VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI.

Scheme of Teaching and Examinations

M.Tech: Production Engineering System Technology (MPT)

(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., Production Engineering System Technology (MPT)
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	22MTP11	Applied Mathematics	03	00	00	03	50	50	100	3
2	IPCC	22MPT12	CAE and CIM	03	02	00	03	50	50	100	4
3	PCC	22MPT13	Decision-Making Techniques	03	00	02	03	50	50	100	4
4	PCC	22MPT14	Theory of Metal Cutting	02	00	02	03	50	50	100	3
5	PCC	22MPT15	Composite Materials	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	22MPTL17	Production Engineering Laboratory	01	02	00	03	50	50	100	2
8	AUD/AEC	22AUD18/ 22AEC18	BOS recommended ONLINE courses (NPTEL/MOOC/Coursera/MIT, etc.)	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): **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 prerequisite courses suggested by the concerned Board of Studies. Ability Enhancement Courses will be suggested by the BoS if prerequisite courses are not required for the programs. **Ability Enhancement Courses**:

- These courses are prescribed to help students to enhance their skills in 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.

I SEMESTER

Semester- I			
Applied Mathematics			
Course Code	22MTP11	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40 Hrs	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- To have an insight into solving Linear Algebraic Equations.
- Learn to use the roots of equations.
- To develop proficiency in solving ordinary and partial differential equations arising in engineering applications, using numerical methods.
- To enable learning concepts of Sampling theory, RBD and their implication in Mechanical Engineering.
- To understand the techniques of Simple mathematical models in estimating high accuracy and their applications.

Module-1	
Approximations and round off errors: Significant figures, accuracy and precision, error definitions, round off errors, inherent error and truncation errors, problems. Mathematical modeling and Engineering problem solving: A Simple mathematical models, conservation laws of Engineering. **8Hrs**	
Teaching-Learning Process	Chalk and Talk / White board, Power Point Presentation.

Module-2	
System of Linear Algebraic Equations and Eigen Value Problems: Guass-Jordan method, Cholesky Method, Partition method, Bounds on Eigen, values, Jacobi Method, Given Method for symmetric matrices, Householder`s method for symmetric matrices. **8Hrs**	
Teaching-Learning Process	Chalk and Talk / White board, Power Point Presentation

Module-3	
Roots of Equations by numerical methods: Introduction, Secant method, Newton-Raphson method, Horner`s method. Numerical solutions of ordinary differential equations: Introduction, Picard`s method of successive opproximation, solution of ODE by simultaneous& higher order equations (Picard`s & RungeKutta methods) **8Hrs**	
Teaching-Learning Process	Chalk and Talk / White board, Power Point Presentation

Module-4

Numerical solution of one dimensional wave equation, Heat equation,(Schmidt`s explicit formula)& Laplace equation(Gauss-Seidel process) by finite differential schemes. Illustrative examples on each method. **8Hrs**

Teaching-Learning Process	Chalk and Talk / White board, Power Point Presentation

Module-5
Sampling theory: Testing of hypothesis: Chi square test & F- test. Analysis of variation (ANOVA): One way classification, Design of experiments, RBD. **8Hrs**

Teaching-Learning Process	Chalk and Talk / White board, Power Point 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) from each

Suggested Learning Resources:

Books

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.
4. R.E, Walpole, R.H.Myres, S.L.Myres and Keying Ye, "Probability and Statistics for Engineers and Scientists", 9th Edition, Pearson, 2012
5. Dr. B.S. Grewal, "Numerical Methods in Engineering and Science", Khanna Publishers, 1999
6. K Shankar Rao, "Introduction to Partial Differential Equations" Prentice - Hall of India Pvt. Lt. , 1995 Edition

C. Ray Wylie and Louis C Barrett, "Advanced Engineering Mathematics". 6th edition, McGraw-Hill, 1995.

Web links and Video Lectures (e-Resources):

- http://.ac.in/courses.php?disciplineID=111
- http://www.class-central.com/subject/math(MOOCs)
- http://academicearth.org/
- http://www.bookstreet.in.
- VTU e-Shikshana Program
- VTU EDUSAT Program

Skill Development Activities Suggested

- Quizzes
- Assignments
- Seminars

Course outcome

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.	L1, L2, L3, L4
CO2	Learn various numerical methods to solve system of linear equations	L1, L2, L3, L4,L5
CO3	Analyze and solve PDE‟s related to wave equation arising in vibration analysis.	L1, L2, L3, L4,L5

Program Outcome of this course

Sl. No.	Description	POs
1	An ability to independently carry out research /investigation and development work to solve practical problems.	PO1
2	An ability to write and present a substantial technical report/document.	PO2
3	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	PO3
4	Understand contemporary issues in manufacturing engineering and develop relationship between product design and manufacturability to create safe, reliable, and cost-effective products.	PO4
5	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	PO5
6	Employ advanced prototyping methods to shorten design cycles and narrow alternatives without restricting innovation.	PO6
7	Understand and debate the roles and responsibilities of a product designer/manufacturer on society.	PO7

Mapping of COS and POs **(Indicative only)**

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

CAE and CIM			
Course Code	22MPT12	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 10-12 Lab slots	Total Marks	100
Credits	04	Exam Hours	03

Course objectives:

- To learn the basic concepts of Computer Aided Engineering and different discretization methods.
- To learn the different meshing techniques.
- To imbibe the basic knowledge of CAD, CAE and CIM
- To develop the fundamental skill sets in CNC Programming
- To inculcate the fundamental knowledge in automated material handling and storage system.

MODULE-1

Elemental Properties: Introduction to Computer Aided Engineering, CAE in product development discretization methods – Finite Element Method (FEM), Finite Difference Method (FDM) and Finite Volume Method (FVM), CAE tools Pre processor, Solver, Post processor.

Element Shapes: 1D, 2D and 3D elements, Nodal unknowns and Field variables. **8Hrs**

Teaching-Learning Process	Chalk and Talk, Power point presentation, Animations

MODULE-2

Meshing Techniques: Discretization of a structure, 1D, 2D and 3D element meshing, Elements selection criteria, Refining mesh, Effect of mesh density in critical region, use of symmetry.

Problems on Beams and Trusses **8Hrs**

Teaching-Learning Process	. Chalk and Talk, Power point presentation, Animations

MODULE-3

Production development through CIM: Computers in Industrial manufacturing, Product cycle & Production development cycle, Introduction of CAD/CAM & CIM, sequential and concurrent engineering, soft and hard prototyping.

Computer Process Monitoring: Process control methods, direct digital control, supervisory computer control, steady state optimal control, on line search strategies, adaptive control. **8Hrs**

Teaching-Learning Process	Chalk and Talk, Power point presentation, Animations

MODULE-4

Computer Integrated Manufacturing: Fundamentals of CAD/CAM, Computerized Manufacturing planning systems, shop floor control & automatic identification techniques. Computer Network for manufacturing, and the future automated factor. **8Hrs**

Teaching-Learning Process	Chalk and Talk, Power point presentation, Animations

MODULE 5

Automated material Handling Storage: Material functions, types of material handling equipment, analysis of material handling systems, design of system, conveyor system, automated guided vehicle systems, automated storage/retrieval systems, caroused storage systems work in process storage, interfacing handling & storage with manufacturing. **8Hrs**

Teaching-Learning Process	Chalk and Talk, Power point presentation, Animations

PRACTICAL COMPONENT OF IPCC

Sl. No	Experiments
1	Study of Finite Element Analysis Package - 1D, 2D, Structural problems
2	Evaluation of displacement (Strain) and Stress.
3	Problems involving on Beams and Trusses
4	Problems involving Trusses
5	Study of functions assigned to Alphabets and Symbols. G and M codes, grouping of codes, Assigned and Unassigned, Model and Non Model codes.
6	Writing the program for Step Turning
7	Writing the program for Taper Turning
8	Writing the program for Threading
9	Writing the program for Milling
10	Writing the program for Drilling
Experiments/ Activities/Demonstrations/Visits/Analytics etc., that enhances the skill of the learners (Activities are only for CIE)	
1	Exercises on Robots
2	General Configuration of
3	a. Robot, b. Different Programming methods
4	Overview of Robot languages.

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

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 have to 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 has to secure an aggregate of 50% of maximum marks of the course(CIE+SEE)

Suggested Learning Resources:

Books

1. CAD/CAM -Zimmers& Grover – PHI
2. CAD/CAM/CIM - P.Radhakrishna - New Age International - 2nd edition
3. CAD/CAM - P.N.Rao - TMH

Web links and Video Lectures (e-Resources):

https://www.youtube.com/watch?v=fQ17i9RThvk

https://www.youtube.com/watch?v=NXel87Do0bA

https://www.youtube.com/watch?v=5qQCNg0Ja5Y

https://www.youtube.com/watch?v=Sx_j50K5qZo

https://www.youtube.com/watch?v=1_Bv9BJE2lI

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Quizzes
- Assignments
- Seminars

Course outcome

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

Sl. No.	Description	Blooms Level
CO1	Different element properties	L1, L2, L3, L4
CO2	Meshing techniques	L1, L2, L3, L4
CO3	Categorize computer aided quality control work for manufacturing.	L1, L2, L3, L4
CO4	List and explain different flow lines and transfer mechanisms	L1, L2, L3, L4,L5
CO5	Categorize Automated material Handling Storage system.	L1, L2, L3, L4

Program Outcome of this course

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

Mapping of COS and POs **(Indicative only)**

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

(Note : High - 3, Medium – 2, and Low – 1)

Decision- Making Techniques			
Course Code	22MPT13	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:2	SEE Marks	50
Total Hours of Pedagogy	40 Hrs theory +10-12 activities	Total Marks	100
Credits	04	Exam Hours	03

Course Learning objectives:

- To provide greater insight into decision-making processes with strong fundamentals.
- To understand how people perceive and decide about risk and transform domain situation to LPP and solve it.
- To formulate domain situations into Transportation, Assignment, and Travelling salesman problems and derive Optimum solutions.
- To formulate game theory problems and obtain solutions using different methods and to understand the fundamentals of Queues.
- To develop an appropriate network diagram for the given problem and analyse the project using CPM/PERT, Crash the project and obtained minimum cost/time schedule.

Module-1

Introduction: Statistics and managerial decisions, statistical data and Operations Research techniques.

Fundamentals of Statistics and Probability: Presentation and Analysis of Statistical Data, Measures of Central tendency and Location, Measure of Dispersion, Skewness and Kurtosis: Numerical Problems, Introduction to Probability and basic rules of probability**.** **8Hrs**

Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Analytical methods, Problem solving, Numerical exercises, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments.

Module-2

Decision Making under Uncertainty: Alternative criteria for decision under uncertainty. Numerical Examples.

Linear Programming Problem: Formulation of LPPs, Solution of LPPs by graphical method.

Solution of LPP by simplex method: Concept of duality and solution of dual problems, Solution of LPP by dual simplex

Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Analytical methods, Problem solving, Numerical exercises, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments

Module-3

Transportation and Assignment Problems: Structure of transportation problem and various methods to find IBFS, Optimality test of transportation problems by MODI method, Solution of degeneracy and unbalanced transportation problems, Time minimisation problems, Assignment problems and solution by Hungarian method, Flight scheduling problems, and Travelling Salesman-problem (TSP). **8Hrs**

Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Analytical methods, Problem solving, Numerical exercises, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments

Module-4

Theory of Games: Two person zero sum game, Mini-max & Maxi-min strategies, Solution of game by dominance rules, arithmetic and algebraic methods, m×2 and 2×n games: Solution by method of sub games and graphical method. 3×3 games: Solution by method of matrices, approximate method using iterative procedure.

Waiting Line: Basic structure of queuing systems and characteristics, Expressions for [(M/M/l):(FCFS/∞/∞)] queuing model**.** Simple Problems. **8Hrs**

Teaching-Learning	Chalk and talk, Videos, PowerPoint Presentation, Animations, Analytical methods, Problem solving, Numerical exercises, Creating conducive environment in classroom for discussions and understanding

Process	through peer learning, promoting self learning activities and Giving assignments

Module-5

Network Analysis: PERT and CPM, Network construction and determination of critical path, Calculation of ES, EF, LS, LF, TF, FF and IF, Crashing of projects to obtain minimum cost/minimum time schedule.

Simulation of Management Systems: Simulation and Monte Carlo method, Waiting line and inventory simulation models. **8Hrs**

Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Analytical methods, Problem solving, Numerical exercises, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments

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:

Text Books:

1. Quantitative Techniques for Managerial Decisions – U K Srivastava, G V Shenoy, and S C Sharma, - New Age International (P) Ltd., Publishers
2. Operations Research: P K Gupta and D S Heera – S Chand & Company Ltd.

Reference Books

1. Operations Research - H. A. Taha- Prentice Hall of India
2. Introduction to Operations Research - Hillier and Liberman- McGraw Hill International
3. Operations Research – S. D Sharma, Kedar Nath Ram Nath & Company Ltd.

Web links and Video Lectures (e-Resources):

- https://www.bbau.ac.in/dept/UIET/EME-601%20Operation%20Research.pdf
- https://www.youtube.com/watch?v=FdKgeeb4q3w
- https://www.youtube.com/watch?v=jemAWA_WQCE
- https://www.youtube.com/watch?v=gbL3vYq3cPk
- https://www.youtube.com/watch?v=M8POtpPtQZc
- https://www.youtube.com/watch?v=-YBlR1UF-UY
- https://www.youtube.com/watch?v=rCLlyT547MY
- https://www.youtube.com/watch?v=lwX8HvF7DYM
- https://www.youtube.com/watch?v=JxnPBrNccqY
- https://www.youtube.com/watch?v=Wgkcrtjrr7s
- https://www.youtube.com/watch?v=v5ZfvATEoDY
- https://www.youtube.com/watch?v=xGkpXk-AnWU
- https://www.youtube.com/watch?v=YueJukoFBMU
- https://www.youtube.com/watch?v=fSuqTgnCVRg
- https://www.youtube.com/watch?v=KUskbAasVCY
- https://www.youtube.com/watch?v=Z-YqfAA9lew
- https://www.youtube.com/watch?v=_g0Aw99V2Dc

- https://www.youtube.com/watch?v=Nrmr8mfELcY
- https://www.youtube.com/watch?v=USr10xc98II
- https://www.youtube.com/watch?v=4OdutS9mSZA
- https://www.youtube.com/watch?v=j8CbEoF9c6Y

Skill Development Activities Suggested

- At the end of the lecture/presentation, numerical exercises are to be taken up to solve problems related to the topics covered. Additional problems are to be given for practice and also as assignments under each of the topics covered.
- Field visits are to be made to collect empirical data pertaining to various decision-making models and subsequently the appropriate model is to be applied to solve the problems.

Course outcome

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

Sl. No.	Description	Blooms Level
CO1	To explain the need for Statistics in managerial decision making and compute the various measures of central tendency, dispersion, skewness and kurtosis for the collected statistical data	L1, L2, L3, L4
CO2	Identify situations of DMUR and solve it. Formulate LPP and derive optimal solutions using graphical method or Simplex method of different varieties	L1, L2, L3, L4
CO3	Identify the situations appropriate for the application of Transportation, Assignment, and Travelling salesman problems and derive optimum solution.	L1, L2, L3, L4
CO4	Identify the areas of application of Game theory and formulate mathematical problems with competitive situations and derive solutions. Explain waiting line problems and derive solution for [(M/M/l):(FCFS/∞/∞)] queuing model.	L1, L2, L3, L4, L5
CO5	Apply the appropriate network techniques (PERT/CPM) to projects and Obtain optimum time/cost Networks through crashing. Apply Monte-Carlo simulation for waiting line and inventory situations.	L1, L2, L3, L4, L5

Program Outcome of this course

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

Mapping of COS and POs **(Indicative only)**

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

(Note : High - 3, Medium – 2, and Low – 1)

Theory of Metal Cutting

Course Code	22MPT14	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	25 Hrs Theory +10-12 activities	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- Understand and analyze the fundamentals of different cutting too land materials.
- Understand and analyze Mechanics of metal cutting.
- Understandandanalyzecuttingforceanditsmeasurementsusingdynamometers and temperature distribution during metal cutting.
- Understand and analyze tool wear and tool life-mechanisms and effects.
- Understand and analyze the Thermal Aspects and selection of cutting fluids and Optimum cutting speed and cost techniques.

