Electro-hydraulic and Electro-pneumatic Systems: Physical concepts of pneumatics and electrical. Electro-pneumatic components operation and application interpretation of electric ladder diagram. P.PI & PID – controllers & applications.	
Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50 marks. The question paper will have ten full questions carrying equal marks.
2. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
3. Each full question will have a sub-question covering all the topics under a module.
4. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Books

(1) **Quality Planning and Analysis -** Tata McGraw - Juran, J.M and Gryna, F.M. – Hill publishing Company Ltd., New Delhi, India – 1982.

(2) **Maintainability and Reliability Handbook of Reliability Engineering and Management -** Editors – Ireson. W.G. andCooms-C.F. McGraw - Hill BookCompany Inc. – 1988.

(3) **Concepts in Reliability Engineering-**Srinath L S - Affiliated East- West PressPrivate Limited, New Delhi, India. – 1985.

Web links and Video Lectures (e-Resources):

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Correlate the basics of hydraulics to the performance of fluid power systems.	L2
CO2	Explain the working principle of hydraulic systems including pumps and controllers.	L3
CO3	Correlate the basics of pneumatics to the performance of pneumatic systems.	L2
CO4	Design and analyse problems relating to Pneumatic and Hydraulic control systems and components.	L4
CO5	Design hydraulic and pneumatic power circuits.	L4

Mapping of COS and POs

(Below table is only indicative and hence course teacher can revise it)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1										
CO2										
CO3										
CO4										
CO5										

NETWORKING AND IoT			
Course Code	**22MTE333**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	**3:0:0**	SEE Marks	50
Total Hours of Pedagogy	**40**	Total Marks	100
Credits	**03**	Exam Hours	03

Course Learning Objectives:

- Learn to interpret the design aspects and communication models of IoT.
- Study to examine the design, development, security and deployment challenges pertaining to IoT.
- Understanding on how to analyze the media access control protocols, routing protocols and node discovery strategies used in IOT.
- Study to explain the data dissemination and aggregation techniques used by IoT sensors, Examine the domain specific IoT applications.
- Study to apply python programming to and develop simple IoT applications

Module-1 (08 Hrs)	
Introduction to IoT Defining IoT, Characteristics of IoT, Physical design of IoT, Logical design of IoT, Functional blocks of IoT, Communication models &APIs. **IoT& M2M** Machine to Machine, Difference between IoT and M2M, Software define Network	
Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-2 (08 Hrs)	
Network & Communication aspects Wireless medium access issues, MAC protocol survey, Survey routing protocols, Sensor deployment & Node discovery, Data aggregation & dissemination.	
Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-3 (08 Hrs)	
Challenges in IoT: Design challenges, Development challenges, Security challenges, Other challenges.	
Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-4 (08 Hrs)	
Domain specific applications of IoT Home automation, Industry applications, Surveillance applications, Other IoT applications.	
Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-5 (08 Hrs)	
Developing IoTs: Introduction to Python, Introduction to different IoT tools, Developing applications through IoT tools, Developing sensor based application through embedded system platform, Implementing IoT concepts with python.	
Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50 marks. The question paper will have ten full questions carrying equal marks.
2. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
3. Each full question will have a sub-question covering all the topics under a module.
4. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Books

(1) IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things.by David Hanes,Cisco Press,2007
(2) Vijay Madisetti, ArshdeepBahga, "Internet of Things: A Hands-On Approach"
(3) Computer Networks; By: Tanenbaum, Andrew S; Pearson Education Pte. Ltd., Delhi, 4th Edition
(4) WaltenegusDargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice
(5) Data and Computer Communications; By: Stallings, William; Pearson Education Pte. Ltd., Delhi, 6th Edition

Web links and Video Lectures (e-Resources):

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Interpret the design aspects and communication models of IoT.	L3
CO2	Examine the design, development, security and deployment challenges pertaining to IoT.	L3
CO3	Analyze the media access control protocols, routing protocols and node discovery strategies used in IOT.	L4
CO4	Explain the data dissemination and aggregation techniques used by IoT sensors and its applications.	L3
CO5	Apply python programming to and develop simple IoT applications	L3

Mapping of COS and POs

(Below table is only indicative and hence course teacher can revise it)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1										
CO2										
CO3										
CO4										
CO5										

ADVANCED MATERIALS TECHNOLOGY			
Course Code	**22MTE334**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	**3:0:0**	SEE Marks	50
Total Hours of Pedagogy	**40**	Total Marks	100
Credits	**03**	Exam Hours	03

Course Learning Objectives:

- Understand the basic structure properties of newer materials,
- Learn how to decide the application of various newer materials to engineering applications,
- Awareness of composites and their manufacturing,
- Study the concept of Nano technology
- Knowledge of surface engineering and powder metallurgy.

Module-1 (05 Hrs)

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), applications of composites.

Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-2 (05 Hrs)

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.

Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-3 (05 Hrs)

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

Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-4 (05 Hrs)

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

Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-5 (05 Hrs)

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.

Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Tutorial/Activity Sessions:

- 10-12 tutorial/activity sessions need to be planned, which may be distributed among all the modules to cover entire portion of the syllabus within nearly 40 hours.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50 marks. The question paper will have ten full questions carrying equal marks.
2. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
3. Each full question will have a sub-question covering all the topics under a module.
4. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Books

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 Nanotechnology, Rakesh Rath, S Chand & Co.
6 Nanotechnology – Basic Science & Emerging Technologies, -Mick Wilson, Kamali Kannangara, Overseas Press India.
7 ASM Handbook on Metal Casting - Vol.15, 9th Edition, ASM publication.
8 ASM Handbook on Powder Metallurgy -Vol 17, ASM publications.

Web links and Video Lectures (e-Resources):

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Explain the basic structure properties of newer materials,	L2
CO2	Decide the application of various newer materials to engineering applications,	L3
CO3	Discuss the knowledge gained on composites and their manufacturing,	L3
CO4	Explain the concept of Nano technology	L2
CO5	Clarify the knowledge of surface engineering and powder metallurgy.	L3

Mapping of COS and POs

(Below table is only indicative and hence course teacher can revise it)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1										
CO2										
CO3										
CO4										
CO5										

PRODUCT DESIGN TECHNOLOGY			
Course Code	**22MTE335**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	**3:0:0**	SEE Marks	50
Total Hours of Pedagogy	**40**	Total Marks	100
Credits	**03**	Exam Hours	03

Course Learning Objectives:

- Learn how to demonstrate their knowledge in various aspects of product development.
- Earn knowledge of identifying the customer needs and aspects,
- To have idea of product specifications,
- Knowledge of product survey and methods of surveys and
- Awareness of ergonomics and aesthetics designs with customer needs.

