VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI.

Scheme of Teaching and Examinations and Syllabus

M.Tech., Production Technology(MPY)

(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 Technology(MPY)
Choice Based Credit System (CBCS) and Outcome-Based Education(OBE)

I SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Hours per Week			Examination				Credits
				Theory	Practical/Seminar	Tutorial/ Skill Development Activities	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	P	T/SDA					
1	BSC	22MST/MTE/MPD/MEM /MPM/MPY/MSE11	Mathematical Methods in Engg.	03	00	00	03	50	50	100	3
2	IPCC	22MPY12	CAE and CIM	03	02	00	03	50	50	100	4
3	PCC	22MPY13	Decision-Making Techniques	03	00	02	03	50	50	100	4
4	PCC	22MPY14	Advanced Foundry Technology	02	00	02	03	50	50	100	3
5	PCC	22MPY15	Theory of Metal Cutting	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	22MPYL17	Production Engg. Laboratory	01	02	00	03	50	50	100	2
8	AUD/AEC	22AUD18/ 22AEC18	BOS recommended ONLINE courses	Classes and evaluation procedures are as per the policy of the online course providers.							PP
			TOTAL	**17**	**04**	**06**	**21**	**350**	**350**	**700**	**22**

Note: BSC-Basic Science Courses, PCC: Professional core. IPCC-Integrated Professional Core Courses, MCC- MandatoryCredit 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 in fields connected to the field of specialisation as well allied fields that leads toemployable 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.

Programme Outcome:

PO1 - An ability to independently carry out research /investigation and development work to solve practical problems.

PO2 - An ability to write and present a substantial technical report/document.

PO3 - Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program

PO4 - Understand contemporary issues in manufacturing engineering and develop relationship between product design and manufacturability to create safe, reliable, and cost-effective products.

PO5 - Understand the process of converting customer needs into engineering specifications to create product designs that are sensitive to user needs and robust against unanticipated uses and misuse

PO6 - Employ advanced prototyping methods to shorten design cycles and narrow alternatives without restricting innovation.

PO7 - Understand and debate the roles and responsibilities of a product designer/manufacturer on society.

Semester- I

MATHEMATICAL METHODS IN ENGG.

(common to MPY/MTE/MPD/MEM/MPM/MST/MSE)

Course Code	22MPY11	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 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

Errors and Simple Mathematical modelling: Error definition, round off errors and truncation errors. Mathematical modelling and Engineering problem solving: Simple mathematical model, Conservation Laws of Engineering. Engineering Applications on : i) Deflection of Beams ii) Terminal velocity of a freely falling body (RBT Levels: L1 & L2) (Text Book:1) **8 Hrs**

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-2

System of Linear Algebraic Equations And Eigen Value Problems: Gauss-Jordan Method, Cholesky Method, Partition method, Givens method for symmetric matrices, (RBT Levels: L1 & L2) (Text Book:3) **8Hrs**

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-3

Roots of Equations: Muller's method, Graeffe's roots squaring method. Numerical solutions of second order ordinary differential equations: Runge Kutta method & Milne's Predictor-corrector method.. (RBT Levels: L2 & L3) (Text Book:3) **8Hrs**

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-4

Partial Differential Equations: Numerical solution of one dimensional wave equation, Heat equation,(Schmidt`s explicit formula)& Laplace equation(Gauss-Seidel process) by finite difference schemes. (RBT Levels: L2 & L3) (Text Book:6). **8Hrs**

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-5	
Sampling theory: Testing of hypothesis (Single mean & single proportion only), Chi square test and F-test. Analysis of Variance (ANOVA): one way classification, Design of experiments, RBD. (RBT Levels: L2 & L3) (Ref. Book:4). **8Hrs**	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Assessment Details (both CIE and SEE)

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

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **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. 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
7. 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 (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Acquire the idea of significant figures, types of errors during numerical computation.	
CO2	Learn various numerical methods to solve system of linear equations	
CO3	Analyze and solve PDE‟s related to wave equation arising in vibration analysis.	
CO4	Understand sampling theory	
CO5	Acquire knowledge of algebraic equations and analyze	

Program Outcome of this course

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

Mapping of COS and Pos

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

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

Semester I

CAE and CIM			
Course Code	**22MPY12**	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	1.Chalk and Talk are used for Problem Solving./White board 2. Power-point Presentation

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 Trusse.