Module-1

Mechanics of Metal Cutting: Mechanism of chip formation, Orthogonal & Oblique cutting, types of chips, built-up edge, Determination of shear plane angle, forces on the chips, forces in orthogonal cutting, Merchant circle diagram and analysis, Theory of Lee & Shaffer, coefficient of friction, power & energy relationship, velocity relationship, shear-strain, factors affecting forces and power, problems **Geometry Of Cutting Tools**: Single point and multi point cutting tools, tools nomenclature, tool point reference systems, tool signature, Recommended tool angles, Effect of cutting parameters on tool geometry. **5Hrs**

Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Analytical methods, Problem solving, Numerical exercises, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments

Module-2

Tool Materials And Their Properties: Characteristics of tool materials, types of tool materials – carbon tool steels, high speed steels, cast alloys, cemented carbides, ceramics, diamonds, SIALON, CBN, UCON, recommended cutting speeds for the above tools, discussion on die steels, air, water, oil hardening of tools and their applications.

Tool Wear, Tool Life: Mechanisms of tool wear, Sudden & gradual wear, crater wear, flank wear, tool failure criteria, tool life equations, effect of process parameters on tool life, tool life tests, conventional & accelerated tool wear measurement, machinability index. **5Hrs**

Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Analytical methods, Problem solving, Numerical exercises, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments.

Module-3

Measurement Of Cutting Forces: Reasons for measuring cutting forces, Classification of cutting force dynamometers – mechanical, hydraulic, pneumatic, optical, inductance, piezoelectric, and strain gage

type dynamometers. **Dynamometers For Machine Tools:** Dynamometers for lathe, drilling, grinding and milling, Calibration of dynamometers. **5Hrs**

Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments

Module-4

Thermal Aspects In Metal Cutting: Heat sources in metal cutting, temperature in chip formation, temperature distribution, and experimental determination of tool temperatures. **Cutting Fluids:** Basic actions of cutting fluids, properties of cutting fluids, selection of cutting fluids, application of cutting fluids, filtration of fluids, recommended cutting fluids. **5Hrs**

Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments

Module-5

Economics Of Machining: Introduction, elements of total production cost, optimum cutting speed and tool life for minimum cost, optimum cutting speed and tool life for maximum production, problems.

Advanced Machining Techniques: Cryo machining & high speed machining. Causes of vibration and chatter in machining, and their remedy. **5Hrs**

Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments

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.

Suggested Learning Resources:

Books

1. Metal Cutting Principles - M.C. Shaw - Oxford Publication – 1985.
2. Fundamentals of metal cutting & Machine Tools-by B.L.Juneja& G.S–Sekhar -Wiley Eastern.

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program
- https://www.youtube.com/playlist?list=PLSGws_74K018JY-1RyIj0cm4yppa1h54r
- https://www.youtube.com/watch?v=HYpgpMymDcI
- https://www.youtube.com/watch?v=fdQjDV7qGsM
- https://www.youtube.com/watch?v=IAl9-mTj3gc
- https://www.youtube.com/watch?v=U7exNCTgPcY
- https://www.youtube.com/watch?v=YDSdhiMksoQ

Skill Development Activities Suggested

- Quizzes
- Assignments
- Seminars

Course outcome

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

Sl. No.	Description	Blooms Level
CO1	Explain the fundamentals of different cutting tool and materials	L1, L2
CO2	Explain Mechanics of metal cutting.	L1, L2, L3, L4
CO3	Explain cutting force and its measurement using dynamometers and temperature distribution during metal cutting	L1, L2, L3, L4
CO4	Explain tool wear and tool life -mechanisms and effects.	L1, L2, L3
CO5	Explain the Thermal Aspects and selection of cutting fluids and Optimum cutting speed and cost techniques	L1, L2, L3, L4

Program Outcome of this course

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

Mapping of COS and POs **(Indicative only)**

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

(Note : High - 3, Medium – 2, and Low – 1)

Composite Materials

Course Code	22MPT323	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	25 Hrs Theory +10-12 activities	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- Identify, describe and evaluate the properties of fibre reinforcements, polymer matrix materials and commercial composites.
- Identify, describe rule of mixture and failure criteria for composites.
- Develop competency in one or more common composite manufacturing techniques, and be able to select the appropriate technique for manufacture of composite materials.
- Understand and analyse fabrication of composites and design of structure of composites.
- Understand and recommend composites for different applications and MMCs

Module-1

Introduction to composite materials: Definition, Classification, Types of matrices & reinforcements, characteristics & selection, Fiber composites, laminated composites, particulate composites, prepegs, sandwich, construction. **5Hrs**

Teaching-Learning Process	Chalk and Talk / White board, Power Point Presentation, Video Demonstration or Simulation.

Module-2

Micro mechanical analysis of a lamina: Introduction, Evaluation of the four elastic moduli – Rule of mixture, Macro mechanics of a lamina: Hooke's law for different types of materials, number of elastic constants, Laminate code, Failure criterion. **5Hrs**

Teaching-Learning Process	Chalk and Talk / White board, Power Point Presentation, Video Demonstration or Simulation.

Module-3

Manufacturing: Lay up and curing – open and closed mould processing – Hand layup techniques Bag moulding and filament winding. Pultrusion, Pulforming, Thermoforming, Injection moulding, Cutting, Machining and joining, tooling, Quality assurance Introduction, material qualification, types of defects, NDT methods. **5Hrs**

Teaching-Learning Process	Chalk and Talk / White board, Power Point Presentation, Video Demonstration or Simulation.

Module-4

Fabrication of Composites: Cutting, machining, drilling, mechanical fasteners & adhesive bonding joining computer aided design manufacturing tooling fabrication equipment Design of Fibre Reinforced Composite structures: Introduction, Composite structural design, Design criteria, Laminate design, Mathematical analysis of the laminate, Design of composite stiffeners **5Hrs**

Teaching-Learning Process	Chalk and Talk / White board, Power Point Presentation, Video Demonstration or Simulation.

Module-5

Application developments: Aircrafts, missiles, space hardware, automobile, electrical and electronics, marine, recreational and sports equipment-future potential of composites. Metal matrix composites: Reinforcement materials, types, Characteristics & Selection, base metals-selection, applications. Powder metallurgy technique, liquid metallurgy technique. **5Hrs**

Teaching-Learning Process	Chalk and Talk / White board, Power Point Presentation, Video Demonstration or Simulation.

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 **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) 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. Composite Materials Handbook - Mein Schwartz - McGraw Hill Book Company - 1984.
2. Mechanics of Composite Materials - AutarK.Kaw - CRC Press New York - 1stedi, 1997
3. Composite Materials hand book - MeingSchwaitz - McGraw Hill Book Company
4. Forming Metal hand book, ASM handbook, V15, 1988, P327-338.
5. Composite Science and Engineering - K.K.Chawla - Springer

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=H1SIpk0h4-Q
- https://www.youtube.com/watch?v=slgtMk8k4lk
- https://www.science.org.au/curious/technology-future/composite-materials
- https://www.spiedigitallibrary.org/conference-proceedings-of-spie/10596/1059603/Current-and-future-needs-and-research-for-composite-materials-NDE/10.1117/12.2291921.full?SSO=1
- https://www.youtube.com/watch?v=_m29-u37TI8

Skill Development Activities Suggested

- Quizzes
- Assignments
- Seminars

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

Sl. No.	Description	Blooms Level
CO1	Identify, describe and evaluate the properties of fibre reinforcements, polymer matrix materials and commercial composites.	L1, L2, L3, L4
CO2	Identify, describe rule of mixture and failure criteria for composites	L1, L2, L3, L4,L5
CO3	Develop competency in one or more common composite manufacturing techniques, and be able to select the appropriate technique for manufacture of composite materials	L1, L2, L3, L4,L5
CO4	Explain fabrication of composites and design of structure of composites.	L1, L2, L3, L4,L5
CO5	Understand and recommend composites for different applications and MMCs	L1, L2, L3, L4

Program Outcome of this course

Sl. No.	Description	POs
1	An ability to independently carry out research /investigation and development work to solve practical problems.	PO1
2	An ability to write and present a substantial technical report/document.	PO2
3	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	PO3
4	Understand contemporary issues in manufacturing engineering and develop relationship between product design and manufacturability to create safe, reliable, and cost-effective products.	PO4
5	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	PO5
6	Employ advanced prototyping methods to shorten design cycles and narrow alternatives without restricting innovation.	PO6
7	Understand and debate the roles and responsibilities of a product designer/manufacturer on society.	PO7

Mapping of COS and POs **(Indicative Only)**

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

(Note : High - 3, Medium – 2, and Low – 1)

Semester- I

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:

- To give an overview of the research methodology and explain the technique of defining a research problem
- To explain the functions of the literature review in research.
- To explain carrying out a literature search, its review, developing theoretical and conceptual frameworks and writing a review.
- To explain various research designs and their characteristics.
- To explain the details of sampling designs, and also different methods of data collections.
- To explain the art of interpretation and the art of writing research reports.
- To explain various forms of the intellectual property, its relevance and business impact in the changing global business environment.
- To discuss leading International Instruments concerning Intellectual Property Rights

MODULE-1

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

Defining the Research Problem: Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, An Illustration. **8Hrs**

Teaching-Learning Process	Power-point Presentation, Chalk and Talk are used for Problem Solving,

MODULE-2

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

Research Design: Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs, Important Experimental Designs. **8Hrs**

Teaching-Learning Process	Power-point Presentation, Chalk and Talk are used for Problem Solving,

MODULE-3

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

Measurement and Scaling: Qualitative and Quantitative Data, Classifications of Measurement Scales, Goodness of Measurement Scales, Sources of Error in Measurement Tools, Scaling, Scale Classification Bases, Scaling Techniques, 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. **8Hrs**

Teaching-Learning Process	Power-point Presentation, Chalk and Talk are used for Problem Solving,

MODULE-4

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

Chi-square Test: Test of Difference of more than Two Proportions, Test of Independence of Attributes, Test of Goodness of Fit, Cautions in Using Chi Square Tests. **8Hrs**

Teaching-Learning Process	Power-point Presentation, Chalk and Talk are used for Problem Solving,

MODULE-5

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

Intellectual Property: The Concept, Intellectual Property System in India, Development of TRIPS Complied Regime in India, Patents Act, 1970, Trade Mark Act, 1999,The Designs Act, 2000, The Geographical Indications of Goods (Registration and Protection) Act1999, Copyright Act,1957,The Protection of Plant Varieties and Farmers‟ Rights Act, 2001,The Semi-Conductor Integrated Circuits Layout Design Act, 2000, Trade Secrets, Utility Models, IPR and Biodiversity, The Convention on Biological Diversity (CBD) 1992, Competing Rationales for Protection of IPRs, Leading International Instruments Concerning IPR, World Intellectual Property Organisation(WIPO),WIPO and WTO, Paris Convention for the Protection of Industrial Property, National Treatment, Right of Priority, Common Rules,Patents,Marks, Industrial Designs, Trade Names, Indications of Source, Unfair Competition, Patent Cooperation Treaty (PCT), Advantages of PCT Filing, Berne Convention for the Protection of Literary and Artistic Works, Basic Principles, Duration of Protection, Trade Related Aspects of Intellectual Property Rights(TRIPS) Agreement, Covered under TRIPS Agreement, Features of the Agreement, Protection of Intellectual Property under TRIPS, Copyright and Related Rights, Trademarks, Geographical indications, Industrial Designs, Patents, Patentable Subject Matter, Rights Conferred, Exceptions, Term of protection, Conditions on Patent Applicants, Process Patents, Other Use without Authorization of the RightHolder, Layout-Designs of Integrated Circuits, Protection of Undisclosed Information, Enforcement of Intellectual Property Rights, UNSECO. **8Hrs**

Teaching-Learning Process	Power-point Presentation, Chalk and Talk are used for Problem Solving,

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. C.R. Kothari, Gaurav Garg, "Research Methodology: Methods and Techniques", New Age International, 4th Edition, 2018.
2. Ranjit Kumar, "Research Methodology a step-by-step guide for beginners", SAGE Publications, 3rd Edition, 2011 (For the topicReviewing the literature under module 2)
3. Study Material - Professional Programme Intellectual Property Rights, Law and Practice, The Institute of Company Secretaries ofIndia, Statutory Body Under an Act of Parliament, September 2013. (For the topic Intellectual Property under module 5)
4. William M. K. Trochim ; 1st Edition, illustrated ; Publisher, Atomic Dog Pub., 2005
5. Fink A, "Conducting Research Literature Reviews: From the Internet to Paper", Sage Publications, 20112009.

Web links and Video Lectures (e-Resources):

3. https://archive.nptel.ac.in/courses/127/106/127106227/
- https://www.youtube.com/watch?v=GSeeyJVD0JU

Skill Development Activities Suggested

1. Skill Development Activities Suggested:
2. Interact with industry (small, medium, and large).
3. Involve in research/testing/projects to understand their problems and help creative and innovative methods to solve the problem.
4. Involve in case studies and field visits/ fieldwork.
5. to the use of standards/codes etc., to narrow the gap between academia and industry.
6. Handle advanced instruments to enhance technical talent.
7. Gain confidence in modelling of systems and algorithms for transient and steady-state

operations, thermal study, etc.

8. Accustom Work on different software/s (tools) to simulate, analyse and authenticate the output to interpret and conclude.

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	2
CO2	Explain the functions of the literature review in research, carrying out a literature search, developing theoretical and conceptual frameworks and writing a review	2
CO3	Explain various research designs, sampling designs, measurement and scaling techniques and also different methods of data collections.	2
CO4	Explain several parametric tests of hypotheses, Chi-square test, art of interpretation and writing research reports	2
CO5	Discuss various forms of the intellectual property, its relevance and business impact in the changing global business environment and leading	2

Program Outcome of this course

Sl. No.	Description	POs
1	An ability to independently carry out research/investigation and development work to solve practical problems.	1
2	An ability to write and present a substantial technical report/document.	2
3	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.	3
4	Students should be able to design, synthesize and analyse a physical engineering systems using modern tools and techniques.	4
5	Students should be able to conduct analytical and experimental investigations on Industrial and societal problems to provide sustainable solutions.	5

Mapping of COS and POs (Indicative only)

	PO1	PO2	PO3	PO4	PO5
CO1	**3**	**3**	**3**	**1**	**3**
CO2	**3**	**3**	**2**	**1**	**1**
CO3	**3**	**3**	**1**	**1**	**1**
CO4	**3**	**3**	**2**	**1**	**1**
CO5	**3**	**3**	**1**	**2**	**1**

Note : High - 3, Medium – 2, and Low – 1

Semester I

Production Engineering Laboratory			
Course Code	22MPTL17	**CIE Marks**	50
Teaching Hours/Week (L:P:SDA)	1:2:0	**SEE Marks**	50
Credits	02	**Exam Hours**	03

Course objectives:

- Understand usage of G and M codes and write CNC program for a given component.
- Use CAM package for simulating tool path, power requirement and cycle time, etc.
- Measure cutting forces during machining using different Dynamometers
- Understand the different specimen preparation techniques.

Sl. No	Experiments
1	Simulation of Cutting/Milling operations on a computer using CAM packages
2	Determination of Chip reduction co-efficient (reciprocal of chip thickness ratio) during single point turning.
3	Forces measurements during orthogonal turning
4	Torque and Thrust measurement during drilling.
5	Measurement of Chip tool Interface temperature during turning using thermocouple technique
6	To prepare metallic samples for metallographic examination and to study the principle and construction of the Metallurgical Microscope.
Experiments beyond the syllabus (For CIE only)	
1	To become familiar with the use of a kinematics graphics simulator in order to perform robot motion and programming. To use trajectory planning concepts on the model of a singlelink robotic manipulator. To familiarize students with the use of a vision system
2	Study of capstan lathe and its tooling and prepare a tool layout and job as per given drawing

Course outcomes

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

- Understand usage of G and M codes and write CNC program for a given component.
- Use CAM package for simulating tool path, power requirement and cycle time, etc.
- Measure cutting forces during machining using different Dynamometers.
- Understand the different specimen preparation techniques.

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.

BOS recommended ONLINE courses (NPTEL/MOOC/Coursera/MIT, etc.)			
Course Code	22AUD18/22AEC18	Credits	PP

II SEMRSTER

Semester- II

Quality and Reliability Engineering			
Course Code	22MPT21	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	25 Hrs Theory +10-12 Activities	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- To understand the fundamentals of Quality tools and techniques
- To apply the quality and reliability tools and techniques to real world problems
- To Interpret the results of quality and reliability study for decision-making

Module-1

Basic Concepts: Definitions of quality, Dimensions of quality, Quality characteristics, Quality of design, Quality of conformance, and Quality of performance, Quality control, Statistical quality control, Cost of quality Vs Value of quality.