Module-1 (05 Hrs)

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.

Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-2 (05 Hrs)

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.

Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-3 (05 Hrs)

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.

Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-4 (05 Hrs)

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

Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-5 (05 Hrs)

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

Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Tutorial/Activity Sessions:

- 10-12 tutorial/activity sessions need to be planned, which may be distributed among all the modules to cover entire portion of the syllabus within nearly 40 hours.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50 marks. The question paper will have ten full questions carrying equal marks.
2. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
3. Each full question will have a sub-question covering all the topics under a module.
4. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Books

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.
3 Product Design and Manufacturing, A C Chitale and R C Gupta, PH1.
4 New Product Development, Timjones Butterworth Heinmann, Oxford, UCI.1997.

Web links and Video Lectures (e-Resources):

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Demonstrate their knowledge in various aspects of product development.	L2
CO2	Identifying the customer needs and aspects,	L2
CO3	Exhibit an idea of product specifications,	L3
CO4	Apply the knowledge of product survey and methods of surveys and	L3
CO5	Create an awareness of ergonomics and aesthetics designs with customer needs.	L3

Mapping of COS and POs

(Below table is only indicative and hence course teacher can revise it)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1										
CO2										
CO3										
CO4										
CO5										

PROJECT WORK PHASE – 1			
Course Code	**22MTE34**	CIE Marks	100
Number of contact Hours/Week	**0-6-0**	SEE Marks	**--**
Credits	**03**	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: The project work shall be carried out individually. However, in case a disciplinary or interdisciplinary project requires more participants, then a group consisting of not more than three shall be permitted.
Students in consultation with the guide/co-guide (if any) in disciplinary project or guides/co-guides (if any) of all departments in case of multidisciplinary projects, shall pursue a literature survey and complete the preliminary requirements of the selected Project work. Each student shall prepare a relevant introductory project document, and present a seminar.

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 shall be awarded by a committee comprising of HoD as Chairman, all Guide/s and co-guide/s (if any) and a senior faculty of the concerned departments. The CIE marks awarded for project work phase -1, shall be based on the evaluation of Project Report, Project Presentation skill, and performance in the Question-and-Answer session in the ratio of **50:25:25**.
- There will be **no SEE**.

INTERNSHIP			
Course Code	**22MTEI36**	CIE Marks	50
Number of contact Hours/Week	**6 Weeks**	SEE Marks	50
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 objectives 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: 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.

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 report, presentation and question and answer session shall be awarded in the ratio of 50:25:25 for the **total CIE of 50 marks** by the committee constituted for the purpose by the Head of the Department. The committee shall consist of three faculty from the department with committee comprising of HoD as Chairman, all Guide/s and co-guide/s (if any) and a senior faculty of the concerned departments.

Semester End Examination

SEE marks for the internship report (30 marks), seminar (20 marks) and question and answer session (10 marks) shall be awarded in the ratio of 50:25:25 for the **total SEE of 50 marks** (based on the quality of report and presentation skill, participation in the question and answer session) by the examiners appointed by the University.

IV SEMESTER

PROJECT WORK PHASE -2

Course Code	**22MTE41**	CIE Marks	100
Number of contact Hours/Week	**8 Hours/Week**	SEE Marks	100
Credits	**18**	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 instill 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 - II: Students in consultation with the guide/co-guide (if any) in disciplinary project or guides/co-guides (if any) of all departments in case of multidisciplinary projects, shall continue to work of Project Work phase -1to complete the Project work. Each student / batch of students shall prepare project document, and present a seminar.

CIE marks shall be awarded by a committee comprising of HoD as Chairman, all Guide/s and co-guide/s (if any) and a senior faculty of the concerned departments. The CIE marks awarded for project work phase -2, shall be based on the evaluation of Project Report, Project Presentation skill, and performance in the Question-and-Answer session in the ratio of 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.

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.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI.

MODIFIED DRAFT SCHEME

Scheme of Teaching and Examinations and Syllabus
M.Tech. in Tool Engineering (MTE)
(Effective from the Academic year 2022-23)

Registrar,
Visvesvaraya Technological University
JnanaSangam, Machhe, Belagavi-590018
eMail: registrar@vtu.ac.in
contact: 0831-2498112

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
Scheme of Teaching and Examinations – 2022
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	Tutorial/ Skill Development Activities	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	P	T/SDA					
1	PCC	22MTE21	Die Casting and Die Design	02	00	02	03	50	50	100	3
2	IPCC	22MTE22	Plastic Mould Design	03	02	00	03	50	50	100	4
3	PEC	22MTE23X	Professional Elective-1	02	00	02	03	50	50	100	3
4	PEC	22MTE24X	Professional Elective-2	02	00	02	03	50	50	100	3
5	MPS	22MTE25	Mini Project with Seminar	00	04	02	--	100	--	100	3
6	PCCL	20MTEL26	Tool Design Engineering Lab-2	01	02	00	03	50	50	100	02
7	AUD/ AEC	22AUD27	Suggested ONLINE courses	Classes and evaluation procedures are as per the policy of the online course providers.							PP
TOTAL				**10**	**08**	**08**	**15**	**350**	**250**	**600**	**18**

Note: PCC: Professional core courses, PEC: Professional Elective Courses, IPCC-Integrated Professional Core Courses. MPS-Mini Project with Seminar; AUD/AEC; Audit Courses / Ability Enhancement Courses (Mandatory), PCCL-Professional Core Course lab,
L-Lecture, P-Practical, T/SDA-Tutorial / Skill Development Activities (Hours are for Interaction between faculty and students)

Professional Elective-1		**Professional Elective-2**	
Course Code under 22MTE23X	**Course title**	**Course Code under 22MTE24X**	**Course title**
22MTE/MSE/MPT/MEM/	Operations Management	22MTE/MPM/	Agile Manufacturing
22MTE/MTE/MCM232	Value Engineering	22MTE242	Nano Science and Nano Materials
22MTE233	Testing of Materials	22MTE/MAU/	Non-Traditional Machining
22MTE234	Plastic Processing	22MTE244	Design for Manufacture
22MTE235	CNC Machining and Programming	22MPD/MAU/	Industry 4.OF

Note:

1 Mini Project with Seminar: This may be hands-on practice**,** survey report, data collection and analysis, coding, mobile app development, field visit and report preparation, modelling of system, simulation, analysing and authenticating, case studies, etc.

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. Students can present the seminar based on the completed mini-project. Participation in the seminar by all postgraduate students of the program shall be mandatory.