8Hrs

Teaching-Learning Process	1.Chalk and Talk are used for Problem Solving./White board 2. Power-point Presentation

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	1.Chalk and Talk are used for Problem Solving./White board 2. Power-point Presentation

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	1.Chalk and Talk are used for Problem Solving./White board 2. Power-point Presentation

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	1.Chalk and Talk are used for Problem Solving./White board 2. Power-point Presentation

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):

- VTU e-Shikshana Program
- VTU EDUSAT Program

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

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)

Semester I

Decision- Making Techniques			
Course Code	**22MPY13**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:2	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 10-12 Activity	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 analyze 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**.** **8 Hrs**

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. **8 Hrs**

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/I):(FCFS/∞/∞)] queuing model**.** Simple 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-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
3. 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

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 (Course Skill Set)

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

	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)

Semester I

ADVANCED FOUNDRY TECHNOLOGY			
Course Code	22MPY14	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	25 Hrs + 10-12Activities	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- To understand the concept of solidification & gating system
- To understand the design & quality control of casting.
- Understand the working principle of various furnaces.
- Identify characteristics of non ferrous metals.

Module-1

Solidification of Casting: Concept of solidification of metals, Homogenous and heterogeneous nucleation, Growth mechanism, Solidification of pure metals and alloys, Mechanism of columnar and dendritic growth, Coring or Segregation, Solidification time and Chvorinov's rule, Concept of progressive and directionalsolidifications.
Principles of Casting and Risering: Purpose of the gating system, Components of the gating System and its functions, Design of the gating System, types of gates, Gating ratio and its functions, Definitionand functions of the riser, Types of risers and their application,
Design of the riser - its shape, Size and location. Use of insulatingmaterial and exothermic compounds in risers.
05 Hrs

Teaching-Learning Process	1.Chalk and Talk are used for Problem Solving./White board 2. Power-point Presentation 3. Video demonstration or Simulations

Module-2

Design of Casting: Factors to be considered in casting design, Design consideration in pattern making, moulding techniques and core making and assembly, Cooling stresses and hot spots in casting and modification in casting geometry to overcome them.
Casting Quality Control: Casting defects and factors responsible for them, Different inspection and testing methods to evaluate the casting, Quality control activities in a foundry, Salvaging methods of defective casting. **05 Hrs**

Teaching-Learning Process	1.Chalk and Talk are used for Problem Solving./White board 2. Power-point Presentation 3. Video demonstration or Simulations

Module-3

Furnace Technology: Study of various furnaces used in foundry, construction and operation of crucible and hearth furnace, Resistance, Arc and Induction furnaces - their construction, Operation and application. Heat treatment furnaces and drying ovens used in foundry.
Gray Cast - Iron Foundry Practice: Chemical Composition and structure of gray cast iron, Moulding, gating and risering techniques, melting of gray cast iron in Cupola and induction furnace, Inoculation of gray cast iron, Application of gray cast iron castings.
Ductile Cast Iron: Chemical composition and structure of ductile cast iron, Melting and spherodization treatment, Inoculation of ductile iron,
Properties and application of ductile iron casting. **05 Hrs**

Teaching-Learning Process	1.Chalk and Talk are used for Problem Solving./White board 2. Power-point Presentation 3. Video demonstration or Simulations