Fundamentals of Probability and Statistics: Basic probability rules, Discrete and continuous probability distributions and their applications in quality control, numerical problems. **5Hrs**

Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Analytical methods, Problem solving, Numerical exercises, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments

Module-2

Control charts for Variables: Concept of variation, sources of variation and types. Objectives of control charts, Choice of variable, Subgroup size and subgrouping, frequency of sampling, control limits. Process capability analysis, Relationship of a Process Tolerance vis-a-vis Specification Tolerance, Process Capability Index, Variable control charts - X bar chart, R chart, σ chart, revision of control limits, numerical problems. Introduction to run-sum test, Group Control charts, mid range and median charts. **5Hrs**

Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Analytical methods, Problem solving, Numerical exercises, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments

Module-3

Control charts for Attributes: Control charts for fraction nonconforming (p chart, np chart) and nonconformities (c chart and u chart) with variable and constant sample size, Choice between variables and attributes control charts, revision of control limits, numerical problems.

Failure Data Analysis : Introduction, Life Testing, Failure Data, Quantitative measures, MTTF, MTBF, Bathtub Curve, Mean Life, Introduction to Failure Mode and Effect Analysis. **5Hrs**

Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Analytical methods, Problem solving, Numerical exercises, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments

Module-4

Acceptance Sampling: Fundamentals of acceptance sampling, Sampling methods, OC Curves and their characteristics, AQL, IQL, LTPD, AOQ/AOQL. Types of acceptance sampling-Single, Double, Multiple, and Sequential sampling plans, Computing ATI, AFI, ASN. comparison amongst sampling plans, numerical problems. **5Hrs**

Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Analytical methods, Problem solving, Numerical exercises, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments

Module-5
System Reliability: Reliability definition, Series, parallel and mixed configuration systems, Block diagram approach, numerical problems. Difficulty in achieving reliability, Different techniques available to improve reliability, Reliability-Cost trade off, numerical problems. **Maintainability and Availability:** Introduction, Techniques available to improve maintainability and availability, trade-off among reliability, maintainability and availability, Simple problems. **5Hrs**

Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Analytical methods, Problem solving, Numerical exercises, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments

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) from each

Suggested Learning Resources:

Text Books

1. Statistical Quality Control – Montgomery D.C. John Wiley & Sons, Inc
2. Statistical Quality Control – Grant and Leavenworth.

Reference Books

1. Quality Planning and Analysis - Juran, J.M and Gryna, F.M. - Tata McGraw Hill publishing Coimpany Ltd., New Delhi, India – 1982
2. Concepts in Reliability Engineering – Srinath K.S. - Affiliated East-West Press Private Limited, New Delhi, India - 1985.
3. Statistical Quality Control – R C Gupta, Khanna Publishers

Web links and Video Lectures (e-Resources):

- http://www.ru.ac.bd/stat/wp-content/uploads/sites/25/2019/03/405_02_Montgomery_Introduction-to-statistical-quality-control-7th-edtition-2009.pdf
- https://www.youtube.com/watch?v=tSbB5GtW1d0
- https://www.youtube.com/watch?v=uPTdz8mkxi8
- https://www.youtube.com/watch?v=os17KYZAnd0
- https://www.youtube.com/watch?v=X_JSyINygNg
- https://www.youtube.com/watch?v=Ugcb7Vlp0Ts
- https://www.youtube.com/watch?v=8XE56DbAGKM
- https://www.youtube.com/watch?v=328lcikqqs0
- https://www.youtube.com/watch?v=CmYpqVn3NoI
- https://www.youtube.com/watch?v=kRGQDaE_fSg
- https://www.youtube.com/watch?v=TFCcfl4DyUo
- https://www.youtube.com/watch?v=3GkDnw94Xxk
- https://www.youtube.com/watch?v=WSr6AU0InMk
- https://www.youtube.com/watch?v=d7Tl3E_lOMc
- https://www.youtube.com/watch?v=hmqsK_lifeI
- https://www.youtube.com/watch?v=kWLOwKC8JIs
- https://www.youtube.com/watch?v=TDPJ_ZareQY

Skill Development Activities Suggested

- At the end of the lecture/presentation, numerical exercises are to be taken up to solve problems related to the topics covered. Additional problems are to be given for practice and also as assignments under each of the topics covered.
- Industrial visits are to be made to understand the application of SQC tools and their usefulness in achieving, maintaining, and improving quality of products/services provided by the industry.

Course outcome

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

Sl. No.	Description	Blooms Level
CO1	Explain the basic concepts of Quality engineering and apply various Probability distributions to the real world Quality problems	L1, L2, L3, L4
CO2	Identify the need for control chart for variables and apply the same to assess, maintain, and improve statistical control of manufacturing processes	L1, L2, L3, L4,L5
CO3	Identify the need for control chart for attributes and apply the same to assess, maintain, and improve statistical control of manufacturing processes. Perform preliminary analysis of failure data.	L1, L2, L3, L4,L5
CO4	Apply the Quality assurance techniques like SSP, DSP, MSP etc., and construct OC curve for the acceptance plans and compute various parameters like ATI, AFI, ASN of Acceptance sampling plans.	L1, L2, L3, L4,L5
CO5	To estimate the Reliability of systems and improve it using different methods, to analyze the availability and maintainability of systems.	L1, L2, L3, L4

Program Outcome of this course

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

Mapping of COS and Pos (Indicative Only)

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

(Note : High - 3, Medium – 2, and Low – 1)

Industrial Design and Ergonomics

Course Code	22MPT/MPD/MAU/MPY/MPE22	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 10-12 Lab slots	Total Marks	100
Credits	04	Exam Hours	03

Course objectives:

- To increase awareness of the need for and role of ergonomics in occupational health.
- To obtain knowledge in the application of ergonomic principles to design of industrial workplaces and the prevention of occupational injuries
- To understand the breadth and scope of occupational ergonomics.

MODULE-1

Method study I / work simplication: Definition and objectives procedures, Selection of jobs.

Recording Tools and Techniques: Operation process chart, flow process charts (Man type-Material type), Flow diagram, critical examination, Develop the improved method.

Method study II/ Work simplication II: Tools for recording the movement of workers: String diagram, travel chart, multiactivity chart, and Man & Machine process chart, Gang process chart, Two handed process chart (operator process chart), principles of motion economy. **8Hrs**

Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments

MODULE-2

Work measurement / Time study: Objectives, purpose/use techniques, Time study equipments**,** selection of job and operator for time study. Basic steps recording the information, examination of data, measurement of operation, rating and levelling, allowances, standard time.

Work Sampling: Procedure, sample size determination, estimation of standard time, advantages and disadvantages.

Synthetic data: Development of standard data, machine time calculation, practical systems of PMTS (work factor system,

Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments

MODULE-3

Introduction: An approach to industrial design - elements of design structure for industrial design in engineering application in modem manufacturing systems. Ergonomics and Industrial Design: Introduction - general approach to the man-machine relationship-workstation design-working position.

Control and Displays: shapes and sizes of various controls and displays-multiple displays and control situations - design of major controls in automobiles, machine tools etc., - design of furniture – design of instruments. **8Hrs**

Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments

MODULE-4

Visual Effects of Line and Form: The mechanics of seeing psychology of seeing, general influences of lined and form. Colour: colour and light - colour and objects - colour and the eye colour consistency - colour terms - reactions to colour and colour continuation - colour on engineering equipments. **8Hrs**

Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments

MODULE 5	
Aesthetic Concepts: Concept of unity - concept of order with variety - concept of purpose style and environment - Aesthetic expressions. Style-components of style - house style, observations style in capital goods. **Industrial Design in Practice:** General design - specifying design equipments - rating the importance of industrial design – industrial design in the design process. **8Hrs**	
Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments

PRACTICAL COMPONENT OF IPCC

Sl. No	Experiments
1	Preparing the Outline process chart and Multiple Activity Chart
2	Construct the Flow process chart for various applications
3	Experiments on the principle of motion economy by Two handed process chart.
4	Draw the Flow diagram and String diagram for various applications.
5	Rating practice using: pin board assembly, dealing a deck of cards and marble collection activity
6	Determining the standard time for simple operations using stopwatch time study
7	Measurement of parameters (heart beat rate, calorie consumption) using walking simulator
8	Measurement of parameters (heart beat rate, calorie consumption, revolutions per minute) using ergonometer.
Experiments/ Activities/Demonstrations/Visits/Analytics etc., that enhances the skill of the learners (Activities are only for CIE)	
1	Exercises on conducting method study for assembling simple components and office work.
2	Development of Layout plans using SLP technique. Experiments on Line balancing.
3	Determination of standard time using PDA device and time study 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. 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

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 experimentsshall 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 have to 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 has to secure an aggregate of 50% of maximum marks of the course(CIE+SEE)

Suggested Learning Resources:

Books

- Introduction to Work Study, ILO, 4th edition, 1992
- Human Factor in Engineering and Design by Mark. S. Sanders and Ernest. J, McCornick McGraw-Hill Book Co., Inc., New York, 1993
- Work Study and Ergonomics by S. Dalela and Sourabh, Standard publishers, 2013
- Human Factors Design Handbook by Wesley Woodson,Peggy Tillman and Barry Tillman, McGraw-Hill, 2nd edition, 1992
- Motion and Time Study by Ralph M. Barnes, Wiley International, 7th Edition
- Work study and ergonomics by Lakhwinder pal singh, Cambridge university press, 2016

Web links and Video Lectures (e-Resources):

- www.nptel.ac.in
- https://youtu.be/gJDYV2SmFeY
- https://youtu.be/KktqRSxfTxo
- https://youtu.be/b05FPBjFH6A?list=PL6mZDY1bMAzhknOcAfFy_FI9vb5rzJzUv
- https://youtu.be/DlCDzSzsCDk
- https://youtu.be/nDUN_Kndxbc

- https://youtu.be/Fh6S5anFnbg
- https://youtu.be/pHc89bejapU
- https://youtu.be/wYvqHJ7FNAM
- https://youtu.be/1sb548iiuPY
- https://youtu.be/kQ-A9zvi7kA
- https://youtu.be/dVFtAEDlnRA
- https://youtu.be/ZrgYdAQ68T4

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Design of a reading table.
- Watering the garden.
- College layout for constructing flow diagram, string diagram.
- At the end of the lecture/presentation, exercises are to be taken up to solve problems related to the topics covered. Additional assignments are to be given under each of the topics covered.

Course outcome

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

Sl. No.	Description	Blooms Level
CO1	Define the various charts and to construct the charts on the basis of present method and develop a new / proposed method and identify the unnecessary movements. Explain the basic work measurement techniques and to gain knowledge of measurement of work, rating and imbibe the concept of allowance in estimating Standard Time.	L1, L2, L3, L4
CO2	Determine the basic concepts of Ergonomics and demonstrate a sound knowledge of Ergonomics in engineering applications.	L1, L2, L3, L4
CO3	Demonstrate a sound knowledge of Man-Machine Interfaces and design of displays and controls in engineering systems	L1, L2, L3

Program Outcome of this course

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

Mapping of COS and POs **(Indicative only)**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**2**	**2**	**2**	**3**	**1**	**1**	**2**
CO2	**2**	**3**	**2**	**2**	**1**	**1**	**2**
CO3	**2**	**3**	**2**	**2**	**3**	**2**	**2**

(Note : High - 3, Medium – 2, and Low – 1)

PROFESSIONAL ELECTIVE – I

Operations Management			
Course Code	22MPT/MSE/MTE/MEM/MPM231	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	25 Hrs Theory +10-12 activities	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- Learn about historical beginning associated with operations management.
- Develop the forecasting of demands.
- Impart models used in decision making, Recognize and apply basic appropriate analytics.
- Interpret material scheduling and controlling of production activities.
- Develop schedules on single machine, flow shop and job shop.

Module-1

OPERATIONS MANAGEMENT CONCEPTS: Introduction, Historical development, The trend: Information and Non-manufacturing systems, Operations management, Factors affecting productivity.

OPERATIONS DECISION MAKING: Introduction, Management as a science, Characteristics of decisions, and Framework for decision making, Decision methodology, Decision support systems, Economic models, and Statistical models. **5Hrs**

Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments

Module-2

FORECASTING DEMAND: Forecasting objectives and uses, Forecasting variables, Opinion and Judgmental methods, Time series methods, Exponential smoothing, Regression and correlation methods. **5Hrs**

Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments

Module-3

AGGREGATE PLANNING AND MASTER SCHEDULING: Introduction- planning and scheduling, Objectives of aggregate planning, Aggregate planning methods, Master scheduling objectives, Master scheduling methods. **5Hrs**

Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments

Module-4

Scheduling of operations: need for scheduling, loading of machines, scheduling context, scheduling flow shops, scheduling of job shops, input output control, operational control issues in mass production systems, operations planning and control based on the theory of constrains, related problems. **5Hrs**

Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments

Module-5

SINGLE MACHINE SCHEDULING: Concept, measures of performance, SPT rule, Weighted SPT rule,EDD rule, minimizing the number of tardy jobs.

FLOW -SHOP SCHEDULING: Introduction, Johnson's rule for 'n' jobs on 2 and 3 machines, CDS heuristic. JOB-SHOP SHEDULING: Types of schedules, Heuristic procedure, scheduling 2 jobs on 'm' machines.

Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments

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

Suggested Learning Resources:

Books

1. Operations Management Monks J.G McGraw Hill International Editions - 1987.
2. Production and Operations Management Pannerselvam. R PHI 2nd edition
3. Production and Operations Management Chary, S.N TataMcGraw Hill. 3rd edition

Web links and Video Lectures (e-Resources):

- https://www.investopedia.com/terms/o/operations-management.asp
- https://www.youtube.com/watch?v=Hy48AFKEepo
- https://www.shipbob.com/blog/demand-forecasting/
- https://www.youtube.com/watch?v=IDITxCjlyFE
- https://decisions.com/videos/scheduling-job-flow/

Skill Development Activities Suggested

At the end of the lecture/presentation, numerical exercises are to be taken up to solve problems related to the topics covered. Additional problems are to be given for practice and also as assignments under each of the topics covered.

Course outcome

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

Sl. No.	Description	Blooms Level
CO1	Describe the basic concept of OM, manufacturing trends in INDIA.	L1, L2, L3
CO2	Design of product layout, process layout and analyse process and capacity	L1, L2, L3, L4,L5
CO3	Applying appropriate inventory planning technique	L1, L2, L3,
CO4	Assess the demand and prioritise MPS	L, L2, L3, L4,L5
CO5	Design MRP, MRPII and schedule the jobs and machines.	L1, L2, L3, L4

Program Outcome of this course

Sl. No.	Description	POs
1	An ability to independently carry out research /investigation and development work to solve practical problems.	PO1
2	An ability to write and present a substantial technical report/document.	PO2
3	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	PO3
4	Understand contemporary issues in manufacturing engineering and develop relationship between product design and manufacturability to create safe, reliable, and cost-effective products.	PO4
5	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	PO5
6	Employ advanced prototyping methods to shorten design cycles and narrow alternatives without restricting innovation.	PO6
7	Understand and debate the roles and responsibilities of a product designer/manufacturer on society.	PO7

Mapping of COS and POs **(Indicative only)**

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

(Note : High - 3, Medium – 2, and Low – 1)

Advanced Fluid Power Systems

Course Code	22MPT/MPY232	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40 Hrs	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

1. To Study the fundamentals of Hydraulic Power Pumps, Actuators and Motors.
2. To develop a sound knowledge of control components in Hydraulic Systems.
3. To have basic skills to design Hydraulic Circuits and analyze them.
4. To acquire the fundamental knowledge on pneumatic control.
5. To develop skill sets to handle Pneumatic Actuators , Valves, Pneumatic circuits and logic circuits

Module-1

Introduction: Pascal Law, Advantages of Fluid Power, Applications of Fluid Power, Components of a Fluid Power.

Hydraulic Power Unit: Introduction, Pumping Theory, Pump Classification, Gear Pumps, (Vane Pumps- simple, balanced & pressure compensated vane pump, Vane design) Piston Pumps- Radial, Axial (Bent axis & Swash plate), Pump Performance, Pump Noise, Ripple in pumps.

Hydraulic Actuators: Linear actuator- cylinders, Mechanics of Hydraulic cylinder loading, limited rotation hydraulic actuator, cylinder cushioning, Gear, Vane & Piston motor, Motor performance, Hydrostatic transmission. **8Hrs**

Teaching-Learning Process	Chalk and talk method, Power Point presentation and YouTube videos, Creating real time stations in classroom discussions, Giving activities &assignments.

Module-2

Power Controlling Elements – Valves : i) Directional Control Valves – Classification, 2/2, 3/2,4/2 & 4/3 ways Dcv's, Different Centre configurations in 4/3 way valves, actuation of DCV's, Indirect actuation, Valve Lap – Lap during Stationary and during switching. **ii) Pressure Control Valves:** Classification, opening & Closing Pressure difference, Cracking Pressure, Pressure Relief Valve – Simple & Compound type, Pressure reducing valve, sequence, unloading &Counter balance valve, Pressure switches. **iii) Flow Control valves** – Fixed throttle, Variable throttle, Pressure Compensation principles, pressure compensated Flow control valve – Reducing & Relief type. **8Hrs**

Teaching-Learning Process	Chalk and talk method, Power Point presentation and YouTube videos, Creating real time stations in classroom discussions, Giving activities &assignments

Module-3

Hydraulic Circuit Design & Analysis: Control of Single & double acting cylinder, Regeneration circuit, cylinder sequencing & Synchronizing circuit. Speed control of cylinder & Motors, Analysis of Hydraulic system with frictional losses, Accumulators &accumulator circuits.