The CIE marks awarded for Mini-Project work and Seminar, shall be based on the evaluation of Mini Project work and Report, Presentation skill and performance in Question-and-Answer session in the ratio 50:25:25. Mini-Project with Seminar shall be considered as a head of passing and shall be considered for vertical progression as well as for the award of degree. Those, who do not take-up/complete the Mini Project and Seminar shall be declared as fail in that course and have to complete the same during the subsequent semester. There is no SEE for this course.

2. Internship: All the students shall have to undergo a mandatory internship of **06 weeks** during the vacation of II and III semesters. A University examination shall be conducted during III semester and the prescribed internship credit shall be counted in the same semester. The internship shall be considered as a head of passing and shall be considered for vertical progression as well as for the award of degree. Those, who do not take-up/complete the internship shall be declared as fail in the internship course and have to complete the same during the subsequent University examination after satisfying the internship requirements.

II-Semester

Die Casting and Die Design			
Course Code	**22MTE21**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	**2:0:2**	SEE Marks	50
Total Hours of Pedagogy	**25**	Total Marks	100
Credits	**03**	Exam Hours	03

Course Learning Objectives:

- Get an understanding of various types of dies for castings,
- Understanding the construction and design of dies,
- Knowledge of die casting machine and mechanism of different productions,
- Understand the concept of die constructions with specific cooling systems and
- Prepare drawings of various dies and demonstrate its design

Module-1 (05 Hrs)

Introduction: Classification of casting, Sand casting, Metal mould casting, 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.

Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-2 (05 Hrs)

Die casting Machines: History of Die casting ,machines, Hot chamber, 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.

Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-3 (05 Hrs)

Feed Systems: 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.

Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-4 (05 Hrs)

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 core: Construction, Actuation of side cores, Die casting, defects and remedies.

Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-5 (05 Hrs)

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

1. Old 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

Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Tutorial/Activity Sessions:

- 10-12 tutorial/activity sessions need to be planned, which may be distributed among all the modules to cover entire portion of the syllabus within nearly 40 hours.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50 marks. The question paper will have ten full questions carrying equal marks.
2. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
3. Each full question will have a sub-question covering all the topics under a module.
4. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Books

1 Die casting, Do Ehler H.A New York-McGraw Hill Book Co-Inc. Industrial student Ed. 1951.
2 The Die casting Books, Street, C. Arthur, Surrey, England- Portcullis Press Ltd., 2nd Edition 1986.
3 Die casting and Die designing, E.A Herman, Society of Die Casting Engineers
4 Die casting process control By E A Herman NADCA
5 High Pressure Die casting: H. L. Harvill, Paul Roe Jordan

Web links and Video Lectures (e-Resources):

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Explain the various types of dies for castings,	L2
CO2	Describe the construction and design of dies,	L2
CO3	Discuss the die casting machine and mechanism of different productions,	L2
CO4	Narrate the concept of die constructions with specific cooling systems	L2
CO5	Prepare drawings of various dies and demonstrate its design	L4

Mapping of COS and POs

(Below table is only indicative and hence course teacher can revise it)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1										
CO2										
CO3										
CO4										
CO5										

PLASTIC MOULD DESIGN			
Course Code	**22MTE22**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	**3:2:0**	SEE Marks	50
Total Hours of Pedagogy	**40**	Total Marks	100
Credits	**04**	Exam Hours	03

Course Learning objectives:

The student will:

- Students will get an understanding of various types of moulds and mould design,
- Understanding the various behaviour of plastic used for moulds
- Study the manufacturing concepts of plastics in moulds.
- Understand the special moulds especially used in thread components.
- Expose to exercise of mould designs with working drawings.

Module-1 (08 Hrs)

Introduction to Plastics: Monomer, Polymer, Degree of Polymerisation, classification of Plastics, General review of properties, Application and Processing, Behaviours of various PE, PP, PYC, PPMA, ABS, NYLON, Polyacetal, Polycarbonate, PTFE, PF, UF & MF.

Mould Construction: Parting surface: Straight, stepped, curved parting surface, Design of various Injection mould elements, cores, cavities, and inserts, fitting core and cavity inserts, pillars and bushes.

Teaching-Learning Process	Effective Lecturing, Active Learning, Digital Learning, Case-Based Learning, Effective Class Discussions and Assignments at home/ PPTs.

Module-2 (08 Hrs)

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

Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-3 (08 Hrs)

Cooling System: Need for cooling, cooling and solid cores and cavities, insert cooling, cooling long cores, cooling elements, baffles, bubblers etc., and cooling calculation.

Parting Surfaces: Straight, stepped, curved parting surface.

Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-4 (08 Hrs)

Modules 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.

Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-5 (08 Hrs)

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 mould: 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.

Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

PRACTICAL COMPONENT OF IPCC (May cover all / major modules)

Sl.NO	Experiments
Design of the following types of moulds:	
1.	Two Plate moulds with pin ejection and edge gate
2.	Two plates 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 split 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

Suggested Learning Resources:

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

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Explain the various types of moulds and mould design,	L2
CO2	Discuss the various behaviour of plastic used for moulds	L3
CO3	Explore manufacturing concepts of plastics in moulds.	L2
CO4	Understand the special moulds especially used in thread components.	L3
CO5	Expose to exercise of mould designs with working drawings.	L3

Mapping of COS and POs: (Below table is only indicative and hence course teacher can revise it)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1										
CO2										
CO3										
CO4										
CO5										

Professional Electives-1 (22MSE23X):

OPERATIONS MANAGEMENT			
Course Code	**22MTE/MSE/MPT/MEM/MPM231**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	**3:0:0**	SEE Marks	50
Total Hours of Pedagogy	**40**	Total Marks	100
Credits	**03**	Exam Hours	03

Course Learning Objectives:

- Understand the basic concept of OM, manufacturing trends in INDIA.
- Study on design of product layout, process layout and analyse process and capacity.
- Learn for applying appropriate inventory planning technique.
- Understand to forecast the demand and prepare MPS.
- Learn on constructing MRP, MRPII and schedule the jobs and machines.