Module-4	
Steel Casting Practice: Common steel casting, their composition, structure and properties. Melting and refining of steel, Gating and risering system of steel castings cleaning of steel castings. **Aluminum Foundry Practice:** Composition, properties and application of common aluminum alloy casting, Melting and casting of Al-alloys, Gating and risering system of Al alloy casting. **05 Hrs**	
Teaching-Learning Process	1.Chalk and Talk are used for Problem Solving./White board 2. Power-point Presentation 3. Video demonstration or Simulations
Module-5	
Copper alloy Foundry Practice: General characteristics of common cast copper alloys, Melting and casting of copper alloys, Gating and risering of cu-alloy castings. **Foundry Mechanization and Modernization:** Introduction to modernization, Mechanization of foundry and its advantages, Mechanization of sand plant, moulding and core making mechanization in melting, pouring and shake out units, Material handling equipments and conveyor systems, Brief sketches and description of layouts of job, Captive and mechanized foundries. **05 Hrs**	
Teaching-Learning Process	1.Chalk and Talk are used for Problem Solving./White board 2. Power-point Presentation 3. Video demonstration or Simulations

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:

Reference Books:

1. Principle of metal casting - Heine, et. al - Tata-McGraw-Hill Publication – 2003.

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program

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

- Quizzes
- Assignments
- Seminars

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Understand the concept of solidification and design of gatesand riser in casting.	
CO2	Design casting and apply quality control techniques.	
CO3	Understand and design moulding for grey cast, malleable castiron and ductile cast iron.	
CO4	Understand and design steel, aluminum and copper alloycasting.	
CO5	Modernize the casting techniques improving the efficientquality.	

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

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

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

Semester I

THEORY OF METALCUTTING			
Course Code	**22MPY15**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	25 theory + 10-12 activities	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- 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. **05 Hrs**

Teaching-Learning Process	1.Chalk and Talk are used for Problem Solving./White board 2. Power-point Presentation 3. Video demonstration or Simulations

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. **05 Hrs**

Teaching-Learning Process	1.Chalk and Talk are used for Problem Solving./White board 2. Power-point Presentation 3. Video demonstration or Simulations

Module-3

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

Dynamometers For Machine Tools: Dynamometers for lathe, drilling, grinding and milling, Calibration of dynamometers. **05 Hrs**

Teaching-Learning Process	1.Chalk and Talk are used for Problem Solving./White board 2. Power-point Presentation 3. Video demonstration or Simulations

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. **05 Hrs**

Teaching-Learning Process	1.Chalk and Talk are used for Problem Solving./White board 2. Power-point Presentation 3. Video demonstration or Simulations

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. **05 Hrs**	
Teaching-Learning Process	1.Chalk and Talk are used for Problem Solving./White board 2. Power-point Presentation 3. Video demonstration or Simulations

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.
3. 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. 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

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

- Quizzes
- Assignments
- Seminars

Course outcome (Course Skill Set)

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

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

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

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

(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 Right Holder, 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
3. 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):

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

Skill Development Activities Suggested

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

I Semester

PRODUCTION ENGINEERING LABORATORY			
Course Code	**22MPYL17**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	1:2:0	SEE Marks	50
Credits	03	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	To become familiar with the use of a kinematics graphics simulator in order to perform robot motion and programming.
2	Simulation of Cutting/Milling operations on a computer using CAM packages
3	Determination of Chip reduction co-efficient (reciprocal of chip thickness ratio) during single point turning.
4	Forces measurements during orthogonal turning.
5	Torque and Thrust measurement during drilling.
6	Measurement of Chip tool Interface temperature during turning using thermocouple technique.
7	Study of capstan lathe and its tooling and prepare a tool layout and job as per given drawing.
8	To prepare metallic samples for metallographic examination and to study the principle and construction of the Metallurgical Microscope.
	Demonstration Experiments (For CIE) if any
9	
10	
11	
12	

Course outcomes (Course Skill Set)

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

CO1	Understand usage of G and M codes and write CNC program for a given component.
CO2	Use CAM package for simulating tool path, power requirement and cycle time, etc.
CO3	Measure cutting forces during machining using different Dynamometers
CO4	Perform 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.

Semester End Evaluation (SEE):

- SEE marks for the practical course is 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University.
- All laboratory experiments are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.
Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.
General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
Change of experiment is allowed only once and 10% Marks allotted to the procedure part to be made zero.
The duration of SEE is 03 hours

Suggested Learning Resources:

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

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

End of 1st Semester

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI.