Pneumatic System: Introduction, – Generation of compressed air, air receiver, servicing FRL unit, Air filter, pressure regulation, lubricator, Pneumatic cylinder & air motor – different types of cylinder, cushion assembly. Cylinder performance.

Pneumatic Valve: Directional control valves, impulse valve, Quick exhaust valve, shuttle valve, Twin pressure valve, Time delay valve. **8Hrs**

Teaching-Learning Process	Chalk and talk method, Power Point presentation and YouTube videos, Creating real time stations in classroom discussions, Giving activities &assignments.

Module-4

Pneumatic Circuit & Logic Circuits:- Control of single and double acting cylinder, impulse operation, speed control, sequencing, Pneumatic Vacuum system AND,OR, NOT, NAND, NOR, YES Function, Logic circuits design using shuttle valve & twin pressure valve, Binary Arithmetic, logic & Boolean Algebra, use of kannaughveitch map for pneumatic circuit design. **8Hrs** .	
Teaching-Learning Process	Chalk and talk method, Power Point presentation and YouTube videos, Creating real time stations in classroom discussions, Giving activities &assignments.
Module-5	
Electrical Control in Fluid Power: Contactors, & Switches, Relays, Limit switch, Electro hydraulic & Electro Pneumatic Circuits, Simple Cylinder reciprocation, interlocking using relays, Proximity switches, application of proximity switches, Time dependent will dependent and travel dependent circuits. **8Hrs**	
Teaching-Learning Process	Chalk and talk method, Power Point presentation and YouTube videos, Creating real time stations in classroom discussions, Giving activities &assignments.

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.

Suggested Learning Resources:

Books

1. Fluid Power with applications, Anthony Esposito Pearson edition 2000
2. Oil Hydraulics Majumdar, S.R., TalaMcGRawHllL, 2002
3. Pneumatic systems- "Principles and Maintenance" ,Majumdar S.R ata McGraw-Hill, New Delhi 2005
4. Hydraulics and pneumatics Andrew Par Jaico Publishing House 2005
5. Industrial Hydraulics John Pippenger, Tyler Hicks McGraw Hill International Edition, 1980.
6. Hydraulic Control Systems Herbert E. Merritt, John Wiley and Sons

Web links and Video Lectures (e-Resources):

- https://www.engineering.com/hydraulic-pumps/amp
- https://hydraulicsonline.com/technical-knowledge-hub-news/an-introduction-to-hydraulic-pumps/
- https://www.powermotiontech.com/hydraulics/hydraulic-pumps-motors/article/21884136/engineering-essentials-fundamentals-of-hydraulic-pumps
- https://www.globalspec.com/reference/45968/203279/chapter-6-control-components-in-a-hydraulic-system
- https://whyps.com/hydraulic-system-components-and-their-functions
- https://engineeringlearn.com/pneumatic-control-system/
- https://www.youtube.com/watch?v=YlmRa-9zDF8
  https://www.youtube.com/watch?v=HzaWOFWV
  https://www.youtube.com/watch?v=HzaWOFWVz6E
- https://www.youtube.com/watch?v=HzaWOFWVz6E
- https://www.processindustryforum.com/article/what-is-a-pneumatic-actuator
- https://www.powermotiontech.com/fluid-power-basics/pneumatics/article/21155572/automationdirect-4-basic-pneumatic-circuits
  https://www.electronics-tutorials.ws/combination/comb_1.html

Skill Development Activities Suggested

1. Contents related activities (Activity-based discussions)
2. For active participation of students, instruct the students to prepare Exercise problems
3. Organizing Group wise discussions and machineries issues based activities
4. Quizzes and Discussions
5. Seminars and assignments

Course outcome

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

Sl. No.	Description	Blooms Level
CO1	Recall the basic concept of fluid mechanics	L1, L2, L3
CO2	identify different components of hydraulic system	L1, L2, L3, L4
CO3	Analyze the requirement of control components and their selection	L1, L2, L3, L4, L5

Program Outcome of this course

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

Mapping of COS and POs **(Indicative only)**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**1**	**1**	**2**	**2**	**2**	**2**	**2**
CO2	**2**	**2**	**2**	**2**	**2**	**-**	**1**
CO3	**1**	**1**	**2**	**2**	**2**	**2**	**2**

(Note : High - 3, Medium – 2, and Low – 1)

Design for Manufacture and Assembly			
Course Code	22MPT233	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	25 Hrs Theory +10-12 activities	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- Understand the principles of manufacturability and design for manufacture.
- Design casting and weldment for economic production quantity.
- Understand the concept of assembly, its design and true position of datum system.
- Design parts cut to length and screw machine parts of various processes, open and closed die forging.
- Design guidelines and background for powder metallurgy part and reviewing of formed parts.

Module-1

NTRODUCTION: General design principles for manufacturability, Process Capability, Feature tolerance, Geometrical tolerance, Surface finish, Review of relationship between attainable Tolerance grades, and different machining processes, Economics of process selection, Principles of Design for Manufacture, Quality Manufacturability, Introduction to Tolerance Charting Technique. **5Hrs**

Teaching-Learning Process	Chalk and Talk / White board, Power Point Presentation, Video Demonstration or Simulation.

Module-2

DESIGN OF CASTINGS: Redesign of castings based on parting line considerations, Minimising core requirements, other design consideration, economic production quantities**.**

DESIGN OF WELDMENTS: Advantages of weldments, Design for economical and efficient welding, Redesigning cast members using weldments, use of welding symbols, Economic production quantities, Design recommendations, cost reduction. **5Hrs**

Teaching-Learning Process	Chalk and Talk / White board, Power Point Presentation, Video Demonstration or Simulation.

Module-3

DESIGN FOR ASSEMBLY: Applications of selective assembly, Design recommendations for different fastening arrangements, Automatic assembly, control of axial play in assemblies, Design for easy assembly, Design for easy disassembly.

TRUE POSITION THEORY AND DATUM SYSTEMS: Theoretically exact dimension, virtual size concept, assembly considerations as applied to True Position Tolerancing, examples, Grouped datum systems, different types examples. **5Hrs**

Teaching-Learning Process	Chalk and Talk / White board, Power Point Presentation, Video Demonstration or Simulation.

Module-4

DESIGN FOR MACHINING: Parts cut to length, screw machined products, Machined round holes, Moulded parts, Parts produced buy planning. shaping & slotting, Broached parts, Ground parts, roller burnished parts, Gears, Economical deburring, re dimensioning of parts based on manufacturing datum.

DESIGN FOR FORGING: Introduction, open die forging. Closed die forging. **5Hrs**

Teaching-Learning	Chalk and Talk / White board, Power Point Presentation, Video Demonstration or Simulation.

Process	

Module-5

DESIGN FOR POWDER METALLURGY: Introduction, Design guidelines, Background, Design for Powder Metallurgy parts.

A review of design considerations in formed metal components, non metallic parts, Designing for heat treatment, Design for quality and mass production. **5Hrs**

Teaching-Learning Process	Chalk and Talk / White board, Power Point Presentation, Video Demonstration or Simulation.

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) from each

Suggested Learning Resources:

Books

1. "Product Design for Manufacture and Assembly" Geoffrey Boothroyd, Peter Dewhurst and Winston A. Knight, Standardsmedia. ISBN-13: 978-1420089271,
2. "Product Design and Development".Karl T. Ulrich and Steven D. EppingerMcGraw-Hill EducationISBN-13: 978-0073404776
3. "Product Design and Manufacturing", Chitale A. K and Gupta R. C, Prentice Hall India Learning Private Limited,ISBN-13: 978- 8120342828, 5th Edition. 2011

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=igWfQpxI100
- https://www.youtube.com/watch?v=6BTofPdLbNo
- https://www.youtube.com/watch?v=SXPsS2vjoRI
- https://dfmpro.com/manufacturing-processes/dfmpro-for-machining/
- https://www.youtube.com/watch?v=n-2oOq3Ao9U

Skill Development Activities Suggested

- Quizzes
- Assignments
- Seminars

Course outcome

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

Sl. No.	Description	Blooms Level
CO1	Explain the principles of manufacturability and design for manufacture	L1, L2, L3, L4
CO2	Design casting and weldment for economic production quantity.	L1, L2, L3, L4,L5
CO3	Understand the concept of assembly, its design and true position of datum system.	L1, L2, L3, L4,L5
CO4	Design parts cut to length and screw machine parts of various processes, open and closed die forging.	L1, L2, L3, L4,L5
CO5	Design guidelines and background for powder metallurgy part and reviewing of formed parts	L1, L2, L3, L4

Program Outcome of this course

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

Mapping of COS and POs **(Indicative only)**

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

(Note : High - 3, Medium – 2, and Low – 1)

Human Resource Management			
Course Code	22MPT/MPY/MPM234	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40 Hrs	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- To enable the students to understand the HR Management and system at various levels in general and in certain specific industries or organizations.
- To help the students focus on and analyse the issues and strategies required to select and develop manpower resources.
- To develop relevant skills necessary for application in HR related issues.
- To Enable the students to integrate the understanding of various HR concepts along with the domain concept in order to take correct business decisions

Module-1

INTRODUCTION: Evolution of HRM, Objectives, Functions and Policies.
HUMAN RESOURCE PLANNING: Uses and benefits, Man Power Inventory, Man Power Forecasting, Methods of Man Power Forecasting, job Description, Job Specification. **8Hrs**

Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments

Module-2

RECRUITMENT: Sources of Man power, Advertisement, Short Listing of Candidates calling Candidates for selection Process.

SELECTION: Selection procedure – Written Test, Group Discussion. Interview – Different methods, advantages and limitations, Psychological testing – Advantages and limitations, Induction procedure, transfers, promotion, exit interview. (Tutorial on written test, Group Discussion, Interviews) **8Hrs**

Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments

Module-3

TRAINING AND DEVELOPMENT: Identification of Training needs, Training Evaluation, Training Budget, Executive Development – Different Approaches, Non-executive development – Different methods.

PERFORMANCE APPRAISAL: Components (all round performance appraisal), Methods. Advantages and limitations of different methods, Personal Counseling based on Annual Confidential Reports. **8Hrs**

Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments

Module-4

COUNSELLING AND HUMAN RESOURCE ACCOUNTING: Characteristics, Need, Function, Types, Suggestions for personnel development, communication function, communication process, effective communication. Human resource records, Advantages of HR accounting, Various methods of accounting. **8Hrs**

Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments

Module-5

INDUSTRIAL RELATIONS: Indian trade union act, standing orders act, Indian factories act

INDUSTRIAL DISPUTES AND SETTLEMENT: Indian Industrial Disputes act, Industrial disputes settlement machinery. Works committee, Board of Conciliation, Voluntary Arbitration, Compulsory arbitration, Court of inquiry, Industrial tribunal, Adjudication. **8Hrs**

Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments

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.

Suggested Learning Resources:

Books

1. Human Resources Management – Dr. K Ashwathappa – Tata McGraw Hill - Edition 1999.
2. Management of Human Resources – CB Mamoria – Himalaya Publication House – 2003.
3. Personnel / Human resource Management – Decenoz and robbins- PHI - 2002
4. Industrial Relations – Arun Monappa – TMH - ISBN – 0-07-451710-8.
5. Human Resources Management – VSP Rao

Web links and Video Lectures (e-Resources):

- https://www.lkouniv.ac.in/site/writereaddata/siteContent/20200407095112659 9shaile_Evolution_of_Human_Resource_Management.pdf
- https://www.investopedia.com/terms/h/human-resource-planning.asp
- https://www.hrhelpboard.com/recruitment.htm
- https://www.accountingnotes.net/human-resource-management/selection-process/selection-process-in-hrm/17676
- https://www.hrhelpboard.com/training-development.htm
- https://www.startuphrtoolkit.com/performance-appraisal-in-hrm/
- https://backup.pondiuni.edu.in/storage/dde/downloads/hrmiv_hra.pdf
- https://www.legalserviceindia.com/legal/article-956-industrial-and-national-tribunal.html

Skill Development Activities Suggested

At the end of the lecture/presentation, numerical exercises are to be taken up to solve problems related to the topics covered. Additional problems are to be given for practice and also as assignments under each of the topics covered.

Course outcome

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

Sl. No.	Description	Blooms Level
CO1	Understand the basic concepts of HRM, Functions and role of HRM	L1, L2, L3, L4
CO2	Know methodology of job selection process implemented in various sectors.	L1, L2, L3, L4,L5
CO3	Analyse the effectiveness in training, evaluating and benchmarking HR training	L1, L2, L3, L4,L5
CO4	Understand the career development concept and methods of personal appraisal	L1, L2, L3, L4,L5
CO5	Understand International activities of HRM, Staffing, communication, appraisal training and interview system.	L1, L2, L3, L4

Artificial Intelligence in Manufacturing			
Course Code	22MPT235	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	25 Hrs theory +10-12 activities	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- To understand the modern manufacturing concepts.
- To learn the concept of AI based methods for process controls.
- To analyse the automated material handling systems.

Module-1

Introduction to Modern Manufacturing and AI Based Applications:
Introduction to Modern Manufacturing Process, Industry 4.0, Introduction to AI and its applications in manufacturing, Design in Manufacturing and AI Requirements. **5Hrs**

Teaching-Learning Process	Chalk and Talk / White board, Power Point Presentation, Video Demonstration or Simulation.

Module-2

AI based Methods for Process Control & Monitoring:
Machine Learning methods, AI based Monitoring and control of discrete manufacturing process, Online process monitoring in additive manufacturing, Industrial Machine Vision, Development of Digital Twins. **5Hrs**

Teaching-Learning Process	Chalk and Talk / White board, Power Point Presentation, Video Demonstration or Simulation.

Module-3

AI based Design Space Exploration:
Multi objective heuristic search for DSE, Algorithms for Customizable Manufacturing, Allocation and Layout, Scheduling for flexible manufacturing systems. **5Hrs**

Teaching-Learning Process	Chalk and Talk / White board, Power Point Presentation, Video Demonstration or Simulation.

Module-4

AI & Robotics:
AI based Robot Architecture & Applications in Automated Manufacturing, Robot Vision & Motion, Multi agent and swarm robotics, Robot to Robot and Robot to human coordination (Cobots - collaborative robotics) Reliable & Trusted AI in Robotics. **5Hrs**

Teaching-Learning Process	Chalk and Talk / White board, Power Point Presentation, Video Demonstration or Simulation.

Module-5

Automated material Handling Storage: Material functions, types of material handling equipment, analysis of material handling systems, design of system, conveyor system, automated guided vehicle systems, automated storage/retrieval systems, caroused storage systems work in process storage, interfacing handling & storage with manufacturing. 5Hrs

Teaching-Learning Process	Chalk and Talk / White board, Power Point Presentation, Video Demonstration or Simulation.

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

Suggested Learning Resources:

Books

1. Artificial Intelligence: A Modern Approach, Stuart J. Russell and Peter Norvig, 3rd Edition, Prentice Hall, 2009.
2. Deep Learning - Ian Goodfellow, Yoshua Bengio, Aaron Courville, MIT Press, 2018
3. Additive manufacturing of Metals: The Technology, Materials , Design and Production; Ed. Li Yang, et al.; Springer International Publishing AG 2017
4. Laser Materials Processing, by W M Steen, J. Mazumder, 4th Ed. Springer
5. Handbook of Industrial Robotics by Shimon Y. Nof (Editor), ISBN 9788126540303.

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=lTsvhSYstAE
- https://www.forbes.com/sites/bernardmarr/2018/09/02/what-is-industry-4-0-heres-a-super-easy-explanation-for-anyone/?sh=162dc3409788
- https://professional.mit.edu/news/articles/4-ways-ai-will-change-design-and-manufacturing
- https://www.hpe.com/in/en/what-is/machine-learning.html?jumpid=ps_u8bvx1ziqh_aid-520061736&ef_id=Cj0KCQjwmuiTBhDoARIsAPiv6L9QsMm4otXbOHvIYNeBMp2VcsEEtY3bvg3k77Xbh_JHpT8f4l48jPMaAiuMEALw_wcB:G:s&s_kwcid=AL!13472!3!558204153004!e!!g!!types%20of%20machine%20learning!14386686693!128518518145&
- https://theconversation.com/five-ways- -intelligence-can-help-space-exploration-153664
- https://aibusiness.com/author.asp?section_id=789&doc_id=773741#:~:text=Robotics%20and%20artificial%20intelligence%20are%20two%20related%20but%20entirely%20different,'
- https://www.systema.com/automated-material-handling-systems#:~:text=Automated%20material%20handling%20systems%20ensure,even%20in%20two%20separate%20buildings.