Module-1 (08 Hrs)	
Operations Planning Concepts: Introduction, Operations Functions in Organizations, Historical development, Framework for managing operations, The trend: Information and Non-manufacturing systems, Operations management, Factors affecting productivity, International dimensions of productivity, The environment of operations, Production systems decisions- a look ahead.	
Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-2 (08 Hrs)	
Operations Decision Making: Introduction, Management as a science, Characteristics of decisions, Framework for decision making, Decision methodology, Decision Tree Problems, Economic models- Break Analysis in operations, P/V ratio, Statistical models. **System Design and Capacity:** Introduction, Manufacturing and service systems, Design and systems capacity, Capacity planning.	
Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-3 (08 Hrs)	
Forecasting Demand: Forecasting objectives and uses, forecasting variables, Opinion and Judgmental methods, Time series methods, Moving Average methods, Exponential smoothing, Trend adjusted Exponential Smoothing, Regression and correlation methods, Application and control of Forecasts-Mean Absolute Deviation, BIAS, Tracking Signal. **Aggregate Planning and Master Scheduling:** Introduction- planning and scheduling, Objectives of aggregate planning, Three Pure Strategies, Aggregate planning methods, Master scheduling objectives, Master scheduling methods.	
Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-4 (08 Hrs)	
Material and Capacity Requirements Planning: Overview: MRP and CRP, MRP: Underlying concepts, System parameters, MRP logic, System refinements, Capacity management, CRP activities. **Scheduling and Controlling Production Activities:** Introduction, PAC, Objectives and Data requirements, Loading –Finite and Infinite Scheduling methodology, priority sequencing, capacity control.	
Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-5 (08 Hrs)	
Single Machine Scheduling: Concept, measures of performance, SPT rule, Weighted SPT rule, EDD rule. **Flow –Shop Scheduling**: Introduction, Johnson"s rule for „n" jobs on 2 and 3 machines, CDS heuristic. **Job-Shop Scheduling**: Types of schedules, Heuristic procedure, scheduling 2 jobs on "m" machines.	
Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50 marks. The question paper will have ten full questions carrying equal marks.
2. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
3. Each full question will have a sub-question covering all the topics under a module.
4. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Books

(1) Monks, J.G., Operations Management, McGraw-Hill International Editions, 1987.
(2) Productions & operations management by Adam & Ebert.
(3) Buffa, Modern Production/Operations Management, Wiely Eastern Ltd.
(4) Chary, S.N., Production and Operations Management, Tata- McGraw Hill.
(5) Operations management by James Dilworth.

Web links and Video Lectures (e-Resources):

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Discuss the basic concept of OM, manufacturing trends in INDIA.	L2
CO2	Design of product layout, process layout and analyse process and capacity.	L4
CO3	Applying appropriate inventory planning technique.	L3
CO4	Forecast the demand and prepare MPS.	L4
CO5	Construct the MRP, MRPII and schedule the jobs and machines.	L3

Mapping of COS and POs

(Below table is only indicative and hence course teacher can revise it)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1										
CO2										
CO3										
CO4										
CO5										

VALUE ENGINEERING			
Course Code	22MTE/MTE/MCM232	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	50	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- To inculcate specialized knowledge and skill in advanced manufacturing processes using the principles and methods of engineering analysis and design.

Module-1

INTRODUCTION TO VALUE ANALYSIS: Definition of Value, Value Analysis, Value Engineering, Value management, Value Analysis versus Value Engineering, Value Analysis versus Traditional cost reduction techniques, Symptoms to apply value analysis, Coaching of Champion concept. TYPE OF VALUES: Reasons for unnecessary cost of product, Peeling cost Onion concept, unsuspected areas responsible for higher cost, Value Analysis Zone, attractive features of value analysis. Meaning of Value, types of value & their effect in cost reduction. 10 Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-2

FUNCTIONAL COST AND ITS EVALUATION: Meaning of Function and Functional cost, Rules for functional definition, Types of functions, primary and secondary functions using verb and Noun, Function evaluation process, Methods of function evaluation. Evaluation of function by comparison, Evaluation of Interacting functions, Evaluation of function from available data, matrix technique, MISS technique, Numerical evaluation of functional relationships and case studies. PROBLEM SETTING & SOLVING SYSTEM: A problem solvable stated is half solved, Steps in problem setting system, Identification, Separation and Grouping of functions. Case studies. 10Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-3

VALUE ENGINEERING JOB PLAN: Meaning and Importance of Value Engineering Job plan. Phases of job plan proposed by different value engineering experts, Information phase, Analysis phase, Creative phase, Judgement phase, Development planning phase, and case studies. Cost reduction programs, criteria for cost reduction program, Value analysis change proposal.

10Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-4

VALUE ENGINEERING TECHNIQUES: Result Accelerators or New Value Engineering Techniques, Listing, Role of techniques in Value Engineering, Details with Case examples for each of the Techniques. ADVANCED VALUE ANALYSIS TECHNIQUES: Functional analysis system technique and case studies, Value analysis of Management practice (VAMP), steps involved in VAMP, application of VAMP to Government, University, College, Hospitals,

School Problems etc., (service type problems). 10 Hrs	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation
Module-5	
APPLICATION OF VALUE ANALYSIS: Application of Value analysis in the field of Accounting, Appearance Design, Cost reduction, Engineering, manufacturing, Management, Purchasing, Quality Control, Sales, marketing, Material Management Etc., Comparison of approach of Value analysis & other management techniques. 10Hrs	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks**or**oneSkill Development Activity of 40 marks**to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions)

Suggested Learning Resources:

Books

- Techniquesof Value Analysis and Engineering– Lawrence D. Miles, McGraw – Hill Book Company,2ndEdn.
- Value engineering for Cost Reduction and Product Improvement – M.S. Vittal, Systems Consultancy Services Edn 1993
- Value Management, Value Engineering and Cost Reduction – Edward D Heller Addison Wesley Publishing Company 1971
- Value Analysis for Better Management – Warren J Ridge American Management Association Edn 1969
- Getting More at Less Cost (The Value Engineering Way) – G.Jagannathan Tata Mcgraw Hill Pub. Comp. Edn 1995
- Value Engineering – Arther E Mudge McGraw Hill Book Comp. Edn 1981

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program

Skill Development Activities Suggested

- Quizzes
- Assignments
- Seminars

Activities

- Mini project on live working model/ Problems.
- Seminar
- Assignment

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	To understand the concepts of value engineering, identify the advantages, applications.	
CO2	To understand various phases of value engineering. Analyze the function, its approach and evaluation.	