Scheme of Teaching and Examinations and Syllabus

M.Tech., Production Technology(MPY)

(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 TECHNOLOGY (MPY)
Choice Based Credit System (CBCS) and Outcome Based Education(OBE)

II SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Hours /Week			Examination				Credits
				Theory	Practical/ Seminar	Tutorial/ Skill Development Activities	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	P	T/SDA					
1	PCC	22MPY21	Measurement & Instrumentation Engineering	02	00	02	03	50	50	100	3
2	IPCC	22MPY/MPD /MAU/MPT/	Industrial Design and Ergonomics	03	02	00	03	50	50	100	4
3	PEC	22MPY23x	Professional elective 1	02	00	02	03	50	50	100	3
4	PEC	22MPY24x	Professional elective 2	02	00	02	03	50	50	100	3
5	MPS	22MPY25	Mini Project with Seminar	00	04	02	--	100	--	100	3
6	PCCL	22MPYL26	QT and QC Laboratory	01	02	00	03	50	50	100	02
7	AUD/ AEC	22AUD27	Suggested ONLINE courses	Classes and evaluation procedures are as per the policy of the online course providers.							PP
TOTAL				**10**	**08**	**08**	**15**	**350**	**250**	**600**	**18**

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

Professional Elective 1		**Professional Elective 2**	
Course Code under 22MPT23X	**Course title**	**Course Code under 22MPT24X**	**Course title**
22MPY231	Operations Research	22MPY/MPT/MTE/MSE/MIA/	Agile Manufacturing
22MPY/MPT232	Advanced Fluid Power	22MPY242	Robust Design
22MPY233	Surface Treatment &Finishing	22MPY243	Maintenance Engineering & Management
22MPY/MPT/MPM 234	Human Resources Management	22MPY244	Simulation Modelling of Manufacturing Science
22MPY235	Quality & Reliability Engineering	22MPD/MAU/MDE/MEA/MMD/MTP/MPY/MIA/MAR/CAE/MPE/MPM/MCM245	Industry 4.O

Note:

1 Mini Project with Seminar: This may be hands-on practice**,** survey report, data collection and analysis, coding, mobile app development, field visit and report preparation, modelling of system, simulation, analysing and authenticating, case studies, etc.
CIE marks shall be awarded by a committee comprising of HOD as Chairman, Guide/co-guide, if any, and a senior faculty of the department. Students can present the seminar based on the completed mini-project. Participation in the seminar by all postgraduate students of the program shall be mandatory.
The CIE marks awarded for Mini-Project work and Seminar shall be based on the evaluation of Mini Project work and Report, Presentation skill and performance in Question and Answer session in the ratio 50:25:25. Mini-Project with Seminar shall be considered as a head of passing and shall be considered for vertical progression as well as for the award of degree. Those, who do not take-up/complete the Mini Project and Seminar shall be declared as fail in that course and have to complete the same during the subsequent semester. There is no SEE for this course.

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

Total Cred

II SEMESTER

Semester- II

MEASUREMENT & INSTRUMENTATION ENGINEERING			
Course Code	22MPT21	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- To learn various mechanical measurement techniques for different parameters.
- To learn different electrical related measurement techniques.

Module-1	
Introduction to measurement and measurement System: Generalized measurement system and functional elements, Static and dynamic performance characteristics of measurement devices, Errors in measurements, Statistical analysis of data, Regression analysis, Chi-Square Testing, correlation, estimation of uncertainty and presentation of data, elementary principles of design of experiments. **8 Hrs**	
Teaching-Learning Process	1.Chalk and Talk 2. Power-point Presentation

Module-2	
Signal conditioning and signal processing elements of measurement systems: Effects of noise and interference on measurement circuits, Noise sources and coupling mechanisms, Methods of reducing effects of noise and interference - Signal Conditioning Elements- Analogue signal conditioning, Deflection bridges, Amplifiers, A.C. carrier systems, Current transmitters, Oscillators and resonators - Signal Processing Elements- Analogue-to-digital (A/D) conversion, Successive-Approximation ADCs, Tracking or servo ADCS, Signal processing calculations- Digital signal processing- Digital Filters and the z-Transform, Simple DSP Algorithms **8 Hrs**	
Teaching-Learning Process	1.Chalk and Talk 2. Power-point Presentation