Skill Development Activities Suggested

- Quizzes
- Assignments
- Seminars

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

Sl. No.	Description	Blooms Level
CO1	Learn how AI methods can be used in a manufacturing workflow for process optimization and control	L1, L2, L3, L4
CO2	Discover AI/machine learning methods that enable design automation and customization	L1, L2, L3, L4,L5
CO3	Explore AI/machine learning methods for performance-driven design that automatically translate functional specifications of objects to manufacturable designs	L1, L2, L3, L4,L5
CO4	Learn AI based Robot Architecture & Applications in Automated Manufacturing, Robot Vision & Motion, Multi agent and swarm robotics.	L1, L2, L3, L4,L5
CO5	Explore Material functions, types of material handling equipment, analysis of material handling systems, design of system, conveyor system.	L1, L2, L3, L4

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

Mapping of COS and POs **(Indicative only)**

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

Agile Manufacturing

Course Code	22MPT/MPM/MEM/MIA/MPY/MTE/MSE241	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	25 Hrs Theory +10-12 activities	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- Understand the agile manufacturing and conceptual framework.
- Analyse the four core concept of agile manufacturing.
- Study the implication of advanced manufacturing system.
- Understand and design the agile manufacturing enterprises.
- Design skill and knowledge enhancing technology foragile manufacturing

Module-1

Introduction - What is agile Manufacturing? - Competitive environment of the future the business case for agile manufacturing conceptual frame work for agile manufacturing. **5Hrs**

Teaching-Learning Process	1 .Chalk and Talk / White board. 2. Power Point Presentation. 3. Video Demonstration or Simulation.

Module-2

Four Core Concepts: Strategy driven approach - integrating organization, people technology interdisciplinary design methodology. . **5Hrs**

Teaching-Learning Process	1 .Chalk and Talk / White board. 2. Power Point Presentation. 3. Video Demonstration or Simulation.

Module-3

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. **5Hrs**

Teaching-Learning Process	1 .Chalk and Talk / White board. 2. Power Point Presentation. 3. Video Demonstration or Simulation.

Module-4

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. **5Hrs**

Teaching-Learning Process	1 .Chalk and Talk / White board. 2. Power Point Presentation.

	3. Video Demonstration or Simulation.

Module-5

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. **5Hrs**
.

Teaching-Learning Process	1 .Chalk and Talk / White board. 2. Power Point Presentation. 3. Video Demonstration or Simulation.

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) from

Suggested Learning Resources:

Books

1. Agile manufacturing - Forging new Frontiers - Paul T. Kidd - Addison Wesley Publication
2. Agile Manufacturing – Proceedings of International Conference - Dr. M.P Chowdiah (Editor) – TataMcGraw Hill Publications
3. On Agile manufacturing - Tata McGraw Hill Publications
4. Agile manufacturing - Forging Neat Furniture's - Paul T Kidd – Addition Wesley Publications

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=_n28vUPJzxM
- https://www.youtube.com/watch?v=HQEkn-mJnas
- https://www.youtube.com/watch?v=7M_uMhxZtC4
- https://www.youtube.com/watch?v=VDz-SS6-P4s
- https://www.youtube.com/watch?v=G_0bl6FHo_c

Skill Development Activities Suggested

- Quizzes
- Assignments
- Seminars

Course outcome

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

Sl. No.	Description	Blooms Level
CO1	Explain the agile manufacturing and conceptual framework.	L1, L2, L3, L4
CO2	Explain the four core concept of agile manufacturing.	L1, L2, L3, L4
CO3	Discuss the implication of advanced manufacturing system.	L1, L2, L3, L4
CO4	Plan and design the agile manufacturing enterprises.	L1, L2, L3, L4,L5
CO5	Invent skill and knowledge enhancing technology for agile manufacturing.	L1, L2, L3, L4 L5 L6

Program Outcome of this course

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

Mapping of COS and POs **(Indicative only)**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**1**	**2**	**2**	**2**	**3**	**3**	**2**
CO2	**1**	**2**	**3**	**3**	**3**	**3**	**2**
CO3	**2**	**2**	**2**	**2**	**3**	**3**	**2**
CO4	**1**	**2**	**2**	**3**	**3**	**3**	**2**
CO5	**1**	**2**	**2**	**3**	**3**	**3**	**2**

(Note : High - 3, Medium – 2, and Low – 1)

Advanced Manufacturing Practices			
Course Code	22MPT242	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40 Hrs	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- Students will introduced to the concept of JIT production & TQC
- Students will learn about the effective use of Kanaban as per Toyota production system.
- Students will understand the different plant configuration & their characteristics, Automation & Robotics..

Module-1

Need of CPC for a company, what CPC can do, CPC-getting the right tool. **JIT – Introduction** – The spread of JIT Movement, some definitions of JIT, core Japanese practices of JIT, Creating continuous Flow Manufacture, Enabling JIT to occur, Basic elements of JIT, Benefits of JIT. **8Hrs**	
Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments
Module-2	
Just in Time Production – Primary purpose, profit through cost reduction, Elimination of over production, Quality control, Quality Assurance, Respect for Humanity, Flexible work Force, JIT Production Adapting to changing production Quantities, process layout for shortened lead Times, Standardization of operation, Automation. **Sequence and scheduling used by suppliers:** Monthly and daily Information. Sequenced withdrawal system by sequenced schedule table, problems and counter measures in applying the Kanban system to sub contractors. **8Hrs**	
Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments
Module-3	
Just-in-Time Production with Total Quality Control just in time concept, cutting lot sizes, cutting set-up times, cutting purchase order costs, the JIT cause-Effect chain, Scrap/Quality Improvements, Motivational effects, Responsibility effects, small Group improvement Activities, withdrawal of Buffer Inventory, the total Quality Control Concept. **8Hrs**	
Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments
Module-4	
Total Quality Control-Introduction-Total Quality Control concepts, responsibility, learning from the west, TQC concepts categorized, Goals, Habit of improvement, perfection, Basics, process control, Easy to see Quality control as facilitator, small lot sizes, Housekeeping, Less than full capacity scheduling, Daily machine checking, Techniques and Aids, Exposure of problems, Fool proof Devices, Tools of Analysis, QC Circles, TQC in Japanese-owned US Electronics plant, TQC in Japanese-owned Automotive plants. **8Hrs**	
Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments
Module-5	
Plant Configurations: Introduction-ultimate lant configuration, job shop Fabrication, Frame Welding, Forming Frame parts from Tubing, Dedicated production lines, overlapped production, the daily schedule, Forward Linkage by means of Kanban, physical merger of processes, Adjacency, mixed Models, Automated production Lines, Pseudo Robots, Robots, CAD and Manufacturing, Conveyors and stacker Cranes, Automatic Quality Monitoring. **8Hrs**	
Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments

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.

Suggested Learning Resources:

Books

- Japanese Manufacturing Techniques - Richard Schonberger - Pearson Higher Education.
- Just In Time Manufacturing – Kargoanker (manual).
- An Integrated Approach To Just In Time - Yasuhiro Monden - Toyota Production system.
- Lean Thinking - James Womack - Simon & Schuster Adult - ISBN: 0743249275, 2003.
- The machine that changed the World - James P. Womack, Daniel T Jones, and Daniel Roos - The story of Lean production – by– Harper Perennial edition published -1991.

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program

Skill Development Activities Suggested

At the end of the lecture/presentation, numerical exercises are to be taken up to solve problems related to the topics covered. Additional problems are to be given for practice and also as assignments under each of the topics covered.

Course outcome

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

Sl. No.	Description	Blooms Level
CO1	Explaining the details of types of advanced manufacturing and machining processes, their evolution and need.	L1, L2, L3, L4
CO2	Identifying the correct advanced manufacturing processes by formulating and determining the correct AMPs for development of various complex shaped geometries.	L1, L2, L3, L4
CO3	Hands on experiments on the Advanced Machines such as EDM, WEDM etc.	L1, L2, L3, L4
CO4	Design and development of experimental apparatus of any one advanced or derived and hybrid manufacturing	L1, L2, L3, L4, L5
CO5	Understand the different plant configurations.	L1, L2, L3, L4, L5

Program Outcome of this course

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

Mapping of COS and POs **(Indicative only)**

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

(Note : High - 3, Medium – 2, and Low – 1)

Advanced Materials and Processing

Course Code	22MPT243	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	25 Hrs Theory +10-12 activities	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- Classify materials and physical characteristics.
- Understand iron carbon equilibrium diagram, TTT diagram, heat treatment process of various steels.
- Understand alloys of various nonferrous metals.
- Understand polymers, ceramics and their mechanical – thermal properties.
- Identify the composites and their structure and Understand applications of ceramics.

Module-1

Classification and characteristics: Metals, Ceramics, Polymers and composites. General properties and structure: Atoms, molecules bonds in solids, Crystalline - Defects in Metallic structure, Dislocations and plastic deformation - Strengthening mechanism - grain size, dislocation - Cold work, precipitation hardening, dispersion hardening - phase reactions, fatigue and Creep behavior. **5Hrs**

Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments

Module-2

Ferrous Alloys: Iron carbon equilibrium diagrams - Steels and cast irons - properties, structure, composition and applications transformation hardening in steels - TIT diagrams - Heat treatment processes - Effect of alloying elements - High alloy steels, Stainless steel types, tool Steels, Manganese steels, heat resistant steels, HSLA, Maraging steels. **5Hrs**

Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments

Module-3

Non Ferrous alloys: Alloys of copper, Aluminium, nickel, magnesium, titanium, lead, tin, Zinc - composition, heat treatment, structure, properties and application. **5Hrs**

Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments

Module-4

Polymers and polymerizations: Structure and properties of thermoplastics and thermo sets – Engineering Applications - property modifications - Mechanical and thermal behaviour – processing methods. Ceramics :Nature and structure of Ceramics - Refractory Abrasives glasses - glass ceramics - Advanced ceramics processing methods

5Hrs

Teaching-Learning	Chalk and talk, Videos, PowerPoint Presentation, Animations, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities

Process	and Giving assignments

Module-5

Composites : Definition - classification and characteristics of composite materials - Volume fraction - laminated composites particulate composites, fibrous composites - Types of reinforcements, their shape and size - production and properties of fiber reinforced plastics, Metal Matrix composites and ceramic matrix composites -Applications.
Processing of Polymers: composites, ceramics - thermal spraying - Ion beam machining diamond coating techniques tribological Applications **5Hrs**

Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments

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

Suggested Learning Resources:

Books

1. Engineering Metallurgy, Raymond and Higgens ELBS/EA
2. Introduction to Material Science and Engineering, James.F.ShacklefordMc Millan, NY7th edition
3. Powder Metallurgy-Metals Hand Book, ASM, USAVol.7, 1974
4. Composite Materials - Science and Engineering, Chawla K.K Springer - Verlag, Newyork2nd edition, 1998

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program

Skill Development Activities Suggested

At the end of the lecture/presentation, numerical exercises are to be taken up to solve problems related to the topics covered. Additional problems are to be given for practice and also as assignments under each of the topics covered.

Course outcome

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

Sl. No.	Description	Blooms Level
CO1	Classify materials and physical characteristics.	L1, L2, L3, L4
CO2	Explain iron carbon equilibrium diagram, TTT diagram, heat treatment process of various steels	L1, L2, L3, L4,L5
CO3	Explain alloys of various nonferrous metals.	L1, L2, L3, L4,L5
CO4	Explain polymers, ceramics and their mechanical – thermal properties.	L1, L2, L3, L4,L5
CO5	Acquire basic knowledge of total quality management.	L1, L2, L3, L4

Program Outcome of this course

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

Mapping of COS and POs **(Indicative only)**

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

(Note : High - 3, Medium – 2, and Low – 1)

Simulation and Modelling of Production Systems

Course Code	22MPT244	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40 Hrs	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- Define the basics of simulation modeling and replicating the practical situations in organizations
- Generate random numbers and random variates using different techniques.
- Develop simulation model using heuristic methods.
- Analysis of Simulation models using input analyzer, and output analyzer
- Explain Verification and Validation of simulation model.

Module-1

Principle of Computer Modelling and Simulation: Monte Carlo simulation. Nature of computer- modeling and simulation. Limitations of simulation, areas of applications. System and Environment: Components of a system -discrete and continuous systems, Models of a system –a variety of modeling approaches. Simulation Software: Selection of simulation software, simulation packages. **8Hrs**

Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Analytical methods, Problem solving, Numerical exercises, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments

Module-2

Discrete Event Simulation: Concepts in discrete event simulation, manual simulation using event scheduling, single channel queue, too server queue, simulation of inventory problem.

Statistical Models in Simulation: Discrete distributions, continuous distributions.

Discrete Event Simulation: Concepts in discrete event simulation, manual simulation using event scheduling, single channel queue, too server queue, simulation of inventory problem.

Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Analytical methods, Problem solving, Numerical exercises, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments

Module-3

Random Number Generation: Techniques for generating random numbers- Mid square method -the mod product method - Constant multiplier technique -Additive congruential method –Linear congruential method -Tests for random numbers - The Kolmogorov-Smimov test -the Chi-square test. **8Hrs**

Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Analytical methods, Problem solving, Numerical exercises, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments

Module-4

Random Variable Generation: Inversion transforms technique-exponential distribution, uniform distribution, weibul distribution, continuous distribution, generating approximate normal variates - Erlang distribution. **8Hrs**

Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Analytical methods, Problem solving, Numerical exercises, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments

Module-5

Empirical Discrete Distribution: Discrete uniform - Poisson distribution –geometric distribution -acceptance -rejection technique for Poisson distribution gamma distribution

Design and Evaluation of Simulation Experiments: variance reduction techniques -antithetic variables,

variables-verification and validation of simulation models. **8Hrs**

Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Analytical methods, Problem solving, Numerical exercises, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments

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) from

Suggested Learning Resources:

Books

TEXT BOOKS:

1. **Discrete Event System Simulation** - Jerry Banks & .John S Carson II - Prentice Hall Inc.-1984.
2. **Systems Simulation** - Gordan. G. - Prentice Hall India Ltd - 1991.

REFERENCE BOOKS:

1. **System Simulation with Digital Computer** - NusingDeo - Prentice Hall of India - 1979.
2. **Computer Simulation and Modeling** - Francis Neelamkovil - John Wilely& Sons - 1987.
3. **Simulation Modeling with Pascal -** RathM.Davis& Robert M O Keefe - Prentice Hall Inc. -1989.

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=gbOn3jRc_Wc
- https://www.youtube.com/watch?v=Wp3jyLkfBQs
- https://www.youtube.com/watch?v=WfEZMhpzsT8
- https://www.youtube.com/watch?v=DBmYYpxjqvM
- https://www.youtube.com/watch?v=O46ZlKEjjHE
- https://www.youtube.com/watch?v=OH8MRT8eqRI
- https://www.youtube.com/watch?v=yN6cvjtlQtY
- https://www.youtube.com/watch?v=pt4v5l8-Pjw
- https://www.youtube.com/playlist?list=PL3l_ZG2nBXNLoPB26LeNRVDP6oG6Sz8tu
- https://www.youtube.com/watch?v=Oomz_iZ5d-0

Skill Development Activities Suggested

- At the end of the lecture/presentation, numerical exercises are to be taken up to solve problems related to the topics covered. Additional problems are to be given for practice and also as assignments under each of the topics covered.

Course outcome

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

Sl. No.	Description	Blooms Level
CO1	Describe the role of important elements of discrete event simulation and modeling paradigm.	L1, L2, L3, L4
CO2	Develop skills to apply simulation software to construct and execute goal-driven system models.	L1, L2, L3, L4, L5
CO3	Interpret the model and apply the results to resolve critical issues in a real world environment.	L1, L2, L3, L4, L5

Program Outcome of this course

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

Mapping of COS and POs **(Indicative only)**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**1**	**2**	**2**	**2**	**3**	**3**	**2**
CO2	**1**	**2**	**3**	**3**	**3**	**3**	**2**
CO3	**2**	**2**	**2**	**2**	**3**	**3**	**2**

(Note : High - 3, Medium – 2, and Low – 1)

Management Information Systems			
Course Code	22MPT245	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40 Hrs	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- To elevate students' awareness of information Technology and develop an in-depth and systematic understanding of key aspects of IT management.
- To help students gain a strategic perspective on business.
- To evaluate the value of emerging technologies and their competitive advantage.

Module-1

Fundamentals of Information Systems: Information systems in business, fundamentals of information systems solving business problems with information systems. **8Hrs**

Teaching-Learning Process	Chalk and Talk / White board, Power Point Presentation, Video Demonstration or Simulation.