Sl. No.	Description	POs
PO1	An ability to independently carry out research /investigation and development work to solve practical problems.	
PO2	An ability to write and present a substantial technical report/document.	
PO3	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program	
PO4	Understand contemporary issues in manufacturing engineering and develop relationship between product design and manufacturability to create safe, reliable, and cost-effective products.	
PO5	Understand the process of converting customer needs into engineering specifications to create product designs that are sensitive to user needs and robust against unanticipated uses and misuse	

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**3**	**2**	**2**	**2**	**3**	**3**	**3**
CO2	**3**	**2**	**2**	**2**	**3**	**2**	**3**
CO3	**2**	**2**	**2**	**2**	**2**	**2**	**3**
CO4	**2**	**3**	**2**	**3**	**3**	**3**	**2**
CO5	**3**	**3**	**3**	**2**	**2**	**2**	**2**

Mapping of COS and Pos (indicative only)

TESTING OF MATERIALS			
Course Code	**22MTE233**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	**2:0:2**	SEE Marks	50
Total Hours of Pedagogy	**25**	Total Marks	100
Credits	**03**	Exam Hours	03

Course Learning Objectives:

- Understand and correlate various materials testing methods used in industries.
- Understanding the concept of importance of calibration in testing instruments.
- Gain knowledge on materials testing microscopes,
- Understanding the strain rate testing knowledge and
- Knowledge of lubrication and method of testing the lubrications.

Module-1 (05 Hrs)

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

Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-2 (05 Hrs)

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.

Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-3 (07 Hrs)

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.

Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-4 (03 Hrs)

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.

Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-5 (05 Hrs)

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

Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Tutorial/Activity Sessions:

- 10-12 tutorial/activity sessions need to be planned, which may be distributed among all the modules to cover entire portion of the syllabus/curriculum within nearly 40 hours.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50 marks. The question paper will have ten full questions carrying equal marks.
2. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
3. Each full question will have a sub-question covering all the topics under a module.
4. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Books

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.
3 ASM - Testing of materials.
4 Workability Testing Techniques, G.E. Dieter, ASM 1984.
5 Relevant Codes and Standards.

Web links and Video Lectures (e-Resources):

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Explain the various materials testing methods used in industries.	L2
CO2	Discuss the concept of importance of calibration in testing instruments.	L2
CO3	Demonstrate the knowledge on materials testing microscopes,	L2
CO4	Apply the strain rate testing knowledge	L3
CO5	Discuss the knowledge gained on lubrication and method of testing the lubrications.	L2

Mapping of COS and POs

(Below table is only indicative and hence course teacher can revise it)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1										
CO2										
CO3										
CO4										
CO5										

PLASTIC PROCESSING			
Course Code	**22MTE234**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	**2:0:2**	SEE Marks	50
Total Hours of Pedagogy	**25**	Total Marks	100
Credits	**03**	Exam Hours	03

Course Learning Objectives:

- Understand the basics of plastic processing,
- Knowledge of injection moulding, extrusion and thermo forming,
- Understanding the powder coating, casting, machining and joints of plastics,
- Knowledge of plastic metalizing and printing
- Understand the different processing techniques of engineering plastics.

Module-1 (05 Hrs)	
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	
Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-2 (07 Hrs)	
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	
Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-3 (03 Hrs)	
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	
Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-4 (05 Hrs)	
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 and remedies	
Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-5 (05 Hrs)	
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.	
Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Tutorial/Activity Sessions:

- 10-12 tutorial/activity sessions need to be planned, which may be distributed among all the modules to cover entire portion of the syllabus/curriculum within nearly 40 hours.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50 marks. The question paper will have ten full questions carrying equal marks.
2. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
3. Each full question will have a sub-question covering all the topics under a module.
4. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Books

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.
4. Injection Moulding Theory & Practice, Rubin. J. Irvin, New York John Wiley & Sons.
5. Blow Moulding Hand Book, Rosato, New York-Oxford University- Hanser Publishers.
6. Principles of Rotational Moulding Process, Bruins.

Web links and Video Lectures (e-Resources):

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Explain the basics of plastic processing,	L2
CO2	Exhibit the knowledge of injection moulding, extrusion and thermo forming,	L2
CO3	Discuss the powder coating, casting, machining and joints of plastics,	L2
CO4	Apply the knowledge of plastic metalizing and printing and	L3
CO5	Apply the different processing techniques of engineering plastics.	L3

Mapping of COS and POs

(Below table is only indicative and hence course teacher can revise it)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1										
CO2										
CO3										
CO4										
CO5										

CNC MACHINING and PROGRAMMING			
Course Code	**22MTE235**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	**2:0:2**	SEE Marks	50
Total Hours of Pedagogy	**25**	Total Marks	100
Credits	**03**	Exam Hours	03

Course Learning Objectives:

- Understand evolution, classification and principles of CNC machine tools
- Learn constructional details of CNC machine tools, selection of standard components used for CNC machine tools for accuracy and productivity enhancement.
- Study on selection of drives and positional transducers for CNC machine tools.
- Learn how to apply CNC programming concepts for two axis turning centers and three axis vertical milling centres to generate programs different components.
- Generate CNC programs for popular CNC controllers.
- Learn on how to Analyse and select tooling and work holding devices for different components to be machined on CNC machine tools.

Module-1 (**05 Hrs**)	
INTRODUCTION TO CNC MACHINE: Evolution of CNC Technology, principles, features. Advantages, applications, CNC and DNC concepts, classification of CNC machines- turning centre, machining centre, grinding machine, EDM, types of control systems, CNC controllers, characteristics, interpolators- Computer Aided Inspection.	
Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-2 (**05 Hrs**)	
CONSTRUCTIONAL DETAILS OF CNC MACHINE: CNC Machine building, structural details, configuration and design, guide ways- Frictions, Anti friction and other types of guide ways, elements used to convert the rotary motion to a linear motion – Screw and nut, recirculating ball screw, planetary roller screw, recirculating roller crew, rack and pinion, spindle assembly, torque transmission elements- gears, timing belts, flexible couplings, Bearings.	
Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-3 (**05 Hrs**)	
DRIVE CONTROLS AND WORK HOLDING DEVICES: Spindle drives-DC shunt motor, 3 phase AC induction motor, feed drives- stepper motor, servo principle, DC and AC servomotors, Open loop and closed loop control, Axis measuring system- synchro, synchro-resolver, gratings, moire fringe gratings, encoders, inductosysn, laser interferometer. Introduction to cutting tool materials- Carbides, ceramics, CBN, PCD-inserts classification, qualified, semi qualified and pre- set tooling, tooling system for machining centre and turning=g centre, work hold devices for rotating and fixed work parts.	
Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-4 (**05 Hrs**)	
CNC PROGRAMMING: Coordinate system, structure of a part program, G & M codes, tool length compensation, cutter radius and tool nose radius compensation, do loops, subroutines, canned cycles, mirror image, parametric programming ,machining cycles cycles , manual part programming for machining centre and turning. Computer aided CNC part programming: Need for computer aided part programming, Tools for computer aided part programming, APT/ CAD/CAM based part programming for well –known controllers such as Fanuc, Heidenhain, sinumerik etc., and generation of CNC codes from CAM packages	
Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-5 (**05 Hrs**)	
CNC PROGARMMING LATH AND MILLING: Plan and optimize programmes CNC turning operations. Calculate parameters like speed feed etc and set references for the various operations. Prepare operations and operations sequence for the lath operations like turning, grooving etc. Plan and optimize programmes CNC milling operations. Calculate parameters like speed, feed depth of cut etc and set a references for the various operations. Various methods of work process like edge finding black centre etc. Prepare and sets CNC milling operations.	
Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Tutorial/Activity Sessions:

- 10-12 tutorial/activity sessions need to be planned, which may be distributed among all the modules to cover entire portion of the syllabus/curriculum within nearly 40 hours.