Module-3	
Measurement of temperature, pressure and flow velocity: Measurement of temperature by intrusive (Thermocouples, Thermistors and Resistance Temperature Detector) and non-intrusive (pyrometers) techniques. Measurement of pressure - manometers, elastic type pressure gauges (Bourdon tube, diaphragm, and bellows), strain gauges – capacitive type pressure gauge – piezoelectric pressure sensor, Measurement of vacuum – McLeod gauge, thermal conductivity gauges, Ionization gauge - Testing and calibration of pressure gauges – dead weight tester. Measurement of flow velocity-intrusive and nonintrusive types- Pitot and Pitot static tube, Hot wire Anemometer - Ultrasonic and laser Doppler velocity meter, particle image velocimetry. **8 Hrs**	
Teaching-Learning Process	1.Chalk and Talk 2. Power-point Presentation

Module-4	
Measurement of gas composition, liquid level and noise: Measurement of gas composition- Sampling systems, sampling probe, molecular beam sampling probe - separation methods - gas hormatography, flame ionization detector, Spectroscopic techniques, non-separation methods- Non Dispersive infrared analyzer, Luminescence-based detectors- Principles of liquid level measurement- buoyancy force, differential pressure, capacitor and resistance level indicators, Measurement of noise-sound level meters. **8 Hrs**	
Teaching-Learning Process	1.Chalk and Talk 2. Power-point Presentation

Module-5
Measurement of force, torque, power and acceleration: Force measurement by mechanical balancing, force to displacement transformation and force to pressure transformation- strain gauges, piezoelectric transducer, Load cells for force measurement - Torque and power measurement – dynamometers - measurement of angular velocity – Tachometers, mechanical and fiber optic gyroscopes - Measurement of linear acceleration- Accelerometers – theoretical consideration of a seismic mass accelerometer, piezoelectric and fiber optic accelerometers-Laser Doppler Vibrometer. **8 Hrs**

Teaching-Learning Process	1.Chalk and Talk 2. 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:

- Three Unit Tests each of **20 Marks**
- 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:

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

Suggested Learning Resources:

Web links and Video Lectures (e-Resources):

- .VTU e-Shikshana Program
- VTU EDUSAT Program

Skill Development Activities Suggested

- Quizzes
- Assignments
- Seminars

Course outcome (Course Skill Set)At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Analyse the statistical data obtained through measurement	
CO2	Conditioning the electronic data obtained through measurements	
CO3	Acquire data inputs using sensors from a system	
CO4	Select the correct transducers for measurement of temperature, pressure etc of fluids	
CO5	Select the correct transducers for measurement of force, torque & power etc	

Program Outcome of this course

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

Mapping of COS and POs

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

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

INDUSTRIAL DESIGN AND ERGONOMICS

Course Code	**22MPY/MPD/MAU/MPT/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

Introduction: An approach to industrial design -elements of design structure for industrial design in engineering application in modern manufacturing systems. Ergonomics and Industrial Design: Introduction -general approach to the man- machine relationship- workstation design-working position. 08Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

MODULE-2

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. Ergonomics and Production: ergonomics and product design - ergonomics in automated systems- expert systems for ergonomic design. Anthropometric data and its applications in ergonomic, design limitations of anthropometric data- use of computerized database. 08Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

MODULE-3

Visual Effects of Line and Form: The mechanics of seeingpsychology of seeing general influences of line 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. 08Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

MODULE-4

Aesthetic Concepts: Concept of unity- concept of order with variety - concept of purpose style and environment- Aesthetic expressions. Style-components of style- house style, observation style in capital goods, casestudy08Hrs

Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

MODULE 5

Industrial Design in Practice: General design -specifying design equipments- rating the importance of industrial design -industrial design in the design process. 08Hrs

Teaching-Learning	Chalk and talk method / PowerPoint Presentation

Process	

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

Sl.NO	Experiments
1	Development of Ergonomic Chair for various applications (office & Resting)
2	Design the workspace area such that the work efficiency can be enhanced
3	Design a product using athletics and ergonomics which is useful in day to today's life.
4	Apply the ergonomics in improving the existing product and give min 5 improvement in it.
5	Using House of style and giving an idea on the product development.
6	Implement various concepts and develop new product concepts and make a report on it.