Module-2

Information Systems for Business Operations: Business information systems, Transaction processing systems, management, information systems and decision support systems. Artificial intelligence technologies in business,

Teaching-Learning Process	Chalk and Talk / White board, Power Point Presentation, Video Demonstration or Simulation.

Module-3

Issues in Managing Information Technology: Managing information resources and technologies global information technology, management, planning and implementing change, integrating business change with IT, security and ethical challenges in managing IT, social challenges of information technology. **8Hrs**

Teaching-Learning Process	Chalk and Talk / White board, Power Point Presentation, Video Demonstration or Simulation.

Module-4

E-Business Model: E-commerce frame work, Architectural frame work for e-commerce, Application services and transaction, Models – B2C Transactions, B2B Transactions, Intra-Organizational Transactions.

WWW Architecture: Client server structure of the web, e-Commerce architecture, Technology behind the web. **8Hrs**

Teaching-Learning Process	Chalk and Talk / White board, Power Point Presentation, Video Demonstration or Simulation.

Module-5
Consumer Oriented E-Commerce: Consumer oriented Application: Finance and Home Banking, Home shopping, Home Entertainment, Mercantile Process Models, Consumers perspective, Merchants perspective. **Electronic Data Interchange (EDI):** EDI Concepts, Applications in business – components of international trade, Customs Financial EDI, Electronic fund transfer, Manufacturing using EDI, Digital Signatures and EDI. **8Hrs**

Teaching-Learning Process	Chalk and Talk / White board, Power Point Presentation, Video Demonstration or Simulation.

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

Suggested Learning Resources:

Books

1. Management Information systems- managing information technology in the internet worked. Jams. A O'Brien. Tata McGraw Hill publishing company limited. 2002.
2. Management Information Systems. Laaudon & Laudo. PHI. ISBN 81-203-1282.
3. Management Information Systems. S. Sadogopan. PHI 1998Edn. ISBN 81-203- 1180-9.
4. Information systems for modern management G.R. Murdick PHI 2nd Edition..4. Human Resources Management – Ravi Dharma Rao

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=xisFrwLkR58
- https://www.youtube.com/watch?v=T7eyTJA1qQ4
- https://www.nibusinessinfo.co.uk/content/examples-artificial-intelligence-use-business
- https://planningtank.com/computer-applications/strategic-information-system
- https://www.itproportal.com/features/ten-challenges-facing-it-managers-right-now-and-how-to-overcome-them/
- https://www.geeksforgeeks.org/ethical-issues-in-information-technology-it/
- https://www.bigcommerce.com/articles/ecommerce-website-development/ecommerce-frameworks/
- https://learn.financestrategists.com/finance-terms/b2c/?gclid=Cj0KCQjwmuiTBhDoARIsAPiv6L-s-GLZtTYJaXqdEzWoiJv0k1wJVlN4VG0xJycy3nlsCf-aMUgDPRUaAgH0EALw_wcB

Skill Development Activities Suggested

- Quizzes
- Assignments
- Seminars

Course outcome

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

Sl. No.	Description	Blooms Level
CO1	Relate the basic concepts and technologies used in the field of management information systems	L1, L2, L3, L4
CO2	Compare the processes of developing and implementing information systems	L1, L2, L3, L4,L5
CO3	Outline the role of the ethical, social, and security issues of information systems.	L1, L2, L3, L4,L5

Program Outcome of this course

Sl. No.	Description	POs
1	An ability to independently carry out research /investigation and development work to solve practical problems.	PO1
2	An ability to write and present a substantial technical report/document.	PO2
3	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	PO3
4	Understand contemporary issues in manufacturing engineering and develop relationship between product design and manufacturability to create safe, reliable, and cost-effective products.	PO4
5	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	PO5
6	Employ advanced prototyping methods to shorten design cycles and narrow alternatives without restricting innovation.	PO6
	Understand and debate the roles and responsibilities of a product designer/manufacturer on society.	

Mapping of COS and POs **(Indicative only)**

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

(Note : High - 3, Medium – 2, and Low – 1)

MINI PROJECT WITH SEMINAR			
Course Code	**22MPT25**	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.

QT and QC Laboratory			
Course Code	22MPTL26	**CIE Marks**	50
Teaching Hours/Week (L:P:SDA)	1:2:0	**SEE Marks**	50
Credits	02	**Exam Hours**	03

Course objectives:

- The course aims at building capabilities in the students for analyzing different situations in the industrial/ business scenario involving limited resources and finding the optimal solution within constraints.

Sl. No	Experiments
1	Regression analysis using any of the statistical packages.
2	Correlation analysis using any of the statistical packages.
3	Use of software package to solve LPP problems.
4	Use of software package to solve assignment and transportation problems.
5	Use of software package to solve PERT problems.
6	Use of software package to solve CPM problems.
7	Plotting Quality Control chart for attributes using Software Packages. Plotting appropriate charts and diagrams relevant to various industrial Applications
8	Plotting Quality Control chart for variables using Software Packages. Plotting appropriate charts and diagrams relevant to various industrial Applications
Experiments beyond the syllabus (For CIE only)	
1	Development of simple MIS application programs for use in Library.
2	Development of simple MIS application programs for use in Bank.
3	Development of simple MIS application programs for use in Business shop.
4	Development of simple MIS application programs for use in Hospital.

Course outcomes

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

1. Analyse any real life system with limited constraints and depict it in a model form.
2. Convert the problem into a mathematical model.
3. Solve mathematical model manually as well as using software such as TORA, etc.
4. Understand variety of problems such as assignment, transportation, travelling salesman, etc.
5. Solve the problems using linear programming approach using software.
6. Solve the problems on PERT and CPM using software.
7. Solve Quality Control chart for attributes and variables using Software Packages

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 8^{th} week of the semester and the second test shall be conducted after the 14^{th} 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).

Suggested ONLINE courses			
Course Code	22AUD27	Credits	PP

III SEMESTER

Tool Engineering and Design

Course Code	22MPT31	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:2	SEE Marks	50
Total Hours of Pedagogy	40 Hrs Theory +10-12 activities	Total Marks	100
Credits	04	Exam Hours	03

Course Learning objectives:

- To develop capability to design and select single point and multipoint cutting tools for various machining operations.
- Exposure to variety of locating and clamping methods available
- To enable the students to design jigs and fixtures for simple components
- To expose the students to the design/selection procedure of press tools and die casting dies.

Module-1

Introduction: Concept, meaning and definitions of tool, tool design and tool engineering. Tools-types, classification, features & applications.

Design of Single Point Tool: Tool Signature, Selection of Tool Angles, Design of shank section for single point tool to account for strength and rigidity. Design of Multi Point Tools – Drill, Reamers. **8Hrs**

Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Analytical methods, Problem solving, Numerical exercises, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments

Module-2

DESIGN of peripheral Milling cutters, Design of Broach.

Location and Clamping: General principles of location, 3-2-1 Principle of Location, Principle of Radial location, General study of locating devices. General principles of clamping, Study of various Clamping devices. **8Hrs**

Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Analytical methods, Problem solving, Numerical exercises, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments.

Module-3

Design of Fixtures: Difference between a Jig and a Fixture, Design of Milling fixture, Study of other fixtures like Lathe fixture, Inspection fixture. Study of different types of Drill jigs. **Design of Gauges:** Types of gauges. Factors to be considered in the design of gauges, Design of Plug gauge, Design of Snap gauge. **8Hrs**

Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Analytical methods, Problem solving, Numerical exercises, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments

Module-4

Design of Press Tools: A General study of Press operations. Elements of a Die, Strip layout, calculation of centre of pressure. Design of Blanking Die, Design of Piercing Die, Design of Progressive Die. **8Hrs**

Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Analytical methods, Problem solving, Numerical exercises, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments

Module-5

Design of Forming Dies: Study of Drawing and Bending process, Design of Drawing Die, Design of Bending Die.

Tool Layout and Cam Design of Single Spindle Automats: Classification of Automats and their applications. Tool layout and Cam design for automatic screw cutting machine. **8Hrs**

Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Analytical methods, Problem solving, Numerical exercises, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments

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) from

Suggested Learning Resources:

Books

1. Text book of Production Engineering by P. C. Sharma, Chorotar Publishing house.
2. Tool Design by Donaldson and Golding, Tata McGraw Hill, New Delhi.
3. Fundamentals of Tool Design, ASTME.
4. Jigs and Fixtures by P.H.Joshi, McGraw Hill Education, 3rd edition, 2010.
5. An introduction to Jig and Tool design by Kempester M.H.A., VIVA Books Pvt. Ltd, 2004.

Web links and Video Lectures (e-Resources):

- www.nptel.ac.in
- https://youtu.be/bUrp8JMRwx4
- https://youtu.be/hheFVuUBpxo
- https://youtu.be/K39bnxmIz7Q
- https://youtu.be/Hs_Pz80DD5Y
- https://youtu.be/HVbbSl5WreA
- https://youtu.be/SVo5ETboDTQ
- https://youtu.be/nfoUdm9WdE4
- https://youtu.be/6ZfAfjJTvvA
- https://youtu.be/nuCQTABjHLQ
- https://youtu.be/J_d8IRT9r7E
- https://youtu.be/LKEG3p3yx1g
- https://youtu.be/coLiMQ-hPvA

Skill Development Activities Suggested

- Strip layout for few structures in A4 sheet.
- Pressing operation by clay.
- At the end of the lecture/presentation, numerical exercises are to be taken up to solve problems related to the topics covered. Additional problems are to be given for practice and also as assignments under each of the topics covered.

Course outcome

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

Sl. No.	Description	Blooms Level
CO1	Understand the tool design concept and design the single point cutting tool and Design the milling cutters, broach and clamping devices.	L1, L2, L3, L4
CO2	Understand the application of jigs and fixtures, gauges and design them.	L1, L2, L3, L4
CO3	Understand the concept of press tools and its dies. Design of forming dies and understand the classification and application of automats	L1, L2, L3, L4

Program Outcome of this course

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

Mapping of COS and POs **(Indicative only)**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**1**	**2**	**2**	**2**	**3**	**3**	**2**
CO2	**1**	**2**	**3**	**3**	**3**	**3**	**2**
CO3	**2**	**2**	**2**	**2**	**3**	**3**	**2**

(Note : High - 3, Medium – 2, and Low – 1)

PROFESSIONAL ELECTIVE – III

Surface Treatment and Finishing			
Course Code	22MPT/MSE321	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40 Hrs	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- Explain the fundamentals of Electroplating and Heat treatment methods.
- Understand the advanced coating techniques
- Understand the properties of sprayed metals

Module-1	
Fundamentals of Electro plating, Galvanizing, Hot dip metal coating, thin coating, thin coating, chromium plating, Nickel plating. Vacuum coating, FVD & CVD metal spraying - Methods, surface preparation, mechanical. **8Hrs**	
Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments

Module-2	
Properties of sprayed metals, plasma coating. Plastic coating of metal - PVC coating Spherodising process details, phosphate coating - mechanism of formation. **8Hrs**	
Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments

Module-3	
Testing of surface coating- Methods. Heat treatment methods, Annealing, Normalizing, Tempering, Case hardening methods, flame hardening sub zero treatment. **8Hrs**	
Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments

Module-4	
Heat treatment methods; for gears, spindles, cutting tools. **8Hrs**	
Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments

Module-5

Advanced coating technologies: Hard facing, electro deposition technique, Nano-coatings, coating characterization **8Hrs**	
Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments

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:

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

Suggested Learning Resources:

Books

1. Surface preparations & finishes for Metals - James A Murphy - McGraw Hill.
2. Principles of metal surface treatment and protection – Pergamon Press Gabe, David Russell - Description, Oxford ; New York

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program

Skill Development Activities Suggested

At the end of the lecture/presentation, numerical exercises are to be taken up to solve problems related to the topics covered. Additional problems are to be given for practice and also as assignments under each of the topics covered.

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

Sl. No.	Description	Blooms Level
CO1	Understand the basic concept of coating, plating and metal spray methods in electroplates.	L1, L2, L3, L4
CO2	Understand the mechanism of coating formation and their properties.	L1, L2, L3, L4
CO3	Test coated and spray metal surfaces using suitable heat treatment methods.	L1, L2, L3, L4
CO4	Heat treat gears, spindle and cutting tools. .	L1, L2, L3, L4, L5
CO5	Understand electro deposition and Nano coating technique	L1, L2, L3, L4, L5

Program Outcome of this course

Sl. No.	Description	POs
1	An ability to independently carry out research /investigation and development work to solve practical problems.	PO1
2	An ability to write and present a substantial technical report/document.	PO2
3	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	PO3
4	Understand contemporary issues in manufacturing engineering and develop relationship between product design and manufacturability to create safe, reliable, and cost-effective products.	PO4
5	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	PO5
6	Employ advanced prototyping methods to shorten design cycles and narrow alternatives without restricting innovation.	PO6
7	Understand and debate the roles and responsibilities of a product designer/manufacturer on society.	PO7

Mapping of COS and POs **(Indicative only)**

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

(Note : High - 3, Medium – 2, and Low – 1)

Applied Micro Economics			
Course Code	22MPT322	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40 Hrs	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- To understand the fundamentals Micro-economic theory
- To learn the concepts and tools and techniques of Micro-economic theory
- To analyze the micro-economic situation to arrive at an appropriate decision

Module-1

Introduction: Circular Flow of Economic Activity, Nature of the firm Concept of Economic Profit. Demand Theory and Analysis: Individual and Market Demand, price Elasticity, income elasticity and cross Elasticity. **8Hrs**

Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Analytical methods, Problem solving, Numerical exercises, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments

Module-2

Production Theory and Analysis: Production Function, Production with one variable Input and two inputs, Economies of Scale and Scope, Estimation of Production Function. **8Hrs**

Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Analytical methods, Problem solving, Numerical exercises, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments

Module-3

Cost Theory and Analysis: The Economic Cost Concept, Opportunity Costs, Explicit & Implicit, Marginal, Incremental and Sunk Cost Function, Short and Long run cost Functions, Profit Contribution Analysis Numerical Problems. **8Hrs**

Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Analytical methods, Problem solving, Numerical exercises, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments

Module-4

Market Structure: Perfect Competition and Monopoly, Monopolistic Competition, Oligopoly: Numerical Problems. Barriers to Entry. **8Hrs**

Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Analytical methods, Problem solving, Numerical exercises, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments

Module-5

Pricing Decisions: Price Discrimination, Product Bundling. **8Hrs**

Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Analytical methods, Problem solving, Numerical exercises, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments

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.

Suggested Learning Resources:

Text Books

1. H C Peterson and W C Lewis, Managerial Economics, PHI, New Delhi.
2. Samuelson W F, and S G Marks, Managerial Economics, Dryden Press, FortWorth

Reference Books

1. Managerial Economics, William F Samuelson and Stephen G Marks, John Wiley &Sons.
2. Managerial Economics and Strategy, Jeffrey M Perloff , Pearson
3. Managerial Economics, H L Ahuja, S Chand Publications

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=Uo35Clb6G7k
- https://www.youtube.com/watch?v=kIFBaaPJUO0
- https://www.youtube.com/watch?v=720uyg0Dd_M
- https://www.youtube.com/watch?v=zPQyInnqvrI
- https://www.youtube.com/watch?v=HHcblIxiAAk
- https://www.youtube.com/watch?v=FBWJYH8DZ1g
- https://www.youtube.com/watch?v=z7g6rFjvvkU
- https://www.youtube.com/watch?v=bC0m3RFCGTY
- https://www.youtube.com/watch?v=frHyR9FiKt4
- https://www.youtube.com/watch?v=eylEJ8OKFKE
- https://www.youtube.com/watch?v=9Hxy-TuX9fs

Skill Development Activities Suggested

- At the end of the lecture/presentation, numerical exercises are to be taken up to solve problems related to the topics covered. Additional problems are to be given for practice and also as assignments under each of the topics covered

Course outcome

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

Sl. No.	Description	Blooms Level
CO1	Understand concept like flow of economic activity, profit and demand and price elasticity.	L1, L2, L3, L4
CO2	Estimate production functions with one and two input variables.	L1, L2, L3, L4,L5
CO3	Find optimistic cost considering all relevant factors.	L1, L2, L3, L4,L5
CO4	Compare monopoly and oligopoly competition in market and barriers to enter.	L1, L2, L3, L4,L5
CO5	Understand pricing on multiple product and employment of input.	L1, L2, L3, L4

Program Outcome of this course

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

Mapping of COS and POs **(Indicative only)**

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

(Note : High - 3, Medium – 2, and Low – 1)

Design of Experiments

Course Code	22MPT/MST/MPD/MDE/MEA/MMD/323	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	25 Hrs Theory +10-12 activities	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- Plan data collection, to turn data into information and to make decisions that lead appropriate action.
- Apply the methods taught to real life situations.
- Plan, analyze, and interpret the results of experiments.
- To understand the Orthogonal arrays.
- Analyze the Parameter and tolerance design concepts.