Assessment Details (both CIE and SEE)

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Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50 marks. The question paper will have ten full questions carrying equal marks.
2. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
3. Each full question will have a sub-question covering all the topics under a module.
4. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Books

1 Mechatronics, HMT, Tata MCGraw-Hill publishing company limited , New Delhi, 2005
2 Computer control of manufacturing systems, Koren Y, McGraw Hill, 1986
3 Computer numerical control Machines, Radhakrishnan P , New centre Book Agency, 2002
4 CNC Machining Hand Book, James Madison, Industrial Press Inc, 1996
5 Programming of CNC Machines Ken Evans, John Polywka and Stanley Gabrel, Industrial Press Inc, New York, Second edition 2002
6 CNC Programming Hand book, peter Smid, industrial Press Inc, 2000
7 CAD/CAM , Rao P.N. Tata McGraw-Hill publishing company limited, 2002
8 Computer Numerical , Warren S. Seames, Thomson Delmar , Fourth Edition 2002

Web links and Video Lectures (e-Resources):

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Explain the evolution, classification and principles of CNC machine tools.	L2
CO2	Discuss on details of CNC machine tools, selection of standard components used for CNC machine tools for accuracy and productivity enhancement.	L3
CO3	Select drives and positional transducers for CNC machine tools.	L3
CO4	Apply CNC programming concepts of for two axis turning centers and three axis vertical milling centres to generate programs different components.	L3
CO5	Generate CNC programs for popular CNC controllers.	L3
CO6	Analyse and select tooling and work holding devices for different components to be machined on CNC machine tools.	L4

Mapping of COS and POs

(Below table is only indicative and hence course teacher can revise it)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1										
CO2										
CO3										
CO4										
CO5										
CO6										

AGILE MANUFACTURING			
Course Code	**22MTE/MPM/MEM/MIA/MPY/ MPT/MSE241**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	**3:0:0**	SEE Marks	50
Total Hours of Pedagogy	**40**	Total Marks	100
Credits	**03**	Exam Hours	03

Course Learning Objectives:

- Understand the agile manufacturing and conceptual frame work.
- Study to analyse the four core concept of agile manufacturing.
- Study the implication of advanced manufacturing system.
- Understand and design the agile manufacturing enterprises.
- Learn to develop the design skill and knowledge enhancing technology for agile manufacturing

Module-1 (08 Hrs)	
Introduction -What is agile Manufacturing? - Competitive environment of the future the business case for agile manufacturing conceptual frame work for agile manufacturing.	
Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-2 (08 Hrs)	
Four Core Concepts: Strategy driven approach - integrating organization, people technology interdisciplinary design methodology.	
Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-3 (08 Hrs)	
Agile Manufacturing and Change Management: The change implications. Post failures in advanced manufacturing, changes on the way, traditional management accounting, paradigm, investment appraisal, product costing - performance, measurement and control systems, Traditional organization, control technological and design paradigms traditional problems in workplace- organizational issues - role of technology.	
Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-4 (08 Hrs)	
Agile Manufacturing Enterprise Design: Agile manufacturing - enterprise design, system concepts as the basic manufacturing theory - joint technical & organizational design and a model for the design of agile manufacturing enterprise, enterprise design process insights into design processes, what is interdisciplinary design, Main issues – simple design example.	
Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-5 (08 Hrs)	
Skill & Knowledge Enhancing Technologies for Agile Manufacturing: Skill and Knowledge enhancing Technologies - scheduling - technology design Strategic-Design Concepts. Design and Skill of Knowledge enhancing Technologies for machine tool systems - Historical overview, Lessons, problems and Future development.	
Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Assessment Details (both CIE and SEE)

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Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50 marks. The question paper will have ten full questions carrying equal marks.
2. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
3. Each full question will have a sub-question covering all the topics under a module.
4. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Books

(1) **Agile manufacturing - Forging new Frontiers** - Paul T. Kidd - Addison WesleyPublication -1994.
(2) **Agile Manufacturing – Proceedings of International Conference**- Dr. M.PChowdiah (Editor) – TataMcGraw Hill Publications - 1996.
(3) **On agile manufacturing** - Tata McGraw Hill Publications -1996

Web links and Video Lectures (e-Resources):

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Discuss the agile manufacturing and conceptual frame work.	L2
CO2	Analyse the four core concept of agile manufacturing.	L4
CO3	Analyse the implication of advanced manufacturing system.	L4
CO4	Design the agile manufacturing enterprises.	L4
CO5	Design skill and knowledge enhancing technology foragile manufacturing.	L4

Mapping of COS and POs

(Below table is only indicative and hence course teacher can revise it)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1										
CO2										
CO3										
CO4										
CO5										

NANO SCIENCE AND NANOMATERIALS			
Course Code	**22MTE242**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	**3:0:0**	SEE Marks	50
Total Hours of Pedagogy	**40**	Total Marks	100
Credits	**03**	Exam Hours	03

Course Learning Objectives:

- Understand the importance of nanoscience and nanomaterials in industrial applications.
- Understand the basic properties and designs of nano structures.
- Learn the phase transition process.
- Study of Nano materials in Bio-Medical engineering.
- Gain knowledge of Smart materials and its systems.

Module-1 (08 Hrs)

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 nanomachines.

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.

Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-2 (08 Hrs)

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.

Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-3 (08 Hrs)

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.

Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-4 (08 Hrs)

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.

Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-5 (08 Hrs)

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 materialization, 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.

Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Assessment Details (both CIE and SEE)

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Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50 marks. The question paper will have ten full questions carrying equal marks.
2. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
3. Each full question will have a sub-question covering all the topics under a module.
4. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Books

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.
5. Nano materials and Nano systems for Bio-Medical Applications, M Reza Mozafari (2007), springer.
6. Nanomaterials and Nanotechnologies and design on introduction for engineers and architects, Micheal F. Ashby, P.J. Ferreria, D.L. Sehodek.