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

- Industrial Design for Engineers - Mayall W.H. - London Hiffee books Ltd.-1988.
- Applied Ergonomics Hand Book - Brain Shakel (Edited) - Butterworth scientific. London
- Introduction to Ergonomics - R. C. Bridger - McGraw Hill Publications -1995.
- Human Factor Engineering - Sanders & McCormick - McGraw Hill Publications – 6thedition, 2002.

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program

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

- Quizzes
- Assignments
- Seminars

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Understanding the concepts of Industrial design and man-machine relationship.	
CO2	Design of optimistic display and control devices for various applications.	
CO3	Applying the anthropomorphic data in ergonomic design	

Program Outcome of this course

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

Mapping of COS and Pos (indicative only)

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

Semester- II

OPERATIONS RESEARCH			
Course Code	22MPY231	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40 Hours	Total Marks	100
Credits	3	Exam Hours	3

Course Learning objectives:

- To know different types of rapid prototyping processes.
- To know how to do the rapid prototyping of 3D models.

Module-1

Introduction: OR Methodology, Definition of OR, Application of OR to Engineering and Managerial Problems, Features of OR models, Limitation of OR.
LINEAR PROGRAMMING: Definition, Mathematical formulation, Standard form, solution space, Solution – Feasible, basic feasible, Optimal, Infeasible, Multiple, Optimal, Redundancy, Graphical Method. **08 Hrs**

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

Module-2

Linear programming: Simplex method, variants of simplex algorithm
– Artificial basis techniques, Duality, Economic interpretation of Dual,Solution of LPP using duality concept **08 Hrs**

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

Module-3

Transportation problem: Formulation of transportation model, Basic feasible solution using different methods (North-West corner, Least Cost, Vogel's Approximation Method) Optimality Methods. Unbalanced transportation problem, Variants in Transportation Problems, Applications of Transportation problems.
Assignment problem: Formulation of the Assignment problem, unbalanced assignment problem, travelling salesman problem. **08 Hrs**

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

Module-4

Queuing theory: Queuing system and their characteristics, The M/M/1 Queuing system,Steady state performance analyzing of M/M/1 queuingmodel.
Game theory: Formulations of games, Two person zero sum game, games with and without saddle point, graphical solutions (2xn, mx2 game), and dominance property. **08 Hrs**

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

Module-5

Project management using network analysis: Network construction, determination of critical path and duration, CPM Structured approach, Calculations of schedules and floats, Network crashing. PERT-
Estimation of project duration and variance. **08 Hrs**

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 **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. Introduction to Operation Research -Taha H A - Prentice Hall ofIndia - 6th edition, 1999.
2. Principles of Operations Research theory and Practice -Philips,Ravindran and SolebergWiley India Pvt Ltd.

References:

1. Introduction to Operation Research - Hamdy A Taha
2. Introduction to Operation Research -Hiller and Libermann –McGraw Hill - 5th edn.
3. Operations Research - S.D. Sharma – Kedarnath, Ramnath& Co -
4. Operations Research Theory and Application - J K Sharma – Pearson EducationPvt Ltd - 2ndEdn, ISBN-0333-92394-4. **4.** Operations Research Theory and Application - J K Sharma – Pearson Education Pvt Ltd - 2ndEdn, ISBN-0333-92394-4.

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program

Skill Development Activities Suggested

- Quizzes
- Assignments
- Seminars

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Provide greater insight into decision-making processes, withstrong fundamentals.	
CO2	Understand better how people perceive and decide about risk andtransform domain situation to LPP and solve it.	
CO3	Formulate as Transportation, Assignment, and Travelling salesmanproblems and derive Optimum solutions.	
CO4	Formulate game theory problems and obtain solutions usingdifferent methods. Understand the fundamentals of Queues.	
CO5	Develop an appropriate network diagram for the given problem.	