Module-1

Strategy of Experimentation, Typical applications of Experimental design, Basic Principles, Guidelines for Designing Experiments. **Concepts of random variable,** probability, density function cumulative distribution function. Sample and population, Measure of Central tendency; Mean median and mode, Measures of Variability, Concept of confidence level. Statistical Distributions: Normal, Log Normal & Weibull distributions. Hypothesis testing, Probability plots, choice of sample size. Illustration through Numerical examples. **5Hrs**

Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Analytical methods, Problem solving, Numerical exercises, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments

Module-2

Classical Experiments: Factorial Experiments: Terminology: factors, levels, interactions, treatment combination, randomization, Two-level experimental designs for two factors and three factors. Three-level experimental designs for two factors and three factors, Factor effects, Factor interactions, Fractional factorial design, Saturated Designs, Central composite designs. Illustration through Numerical examples. **5Hrs**

Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Analytical methods, Problem solving, Numerical exercises, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments

Module-3

Measures of variability, Ranking method, Column effect method & Plotting method, Analysis of variance (ANOVA) in Factorial Experiments: YATE's algorithm for ANOVA, Regression analysis, Mathematical models from experimental data. Illustration through Numerical examples.

Quality, Western and Taguchi's quality philosophy, elements of cost, Noise factors causes of variation. Quadratic loss function & variations of quadratic loss function. Robust Design: Steps in Robust Design: Parameter design and Tolerance Design. Reliability Improvement through experiments, Illustration through Numerical examples**.** **5Hrs**

Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Analytical methods, Problem solving, Numerical exercises, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments

Module-4

Types of Orthogonal Arrays, selection of standard orthogonal arrays, Linear graphs and Interaction assignment, Dummy level Technique, Compound factor method, Modification of linear graphs. Illustration through Numerical examples. **5Hrs**

Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Analytical methods, Problem solving, Numerical exercises, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments

Module-5

Evaluation of sensitivity to noise. Signal to Noise ratios for static problems: Smaller-the-better type, Nominal-the – better-type, Largerthe- better type. Signal to Noise ratios for Dynamic problems. Illustration through Numerical examples.

Parameter and tolerance design concepts, Taguchi's inner and outer arrays, parameter design strategy, tolerance design strategy. Illustration through Numerical examples. **5Hrs**

Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Analytical methods, Problem solving, Numerical exercises, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments

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) from

Suggested Learning Resources:

Books

- Design and Analysis of Experiments, Douglas C Montgomerry, Wiley, 8th Edition
- Design and Analysis of Experiments, R. Panneerselvam, PHI
- Quality Engineering Using Robust Design, Madhav S,Phadke, PHI
- Design of Experiments with Minitab, Paul Mathews, New Age International
- Design of Experiments with Minitab, Virgil L Anderson and Robert A Mclean, Taylor and Francis

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=G_IAeHoukvE
- https://www.youtube.com/watch?v=KhjM8YI3agk
- https://www.youtube.com/watch?v=1fgvi1dXfMg
- https://www.youtube.com/watch?v=dmvo_B91vlc
- https://www.youtube.com/watch?v=sIRl1xWrViY

Skill Development Activities Suggested

- Quizzes
- Assignments
- Seminars

Course outcome

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

Sl. No.	Description	Blooms Level
CO1	Plan data collection, to turn data into information and to make decisions that lead appropriate action.	L1, L2, L3, L4, L5
CO2	Plan, analyze, and interpret the results of experiments, To understand the Orthogonal rrays.	L1, L2, L3, L4, L5
CO3	Analyze the Parameter and tolerance design concepts.	L1, L2, L3, L4, L5

Program Outcome of this course

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

Mapping of COS and POs **(Indicative only)**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**2**	**1**	**2**	**3**	**3**	**-**	**2**
CO2	**1**	**1**	**2**	**3**	**3**	**-**	**2**
CO3	**1**	**1**	**2**	**3**	**3**	**-**	**2**

(Note : High - 3, Medium – 2, and Low – 1)

Organizational Behaviour			
Course Code	22MPT324	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	25 Hrs Theory +10-12 activities	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- Define organisational behaviour, analyse discipline and area of application in business.
- Understand personality, interpersonal and intergroup behaviour.
- Understand group types, norms and decision making.
- Understand nature and development of leadership and types of power.
- Learn the management of conflict, development, effectiveness and cross cultural management.

Module-1

Orgnanizational Behavior – Definition, Need for studying Organizational Behavior, Disciplines involved in the study of Organizational Behavior, -Contributing disciplines and area like psychology, social psychology, economics, anthropology etc. Application of Organizational Behavior in Business. **5Hrs**

Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments

Module-2

Individual behaviour – personality, perception, learning, attitudes inter-personal behaviour – Group and inter-group behaviour. **5Hrs**

Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments

Module-3

Group Dynamics – Formal and Informal Group, Group Norms, Group Cohesiveness, Group Behaviour and Group Decision – making. **5Hrs**

Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments

Module-4

Motivation and morale, leadership-nature, styles and approaches, development of leadership including laboratory training. Power and Authority – Definition of Power – Types of Power. **5Hrs**

Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments

Module-5
Management of change- Conflict Management- Organisation Health, Development and Effectiveness. Management of culture, Cross Cultural Management. **5Hrs**

Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments

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) from each

Suggested Learning Resources:

Books

1. **Organizational Behavior** – Stephen. P. Robbins – Prentice Hall, India. - 9th edition 2001.
2. **Organizational Behavior** – Fred Luthans – McGraw Hill.
3. **Human Behavior at work**– Keith Davis – Prentice Hall India – 2007.

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program

Skill Development Activities Suggested

At the end of the lecture/presentation, numerical exercises are to be taken up to solve problems related to the topics covered. Additional problems are to be given for practice and also as assignments under each of the topics covered.

Course outcome

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

Sl. No.	Description	Blooms Level
CO1	Define organisational behaviour, discipline and area of application in business	L1, L2, L3
CO2	Identify personality, interpersonal and intergroup behaviour.	L1, L2, L3, L4,L5
CO3	Identify group types, norms and decision making	L1, L2, L3, L4
CO4	Explain nature and development of leadership and Identify types of power.	L1, L2, L3, L4
CO5	Solve problems of the management of conflict, development, effectiveness and cross cultural management	L1, L2, L3, L4

Program Outcome of this course

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

Mapping of COS and POs **(Indicative only)**

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

(Note : High - 3, Medium – 2, and Low – 1)

Industrial Robotics			
Course Code	22MPT325	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	25 Hrs Theory +10-12 activities	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.
- Program robot and analyse the computational element of robot computer system.
- Transform robot manipulator using knowledge kinematics and mathematical methods.
- Design and control robot cells and understand the application of robots.

Module-1

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-electric-pneumatic drives. Mechanical transmission method – Rotary-to-Rotary motion conversion. Rotary-to-linear motion conversion end effectors – types-grip and problem Remote-Centered compliance Devices- Control of Actuators in Robotic Mechanisms. **5Hrs**

Teaching-Learning Process	Chalk and Talk / White board, Power Point Presentation, Video Demonstration or Simulation.

Module-2

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

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. **5Hrs**

Teaching-Learning Process	Chalk and Talk / White board, Power Point Presentation, Video Demonstration or Simulation.

Module-3

COMPUTER CONSIDERATIONS FOR ROBOTIC SYSTEMS: Computer architecture for robots, hardware, Computational elements in robotic applications – Robot programming – sample programs path planning – Robot's computer system. **5Hrs**

Teaching-Learning Process	Chalk and Talk / White board, Power Point Presentation, Video Demonstration or Simulation.

Module-4

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. **5Hrs**

Teaching-Learning Process	Chalk and Talk / White board, Power Point Presentation, Video Demonstration or Simulation.

Module-5
ROBOT CELL DESIGN AND CONTROL: Specifications of Commerical 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. **5Hrs**

Teaching-Learning Process	Chalk and Talk / White board, Power Point Presentation, Video Demonstration or Simulation.

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) from each

Suggested Learning Resources:

Books

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

Web links and Video Lectures (e-Resources):

- https://intelitek.com/fundamentals-of-robotics/
- https://www.youtube.com/watch?v=7Bahzh3rniw
- https://www.electronicsforu.com/technology-trends/tech-focus/sensors-robotics-artificial-intelligence
- https://www.youtube.com/watch?v=QJ1wixdSlRc
- https://www.youtube.com/watch?v=zyOv6rn3X88
- https://www.therobotreport.com/6-robotics-applications-new-markets/

Skill Development Activities Suggested

- Quizzes
- Assignments
- Seminars

Course outcome

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

Sl. No.	Description	Blooms Level
CO1	Describe the concept of robotics and its drives.	L1, L2, L3, L4
CO2	Able to explain working of sensors and applications and images recognition mechanism.	L1, L2, L3, L4,L5
CO3	Program for robot and explain the computational element of robot computer system.	L1, L2, L3, L4,L5
CO4	Explain robot manipulator using knowledge kinematics and mathematical methods	L1, L2, L3, L4,L5
CO5	Design and control robot cells and understand the application of robots.	L1, L2, L3, L4

Program Outcome of this course

Sl. No.	Description	POs
1	An ability to independently carry out research /investigation and development work to solve practical problems.	PO1
2	An ability to write and present a substantial technical report/document.	PO2
3	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	PO3
4	Understand contemporary issues in manufacturing engineering and develop relationship between product design and manufacturability to create safe, reliable, and cost-effective products.	PO4
5	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	PO5
6	Employ advanced prototyping methods to shorten design cycles and narrow alternatives without restricting innovation.	PO6
7	Understand and debate the roles and responsibilities of a product designer/manufacturer on society.	PO7

Mapping of COS and POs **(Indicative only)**

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

Non Destructive Testing

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

Course Learning objectives:

- To inspect a component in a safe, reliable and cost effective manner without causing damage to the equipment
- To weld inspectors can determine whether a weld is strong or has potential defects that could compromise it integrity
- Ultrasonic testing is to detection of defect, measurement of their parameters assessment of their hazard assessment feasibility operation of the particular tested objected
- Liquid penetrant testing is to provide visual evidence of surface discontinuities in solid non-porous materials
- Magnetic Particle inspection is a NDT method, to detect surface and subsurface flaws in ferromagnetic Materials

Module-1

Introduction: Definition of Non-destructive testing, Need for NDT techniques and its applications, Types of NDT techniques, benefits from Non-destructive Testing, nature of flaws ,various steps involved in NDT, uses of Non-destructive techniques.

Non-Destructive Testing of Welds: Definition of weld, types of weld joints, Welding processes; Gas welding, shielded metal arc welding, TIG spot welding, submerged arc welding, Defects in welded joints, Defects associated with residual stresses, Testing, measurement and control (TMC) of welds, Testing of welded joints; destructive test, Non-destructive tests. **8Hrs**

Teaching-Learning Process	Introduction about Non-destructive testing, and NDT of welds, Chalk and talk used for draw figures and Power Point presentation and YouTube videos, Animation videos, creating right time in classroom discussions. Giving activities &assignments.

Module-2

Ultrasonic Testing : Introduction frequency of ultrasonic Waves, Generation of Ultrasonic waves, Piezo-electric materials for Ultrasonic Transducers, Types of Ultrasonic Waves, Different kinds of Ultrasonic Transducers, Types of ultrasonic waves, Reflection, Refraction and scattering of Ultrasonic beam, working of ultrasonic Flaws detectors, industrial application, Pulse-echo and through transmission Testing, Scanner assemblies for transmission and pulse-echo techniques, types of scan, shear wave and surface wave applications, Resonance techniques, use of Ultrasonic for thickness measurements. **8Hrs**

Teaching-Learning Process	Discussed about ultrasonic testing and Chalk and talk used for draw figures and Power Point presentation and YouTube videos, Animation videos, creating right time in classroom discussions. Giving activities &assignments.

Module-3

Liquid Penetrant Testing: Types of Penetrants, Types of developers, Penetration time, Inspection, Post emulsifiable fluorescent penetrants system, Water washable fluorescent penetrants, Low and High temperature penetrants, High sensitivity fluorescence penetrant examination, Advanced LPT techniques; Ultrasonic pumping to enhance performance, ultrasonically enhanced penetrant inspection of small weldments, Mechanised remote liquid penetrant testing of piping of reactors. **8Hrs**

Teaching-Learning Process	Discussed about liquid penetrant testing and Chalk and talk method and Power Point presentation and YouTube videos, Animation videos, creating right time in classroom discussions. Giving activities &assignments.

Module-4

Eddy current Testing: instrumentation of ECT, inspection of welds, advanced eddy current testing, Multi-frequency ECT, 3D phase array ECT, Remote field ECT, Magnetically based eddy current. Flux leakage, Computer modelling of ECT, Digital signal Processing, Eddy current imaging; eddy current imaging system, imaging and characterisation of defects, Eddy current array instrumentation for fixed position scanning. **8Hrs**	
Teaching-Learning Process	Discussed about liquid Eddy current testing and Chalk and talk method and Power Point presentation and YouTube videos, Animation videos, creating right time in classroom discussions. Giving activities &assignments.
Module-5	
Magnetic particle Flaws detection: Principle of Magnetic Flaw detection, Types and methods of Magnetisation, Magnetic particles, Dry and Wet methods of Magnetic Particles inspection, Use of fluorescent Coated Magnetic particles, Industrial applications, Working of a Few Commercially available Magnetic Crack Detectors, Flaw detection in Rods, pipes and a short work piece, Precautions, Limitations, Residual magnetism, Need for Demagnetisation Research Techniques using Magnetic Particle Methods. **8Hrs**	
Teaching-Learning Process	Discussed about liquid Magnetic particle Flaws detection and Chalk and talk method and Power Point presentation and YouTube videos, Animation videos, creating right time in classroom discussions. Giving activities &assignments.

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.

Suggested Learning Resources:

Books

- Non-Destructive Testing Techniques Ravi Prakash 3rd Edition 2010 New Age International (P) Ltd., publishers
- Non-destructive Testing of Welds Baldev Raj C.V. Subramanian T. Jayakumar Revised Edditon 2000Narosa Publishing House
- Welding Technology O.P. KhannaDhanpatRai Publication 2008

Web links and Video Lectures (e-Resources):

- https://www.asnt.org/MajorSiteSections/About/Introduction_to_Nondestructive_Testing.aspx#:~:text=Nondestructive%20testing%20(NDT)%20is%20the,part%20can%20still%20be%20used.
- https://www.youtube.com/watch?v=tlE3eK0g6vU
- https://www.youtube.com/watch?v=9qw0Dka_YcU
- https://www.youtube.com/watch?v=qpgcD5k1494
- https://www.youtube.com/watch?v=bHTRmTQDZzg

Skill Development Activities Suggested

1. Contents related activities (Activity-based discussions)
2. For active participation of students to learnt about welds, Ultrasonic, Liquid Penetrant, Eddy current and some other testing of demonstration in Labs
3. Instruct the students individual to prepare module wise ppt
4. Organizing Group wise discussions and NDT based activities, Quizzes and Discussions.

Course outcome

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.	L1, L2, L3, L4
CO2	Ultrasonic testing is to detection of defect, measurement of their parameters assessment of	L1, L2, L3, L4

Program Outcome of this course

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

Mapping of COS and Pos **(Indicative only)**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	**2**	**2**	**2**	**3**	**3**	**3**	**2**
CO2	**1**	**1**	**2**	**2**	**3**	**-**	**2**
CO3	**2**	**2**	**2**	**3**	**3**	**-**	**2**

(Note : High – 3, Medium – 2, and Low – 1)

Supply Chain Management			
Course Code	22MPT/MPM/MCM332	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40 Hrs	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- To develop an understanding of basic concepts and role of Logistics and supply chain management in business.
- To understand how supply chain drivers play an important role in redefining value chain excellence of Firms.
- To develop analytical and critical understanding & skills for planning, designing and operations of supply chain.
- To understand, appraise and integrate various supply chain strategies.

Module-1

BUILDING A STRATEGIC FRAME WORK TO ANALYSE SUPPLY CHAINS: Supply chain stages and decision phase, process view of a supply chain. Supply chain flows. Examples of supply chains. Competitive and supply chain strategies. Achieving strategic fit. Expanding strategic scope. Drivers of supply chain performance. Framework for structuring drivers – Inventory, Transportation, Facilities, Information. Obstacles to achieving fit, Case discussions.

DESIGNING THE SUPPLY CHAIN NETWORK: Distribution Networking – Role, Design. Supply Chain Network (SCN) – Role, Factors, Framework for Design Decisions. 8Hrs

Teaching-Learning Process	Chalk and Talk / White board, Power Point Presentation, Video Demonstration or Simulation.