Web links and Video Lectures (e-Resources):

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Explain the importance of nanoscience and nanomaterials in industrial applications.	L2
CO2	Describe the basic properties and designs of nano structures.	L2
CO3	Discuss the phase transition process.	L2
CO4	Apply the knowledge gained on Nano materials in Bio-Medical engineering.	L3
CO5	Demonstrate the knowledge of Smart materials and its systems.	L2

Mapping of COS and POs

(Below table is only indicative and hence course teacher can revise it)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1										
CO2										
CO3										
CO4										
CO5										

NON-TRADITIONAL MACHINING			
Course Code	**22MTE/MAU/MSE243**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	**2:0:2**	SEE Marks	50
Total Hours of Pedagogy	**25**	Total Marks	100
Credits	**03**	Exam Hours	03

Course Learning Objectives:

- Study to appreciate the merits of nontraditional machining and its application in Industries.
- Learn how to Justify and demonstrate the benefits of non-traditional machining processes over traditional machining processes.
- Understand to decide a process suitable for a particular material based on the availability of the sources.
- Understanding the advanced techniques in manufacturing
- Expose for the marching of all tough materials.

Module-1 (05 Hrs)

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**.**

Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-2 (05 Hrs)

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

Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-3 (05 Hrs)

Chemical Machining: Introduction, fundamental principal 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.

Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-4 (05 Hrs)

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.

Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-5 (05 Hrs)

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

Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Tutorial/Activity Sessions:

- 10-12 tutorial/activity sessions need to be planned, which may be distributed among all the modules to cover entire portion of the syllabus within nearly 40 hours.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50 marks. The question paper will have ten full questions carrying equal marks.
2. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
3. Each full question will have a sub-question covering all the topics under a module.
4. The students will have to answer five full questions, selecting one full question from each module.

Suggested Learning Resources:

Books

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.
4 Production technology - HMT Tata McGraw Hill.
5 Metals hand book - ASM Vol-3
6 High velocity forming of metals - F.M Wilson ASTME Pretice Hall.

Web links and Video Lectures (e-Resources):

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Discus the merits of nontraditional machining and its application in Industries.	L2
CO2	Justify and demonstrate the benefits of non-traditional machining processes over traditional machining processes.	L3
CO3	Decide a process suitable for a particular material based on the availability of the sources.	L4
CO4	Apply the advanced techniques in manufacturing	L3
CO5	Exhibit the knowledge gain for the marching of all tough materials.	L3

Mapping of COS and POs

(Below table is only indicative and hence course teacher can revise it)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1										
CO2										
CO3										
CO4										
CO5										

DESIGN FOR MANUFACTURE			
Course Code	**22MTE244**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	**2:0:2**	SEE Marks	50
Total Hours of Pedagogy	**25**	Total Marks	100
Credits	**03**	Exam Hours	03

Course Learning Objectives:

- Understand issues & challenges in implementing & developing lean manufacturing techniques from TPS & its contribution for improving organizational performance.
- Learn how to apply lean techniques to bring competitive business culture for improving organization performance.
- Study for analyzing how lean techniques can be applied to manufacturing & service industry
- Understand how to develop lean management strategy for Supply chain management.
- Study on Analyzing how lean technique can create value generation for organization

Module-1 (05 Hrs)	
Just in time production system. JIT Logic -Pull system Japanese approach to production elimination of waste - JIT implementation requirements JIT application for job shops, Case studies.	
Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-2 (05 Hrs)	
Kanban System: -Kanban rules supplier Kanban and sequence schedule used by supplier. Monthly information & daily information. Later replenish system by Kanban sequenced withdrawal P system by sequence schedule table - problems & counter measures in applying Kanban system to subcontractors - Supplier Kanban circulation in the paternal manufacturer - structure of supplier Kanban sorting office.	
Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-3 (05 Hrs)	
Electro Chemical and Chemical Processes: Electro chemical machining (ECM), Classification ECM process- **The rise of lean production: -** Birth place, concrete example, company as community, Final assembly plant, product development and engineering. Changing customer demand, dealing with the customer, future of lean production. **Shortening of production lead times:** reduction of setup times, practical procedures for reducing setup time.	
Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-4 (05 Hrs)	
Standardization of operations: Machine layout, multi-function workers and job rotation. Improvement activities to reduce work force and increase worker morale -foundation for improvements. **Elements of lean production viz G M Framingharn:** Toyota Takaoka Mass Production V /s lean production, diffusing lean production.	
Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Module-5 (05 Hrs)	
Managing Lean Enterprise: -Finance, Career ladders, geographic spread and advantages of global enterprise. **Prospects for catching up. Simplicity in the natural state:** institutional factors -life time employment - educational commodities -quality & productivity in full circle.	
Teaching-Learning Process	Chalk and Talk / Use of ICT like Power Point Presentations etc

Tutorial/Activity Sessions:

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Assessment Details (both CIE and SEE)

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The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50 marks. The question paper will have ten full questions carrying equal marks.
2. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
3. Each full question will have a sub-question covering all the topics under a module.

Suggested Learning Resources:

Books

1. Productions and Operations Management-ChaselAquilino – Dreamtech latest edition.
2. Toyoto Production System -An integrated approach to Just in Time – YasuhiroMonden - Engineering aild Management Press -Institute of Industrial Engineers Norcross Georgia -1983.
3. The Machine that changed the World. The Story of Lean Production- James PWomack - Daniel TJones - and Daniel Roos -Harper Perennial – editionpublished 1991.

Web links and Video Lectures (e-Resources):

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Explain the issues & challenges in implementing & developing lean manufacturing techniques from TPS & its contribution for improving organizational performance.	L2
CO2	Apply lean techniques to bring competitive business culture for improving organization performance.	L3
CO3	Analyze how lean techniques can be applied to manufacturing & service industry	L4
CO4	Explore the lean management strategy for Supply chain management.	L3
CO5	Analyse how lean technique can create value generation for organization	L4

Mapping of COS and POs

(Below table is only indicative and hence course teacher can revise it)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1										
CO2										
CO3										
CO4										
CO5										

INDUSTRY 4.0			
Course Code	22MPD/MAU/MDE/MEA/MMD/MTP/MPY/MIA/MAR/CAE/MPE/MPM/MCM245	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	25 theory + 10-12 activities	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- To impart basic idea in Industry 4.0.
- To provide students with good depth of knowledge of designing Industrial 4.0 Systems for various application
- Learn the concepts of Robotics and Augmented Reality

Module-1

Introduction to Industry 4.0: Introduction, core idea of Industry 4.0,origin concept of industry 4.0,Industry 4.0 production system, current state of industry 4.0, Technologies, How is India preparing for Industry 4.0 05Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-2

A Conceptual Framework for Industry 4.0: Introduction, Main Concepts and Components of Industry 4.0, State of Art, Supportive Technologies, Proposed Framework for Industry 4.0. 05Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-3

Technology Roadmap for Industry 4.0 : Introduction, Proposed Framework for Technology Roadmap, Strategy Phase, Strategy Phase, New Product and Process Development Phase.

05Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-4

Advances in Robotics in the Era of Industry 4.0: Introduction, Recent Technological Components of Robots-Advanced Sensor Technologies, Internet of Robotic Things, Cloud Robotics, and Cognitive Architecture for Cyber-Physical Robotics, Industrial Robotic Applications- Manufacturing, Maintenance and Assembly. 05Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-5

Obstacles and Framework Conditions for Industry 4.0 : Lack of A Digital Strategy alongside Resource Scarcity, Lack of standards and poor data security, Financing conditions, availability of skilled workers, comprehensive broadband infra- structure, 05Hrs	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Assessment Details (both CIE and SEE)

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Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Books

- Alp Ustundag and Emre Cevikcan,"Industry 4.0: Managing the Digital Transformation".
- Bartodziej, Christoph Jan,"The Concept Industry 4.0".
- Klaus Schwab,"The Fourth Industrial Revolution".
- Christian Schröder ,"The Challenges of Industry 4.0 for Small and Medium-sized Enterprises".

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program

Skill Development Activities Suggested

- Quizzes
- Assignments
- Seminars
- Industrial Visit
- Case study

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Describe Industry 4.0 and scope for Indian Industry	
CO2	Demonstrate conceptual framework and road map of Industry 4.0	
CO3	Describe Robotic technology and Augmented reality for Industry 4.0	

Sl. No.	Description	POs
PO1	An ability to independently carry out research /investigation and development work to solve practical problems.	
PO2	An ability to write and present a substantial technical report/document.	
PO3	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program	
PO4	Understand contemporary issues in manufacturing engineering and develop relationship between product design and manufacturability to create safe, reliable, and cost-effective products.	
PO5	Understand the process of converting customer needs into engineering specifications to create product designs that are sensitive to user needs and robust against unanticipated uses and misuse	
PO6	Employ advanced prototyping methods to shorten design cycles and narrow alternatives without restricting innovation.	
PO7	Understand and debate the roles and responsibilities of a product designer/manufacturer	

Mapping of COS and Pos (indicative only)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	2	3	2	3	3
CO2	2	3	3	2	3	3	3
CO3	3	3	2	3	2	3	3

MINI PROJECT WITH SEMINAR			
Course Code	**22MTE25**	CIE Marks	100
Number of contact Hours/Week	**0-4-2**	SEE Marks	--
Credits	**03**	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 with seminar: This may be hands-on practice**,** survey report, data collection and analysis, coding, mobile app development, field visit and report preparation, modelling of system, simulation, analysing and authenticating, case studies, etc.

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. Students can present the seminar based on the completed mini-project. Participation in the seminar by all postgraduate students of the program shall be mandatory.

The CIE marks awarded for Mini-Project work and Seminar, shall be based on the evaluation of Mini Project work and Report, Presentation skill and performance in Question-and-Answer session in the ratio 50:25:25. Mini-Project with Seminar shall be considered as a head of passing and shall be considered for vertical progression as well as for the award of degree. Those, who do not take-up/complete the Mini Project and Seminar shall be declared as fail in that course and have to complete the same during the subsequent semester.

There is **no SEE** for this course.

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 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.

TOOL DESIGN ENGINEERING LAB - 2			
Course Code	**22MTEL26**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	**1:2:0**	SEE Marks	50
Total Hours of Pedagogy	**25**	Total Marks	100
Credits	**02**	Exam Hours	03

Course Learning Objectives:

- Study to Design, assembly and Drafting of a cavity injection moulding tool for a simple component
- Study to Design, assembly, drafting and Analysis of a 3 Plate mold, split and core mold
- To Develop and implement a program for pick and place of an object using robot.
- Learn to Design, assembly, drafting and Analysis of cavity cold and hot chamber die casting tool.
- Understand to Develop a CIM layout and Trajectory planning of robot using software

Note:

1. These are independent Tool Design exercises for Plastic moulds and Die Casting – Die Designs
2. Student may be given at least five exercises stated below
3. Student must submit a design exercises comprehensive report on the problem solved and give a presentation on the same for the internal evaluation.
4. Any one of the design exercises done (at least five) from the below least has to be asked in the examination for evaluation.
5. Design, drafting and analysis of various Plastic moulds and Die Casting – Die Design tools using appropriate software package.

Sl.NO	Experiments
1	Design, assembly and Drafting of a single cavity injection moulding tool for a simple component
2	Design, assembly, drafting and Analysis of a two-cavity injection molding tool for a given component
3	Design, assembly, drafting and Analysis of a 3 Plate mold for the given component
4	Design, assembly, drafting and Analysis of a split mold for the given undercut component
5	Design, assembly, drafting and Analysis of a side core mold for a given component
6	Develop and implement a program for pick and place of an object using robot.
7	Design, assembly, drafting and Analysis of a single cavity cold chamber die casting tool for a simple component
8	Design, assembly, drafting and Analysis of a two-cavity hot chamber die casting tool for a given component.
9	Develop a CIM layout consisting of machining centres, AGV, Tool rib, Material handling robots, conveyors, raw material storage & finished product storage area using software to obtain complete CIM environment.
10	Trajectory planning of robot using software

Course outcomes (Course Skill Set):

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

- Design, assembly and Drafting of a cavity injection moulding tool for a simple component
- Design, assembly, drafting and Analysis of a 3 Plate mold, split and core mold
- Develop and implement a program for pick and place of an object using robot.
- Design, assembly, drafting and Analysis of cavity cold and hot chamber die casting tool.
- Develop a CIM layout and Trajectory planning of robot using software

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 40% of maximum marks in the semester-end examination (SEE). In total of CIE and SEE student must secure 50% maximum marks of the course.

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.

- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of **scaled-down** marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University.

- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.
- General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
- Change of experiment is allowed only once and 10% Marks allotted to the procedure part to be made zero.

The duration of SEE is 03 hours

Suggested Learning Resources:

Web References

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