Program Outcome of this course

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

Mapping of COS and POs

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

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

Semester- II

Advanced Fluid Power Systems			
Course Code	22MPY/MPT232	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
3. 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. 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)

Semester- II

SURFACE TREATMENT & FINISHING			
Course Code	22MPY233	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	25 Theory + 10-12 Activities	Total Marks	100
Credits	3	Exam Hours	03

Course Learning objectives:

- Identify & understand different coating techniques.
- Understand heat treatment methods gears, spindles, cutting tools.
- Understand special types of coating.

Module-1

Fundamentals of Electro plating, galvanizing, hot dip metal coating, thin coating, thincoating, chromium plating, Nickel plating. Vacuum coating, FVD & CVD metal spraying -Methods, surface preparation, Mechanical. **05 Hrs**

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

Module-2

Properties of sprayed metals, plasma coating. Plastic coating of metal - PVC coating, Spherodising process details, phosphate coating - mechanism of formation. **05 Hrs**

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

Module-3

Testing of surface coating-methods. Heat treatment methods, Annealing, Normalizing,Tempering, Case hardening methods, flame hardening subzero treatment. **05 Hrs**

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

Module-4

Heat treatment methods for gears, spindles, cutting tools. **05 Hrs**

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

Module-5

Advanced coating technologies: Hard facing, electro depositiontechnique, Nano-coatings,coating characterization. **05 Hrs**

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 Mark** or **one Skill Development Activity of 40 marks** to attain the COs and POs
3. 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:

Reference 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 - 2d ed.,1978.
3. Handbook of metal treatment and testing - John wiley & sons.

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program

Skill Development Activities Suggested

- Quizzes
- Assignments
- Seminars

Course outcome (Course Skill Set)

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 spraymethods in electroplates.	
CO2	Understand the mechanism of coating formation and their properties.	
CO3	Test coated and sprays metal surfaces using suitable heat treatmentmethods.	
CO4	Heat treated gears, spindle and cutting tools.	
CO5	Understand electro deposition and Nano coating technique.	

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

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

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

Semester- II

HUMAN RESOURCES MANAGEMENT			
Course Code	22MPY/MPT/MPM234	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	25 Theory + 10-12 Activities	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- Understand HRM functions.
- To know the selection process of candidate.
- To learn the various training techniques & career opportunities for employee
- To learn global HR techniques.

Module-1

HRM in perspective, competitive challenges, uses of HR information, Demographics and employee concerns, social issues, diversity in HRM,
Relationship of Job Requirements and HRM functions, Job Analysis, Job Description, Job Design, Designing work for groups, flexible work schedules, Industrial engineering and ergonomic consideration, HR Planning, Effective HRP, Forecasting and balancing supply and demand of HR, recruiting from inside and outside, Recruiting protected class, Recruiting older people. **05 Hrs**

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

Module-2

Selection, Matching people and job, sources of information about job candidate, The US Employee Polygraph Protection Act, graphology, Medical examination, Drug test, Interview methods Guidelines for interviewers, appropriate and inappropriate interview questions, selection decision. 05Hrs

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

Module-3

Developing effectiveness in HR, Investment in Training, System approach, Conducting the .needs assessment, designing trainingprograms, trainee readiness and motivation, principles of learning, characteristics of trainees, training methods for non-managerial employees, OJT, Technology for training, training methods for MDP, Evaluating, benchmarking HR training. **05 Hrs**

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

Module-4

Career development and Appraisal, identifying career opportunity and requirements, gauging employee potential, career development initiative, Mentor check list, career development for women and minorities, dual career couples, personal career development, Behavioural methods of appraisal, balanced score card, personal score card appraisal interviews; performance diagnosis. **05 Hrs**

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

Module-5

International HRM, Managing across borders, International staffing, Skills of a global manager, content of training program. Non-verbal communications, developing local resources, compensation of host country employees, managers and expatriate managers. Case studies on appraisal system, developing a training session, evaluating a given training program. Preparation of structured and unstructuredinterviews. **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:

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.
5. 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:

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

Suggested Learning Resources:

Textbooks :

1. Managing Human Resources - Wayne F Cascio - Tata McGraw Hill,New Delhi
2. Managing Human Resources - George Bohlander and Scot Snell -Thompson South western.