Module-2

FACILITY LOCATION AND NETWORK DESIGN: Models for facility location and capacity allocation. Impact of uncertainty on SCN – discounted cash flow analysis, evaluating network design decisions using decision trees. Analytical problems.

PLANNING AND MANAGING INVENTORIES IN A SUPPLY CHAIN: Review of inventory concepts, Concepts of Safety Inventory, Concept of Aggregation of Inventory, Concept of product availability. 8Hrs

Teaching-Learning Process	Chalk and Talk / White board, Power Point Presentation, Video Demonstration or Simulation.

Module-3

SOURCING, TRANSPORTATION AND PRICING PRODUCTS: Role of sourcing, supplier – scoring & assessment, selection and contracts. Design collaboration. Role of transportation, Factors affecting transportation decisions. Modes of transportation and their performance characteristics. Designing transportation network. Trade-off in transportation design. Tailored transportation, Routing and scheduling in transportation. International transportation. Analytical problems. Role of Revenue Management in the supply chain, Revenue management for: Multiple customer segments, perishable assets, seasonal demand, bulk and spot contracts. 8Hrs

Teaching-Learning Process	Chalk and Talk / White board, Power Point Presentation, Video Demonstration or Simulation.

Module-4

COORDINATION AND TECHNOLOGY IN THE SUPPLY CHAIN: Co-ordination in a supply chain: Bullwhip effect. Obstacles to coordination. Managerial levers to achieve coordination, Building strategic

partnerships. The role of IT supply Chain, The Supply Chain IT framework, CRM, Internal SCM, SRM. The role of ebusiness in a supply chain, The e-business framework, e-business in practice. Case discussion. 8Hrs

Teaching-Learning Process	Chalk and Talk / White board, Power Point Presentation, Video Demonstration or Simulation.

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. **8Hrs**	
Teaching-Learning Process	Chalk and Talk / White board, Power Point Presentation, Video Demonstration or Simulation.

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

Suggested Learning Resources:

Books

1. Supply Chain Management – Strategy, Planning, Sunil Chopra & Peter Meindl, Pearson Education Asia ISBN: 81-7808-272-1. – 2001
2. Supply Chain and Logistics Management, UpendraKachuru
3. Supply Chain Redesign –Transforming Supply Chains into Integrated Value Systems, Robert B Handfield, Ernest L Nichols, Jr. – Pearson Education Inc, ISBN: 81-7808- 272-1. – 2001.
4. Modelling the Supply Chain, Jeremy F Shapiro, uxbury, Thomson Learning, McGraw Hill
5. Designing & Managing the Supply Chain, David Simchi Levi, Philip Kaminsky& Edith Simchi Levi , McGraw Hill

Web links and Video Lectures (e-Resources):

- https://www.gartner.com/en/topics/supply-chain-management
- https://www.youtube.com/watch?v=Mi1QBxVjZAw
- https://www.youtube.com/watch?v=TTojGYDDR18
- https://www.youtube.com/watch?v=AB7kmDmEbMI
- https://www.youtube.com/watch?v=o8APky4PGJA

Skill Development Activities Suggested

- Quizzes
- Assignments
- Seminars

Course outcome

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

Sl. No.	Description	Blooms Level
CO1	Understand the fundamentals of elements and functions of supply chain, role of drivers and demand forecasting	L1, L2, L3, L4
CO2	To apply various techniques of inventory management and their practical situations.	L1, L2, L3, L4,L5
CO3	Analyze how supply chain decisions related to facility location can be applied to various industries and designing the supply chain.	L1, L2, L3, L4,L5

Program Outcome of this course

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

Mapping of COS and POs **(Indicative only)**

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

(Note : High - 3, Medium – 2, and Low – 1)

Project Management

Course Code	22MPT/MPY333	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40 Hrs	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- To enable the students to understand the project management and its types.
- To help the students focus on and analyse the issues and strategies required to Project Selection and Prioritization
- To develop relevant skills necessary for Resourcing Projects and Budgeting the Projects.
- To enable the students to integrate the understanding of various Network Analysis.

Module-1

Introduction: Definition of project, characteristics of projects, understand projects, types of projects, scalability of project tools, project roles.

Project Selection and Prioritization: Strategic planning process, Strategic analysis, strategic objectives, portfolio alignment – identifying potential projects, methods of selecting projects, financial mode / scoring models to select projects, prioritizing projects, securing and negotiating projects. **8Hrs**

Teaching-Learning Process	Chalk and Talk / White board, Power Point Presentation, Video Demonstration or Simulation.

Module-2

Planning Projects: Defining the project scope, Project scope checklist, Project priorities, Work Breakdown Structure (WBS), Integrating WBS with organisation, coding the WBS for the information system.

Scheduling Projects: Purpose of a project schedule, historical development, how project schedules are limited and created, develop project schedules, uncertainty in project schedules, Gantt chart. **8Hrs**

Teaching-Learning Process	Chalk and Talk / White board, Power Point Presentation, Video Demonstration or Simulation.

Module-3

Resourcing Projects: Abilities needed when resourcing projects, estimate resource needs, creating staffing management plant, project team composition issues.

Budgeting Projects: Cost planning, cost estimating, cost budgeting, establishing cost control.

Project Risk Planning: Risk Management Planning, risk identification, risk analysis, risk response planning. **8Hrs**

Teaching-Learning Process	Chalk and Talk / White board, Power Point Presentation, Video Demonstration or Simulation.

Module-4

Performing Projects: Project supply chain management: - Plan purchasing and acquisitions, plan contracting, contract types, project partnering and collaborations, project supply chain management.

Project Progress and Results: Project Balanced Scorecard Approach, Internal project, customer, financial issues.

Finishing the project: Terminate project early, finish projects on time, secure customer feedback and approval, knowledge management, perform administrative and contract closure. **8Hrs**

Teaching-Learning Process	Chalk and Talk / White board, Power Point Presentation, Video Demonstration or Simulation.

Module-5

Network Analysis: Introduction, network construction - rules, Fulkerson's rule for numbering the events.

AON and AOA diagrams: Critical path method (CPM) to find the expected completion time of a project.

Floats: PERT for finding expected duration of an activity and project, determining the probability of completing a Project.

Predicting the completion time of project: Crashing of simple projects. **8Hrs**

Teaching-Learning Process	Chalk and Talk / White board, Power Point Presentation, Video Demonstration or Simulation.

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) from each

Suggested Learning Resources:

Books

1. Project Management by Timothy J Kloppenborg Cengage Learning, Edition 2009.
2. Project Management, A systems approach to planning scheduling and controlling by S Choudhury, McGraw Hill Education (India) Pvt. Ltd. New Delhi, 2016.
3. Project Management Pennington Lawrence McGraw hill.
4. Project Management A Moder Joseph and Phillips New Yark Van Nostrand, Reinhold.
5. Project Management Bhavesh M. Patal Vikas publishing House.

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=BOU1YP5NZVA
- https://www.simplilearn.com/project-selection-methods-article
- https://www.youtube.com/watch?v=DFL9FkIrXLI
- https://www.techtarget.com/searchcio/definition/project-planning
- https://www.ecosys.net/knowledge/scheduling-project-management-project-scheduling/
- https://www.workbreakdownstructure.com/
- https://docs.oracle.com/en/cloud/saas/project-management/22a/oapjs/how-project-progress-is-calculated.html
- https://www.youtube.com/watch?v=ljtGERVLF5U

Skill Development Activities Suggested

- Quizzes
- Assignments
- Seminars

Course outcome

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

Sl. No.	Description	Blooms Level
CO1	Understand project characteristics and various stages of a project.	L1, L2, L3, L4
CO2	Understand the conceptual clarity about project organization and feasibility analyses	L1, L2, L3, L4,L5
CO3	Analyze the learning and understand techniques for Project planning, scheduling	L1, L2, L3, L4

Program Outcome of this course

Sl. No.	Description	POs
1	An ability to independently carry out research /investigation and development work to solve practical problems.	PO1
2	An ability to write and present a substantial technical report/document.	PO2
3	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	PO3
4	Understand contemporary issues in manufacturing engineering and develop relationship between product design and manufacturability to create safe, reliable, and cost-effective products.	PO4
5	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	PO5
6	Employ advanced prototyping methods to shorten design cycles and narrow alternatives without restricting innovation.	PO6
7	Understand and debate the roles and responsibilities of a product designer/manufacturer on society.	PO7

Mapping of COS and POs **(Indicative only)**

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

(Note : High - 3, Medium – 2, and Low – 1)

Total Quality Management			
Course Code	22MPT/MIA/MPM/MST/MAR334	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	25 Hrs Theory +10-12 activities	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

1. Understand various approaches to TQM
2. Understand the characteristics of quality leader and his role.
3. Develop feedback and suggestion systems for quality management.
4. Enhance the knowledge in Tools and Techniques of quality management.

Module-1

Principles and Practice: Definition, basic approach, gurus of TQM, TQM Framework, awareness, defining quality, historical review, obstacles, benefits of TQM. Quality Management Systems: Introduction, benefits of ISO registration, ISO 9000 series of standards, ISO 9001 requirements. **5Hrs**

Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments

Module-2

Leadership: Definition, characteristics of quality leaders, leadership concept, characteristics of effective people, ethics, the Deming philosophy, role of TQM leaders, implementation, core values, concepts and framework, strategic planning communication, decision making. **5Hrs**

Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments

Module-3

Customer Satisfaction and Customer Involvement: Customer Satisfaction: customer and customer perception of quality, feedback, using customer complaints, service quality, translating needs into requirements, customer retention, case studies. Employee Involvement – Motivation, employee surveys, empowerment, teams, suggestion system, recognition and reward, gain sharing, Performance appraisal, unions and employee involvement, case studies. **5Hrs**

Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments

Module-4

Continuous Process Improvement: process, the Juran trilogy, improvement strategies, types of problems, the PDSA Cycle, problem-solving methods, Kaizen, reengineering, six sigma, case studies.

Statistical Process Control : Pareto diagram, process flow diagram, cause and effect diagram, check sheets, histograms, statistical fundamentals, Control charts, state of control, out of control process, control charts for variables, control charts for attributes, scatter diagrams, case studies. **5Hrs**

Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments

Module-5

Tools and Techniques: Benching marking, information technology, quality management systems, environmental management system, and quality function deployment, quality by design, failure mode and effect analysis, product liability, total productive maintenance. **5Hrs**

Teaching-Learning Process	Chalk and talk, Videos, PowerPoint Presentation, Animations, Creating conducive environment in classroom for discussions and understanding through peer learning, promoting self learning activities and Giving assignments

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

Suggested Learning Resources:

Books

1. Total Quality Management Dale H. Besterfield, Pearson Education India ISBN:8129702606, Edition 03.
2. Total Quality Management, Engineers, M. Zairi head, Publishing.
3. Managing for Quality and Performance Excellence, James R. Evans and W M, Cengage Learning, 9th edition,
4. A New American TQM, four revolutions in management, Shoji Shiba,Alan Graham, Productivity press, Oregon, 1990.
5. Engineering Optimization Methods and Applications
6. Organizational Excellence through TQM, H. Lal, New age Publications, 2008.
7. Introduction to Operations Research- Concepts and Cases, F.S. Hillier. G.J. Lieberman, Tata McGraw Hill, 9th Edition, 2010

Web links and Video Lectures (e-Resources):

- https://www.investopedia.com/terms/t/total-quality-management-tqm.asp
- https://www.youtube.com/watch?v=VD6tXadibk0
- https://aboutthree.com/blog/five-important-factors-in-total-quality-management/
- https://www.youtube.com/watch?v=renlXcpK9sk
- https://www.youtube.com/watch?v=umqtSNPp5Dk
- https://study.com/academy/lesson/five-principles-of-total-quality-management-tqm.html
- https://www.greenlight.guru/blog/total-quality-management-principles

Skill Development Activities Suggested

At the end of the lecture/presentation, numerical exercises are to be taken up to solve problems related to the topics covered. Additional problems are to be given for practice and also as assignments under each of the topics covered.

Course outcome

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

Sl. No.	Description	Blooms Level
CO1	To understand the concept of Quality costs.	L1, L2, L3, L4
CO2	Understand the concept of problem solving using the process.	L1, L2, L3, L4
CO3	Understand the use of control charts for improving the process quality.	L1, L2, L3, L4
CO4	Illustrate design of experiments using Taguchi technique.	L1, L2, L3, L4, L5
CO5	Acquire basic knowledge of total quality management.	L1, L2, L3, L4, L5

Program Outcome of this course

Sl. No.	Description	POs
1	An ability to independently carry out research /investigation and development work to solve practical problems.	PO1
2	An ability to write and present a substantial technical report/document.	PO2
3	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	PO3
4	Understand contemporary issues in manufacturing engineering and develop relationship between product design and manufacturability to create safe, reliable, and cost-effective products.	PO4
5	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	PO5
6	Employ advanced prototyping methods to shorten design cycles and narrow alternatives without restricting innovation.	PO6
7	Understand and debate the roles and responsibilities of a product designer/manufacturer on society.	PO7

Mapping of COS and POs **(Indicative only)**

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

Product Design and Manufacturing			
Course Code	22MPT335	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	25 Hrs Theory+10-12 activities	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- Understand modern product development processes.
- Understand and explain the concept of Industrial design and robust design concepts.
- Understand the concept of Design for manufacture and assembly.
- Understand the legal factors, social issues, engineering ethics related to product design

Module-1

Product Data Management : Product life cycle, Complexity in Product Development, General Description of PDM

Basic functionality of PDM: Information architecture, PDM System architecture, Applications used in PDM systems. Trends in PDM. **5Hrs**

Teaching-Learning Process	Chalk and Talk / White board, Power Point Presentation, Video Demonstration or Simulation.

Module-2

Document Management Systems: Document management and PDM, Document life cycle, Content Management, Document management and related technologies, Document management resources on the Internet. **5Hrs**

Teaching-Learning Process	Chalk and Talk / White board, Power Point Presentation, Video Demonstration or Simulation.

Module-3

Workflow Management in PDM: Structure Management, Engineering Change Management, Release Management, Version Management, Configuration Management. **5Hrs**

Teaching-Learning Process	Chalk and Talk / White board, Power Point Presentation, Video Demonstration or Simulation.

Module-4

Creating Product Structures: Part centric approach, CAD centric approach, Product Structure configuration, Managing Product Structures, PDM Tools: Matrix One, Team Center, Windchill. Enovia, PDM resources on the Internet. **5Hrs**

Teaching-Learning Process	Chalk and Talk / White board, Power Point Presentation, Video Demonstration or Simulation.

Module-5

PDM Implementation Case Studies: Sun Microsystems, Inc., Mentor Graphics Corporation, Ericsson Radio Systems AB, Ericsson Mobile Communications AB, ABB Automation Technology Products, SaabTech Electronics AB. **5Hrs**

Teaching-Learning	Chalk and Talk / White board, Power Point Presentation, Video Demonstration or Simulation.

Process	

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) from each

Suggested Learning Resources:

Books

1. Computer Integrated Design and Manufacturing - David Bed worth. Mark Henderson &. Philips Wolfe - McGraw Hill Inc
2. Visual Modeling with Rational Rose and UML - Terry Quatrain –
3. Wind-chill - RS.O Reference manuals - 2000.

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=oTqtY8yjUw4
- https://www.youtube.com/watch?v=bxHbP-q9InU
- https://www.youtube.com/watch?v=0XFuRPPkZvA
- https://www.technia.com/blog/cad-data-management-on-the-3dexperience-platform/
- https://www.youtube.com/watch?v=JvQI0jkv89k

Skill Development Activities Suggested

- Quizzes
- Assignments
- Seminars

Course outcome

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

Sl. No.	Description	Blooms Level
CO1	Use the Product Design and Development Process, as a means to manage the development of an idea from concept through to production.	L1, L2, L3, L4
CO2	Employ research and analysis methodologies as it pertains to the product design process, meaning, and user experience.	L1, L2, L3, L4,L5
CO3	Apply creative process techniques in synthesizing information, problem-solving and critical thinking.	L1, L2, L3, L4
CO4	Demonstrate and employ hand drawing and drafting principles to convey concepts.	L1, L2, L3, L4,L5
CO5	Use basic fabrication methods to build prototype models for hard-goods and soft-goods and packaging.	L1, L2, L3, L4

Program Outcome of this course

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

Mapping of COS and POs **(Indicative only)**

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

(Note : High - 3, Medium – 2, and Low – 1)

PROJECT WORK PHASE – 1			
Course Code	**22MPT34**	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	**22MPTI36**	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

IV SEMESTER

PROJECT WORK PHASE -2

Course Code	**22MPT41**	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.