Reference Books

1. Human Resource Management - BiswajeetPattanayak - PrenticeHall of India Pvt. Ltd.
2. Human Resource Management - K. Ashwathappa
3. Personnel Management - C.B.Memoria - Himalaya Publishing.

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program

Skill Development Activities Suggested

- Quizzes
- Assignments
- Seminars

Course outcome (Course Skill Set)

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.	
CO2	Know methodology of job selection process implemented in varioussectors.	
CO3	Analyse the effectiveness in training, evaluating and benchmarkingHR training.	
CO4	Understand the career development concept and methods of personalappraisal.	
CO5	Understand International activities of HRM, Staffing, communication, appraisal training and interview system.	

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

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

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

Semester- II

Quality and Reliability Engineering			
Course Code	22MPY335	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 sub-grouping, 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 **one Skill Development Activity of 40 marks** to attain the COs and POs.
3. 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. 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)

Semester- II

AGILE MANUFACTURING			
Course Code	22MPY/MPT/MTE/MSE/MIA/MEM/ MPM241	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	25 Theory +10-12 Activities	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- Understand Agile manufacturing.
- Learning of Four Core Concepts in Agile manufacturing.
- Understand the change management in agile manufacturing.
- To study the enterprise design of agile manufacturing.
- Enhance the skill and Technology of agile 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. **5 Hrs**

Teaching-Learning Process	1. Chalk and Talk are used for Problem Solving./White board 2.Power-point Presentation

Module-2

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

Teaching-Learning Process	1. Chalk and Talk are used for Problem Solving./White board 2.Power-point Presentation

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, control technological and design paradigms traditional problems in work place organizational issues - role of technology. **5 Hrs**

Teaching-Learning Process	1. Chalk and Talk are used for Problem Solving./White board 2.Power-point Presentation

Module-4

Agile Manufacturing Enterprise Design: Agile manufacturing - enterprise design. System concepts as the basic manufacturing theory - joint technical & organizational design and amodel for the design of agile manufacturing enterprise, enterprise design process insights into design processes, what is interdisciplinary design, Main issues - simple design example. 5 **Hrs**

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 - technologydesign strategic-Design Concepts. Design and Skill of Knowledge enhancing Technologies for machine tool systems – Historical overview, Lessons, problems and Future development. **5 Hrs**	
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 **one Skill Development Activity of 40 marks** to attain the COs and POs
3. 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:

Reference Books :

1. Agile manufacturing - Forging new Frontiers - Paul T. Kidd -Addison Wesley Publication1994.
2. Agile Manufacturing – Proceedings of International Conference -Dr. M.P Chowdiah(Editor)–TataMcGraw Hill Publications - 1996.
3. on agile manufacturing - Tata McGraw Hill Publications -1996

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program

Skill Development Activities Suggested

- Quizzes
- Assignments
- Seminars

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Understand the agile manufacturing and conceptual frame work.	
CO2	Analyse the four core concept of agile manufacturing.	
CO3	Study the implication of advanced manufacturing system.	
CO4	Understand and design the agile manufacturing enterprises.	
CO5	Design skill and knowledge enhancing technology for agilemanufacturing.	

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

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

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

Semester- II

ROBUST DESIGN			
Course Code	22MPY242	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- Students will be introduced to production and cost theory along with its analysis.
- Students will learn about market structure & pricing procedure.

Module-1

Quality by Experimental Design: Quality, western and Taguchi quality philosophy, Elements of cost, Noise factors causes of variation, Quadratic loss function and variation of quadratic loss functions.
Robust Design: Steps in robust design: parameter design and tolerance design, reliability improvement through experiments, illustration through numerical examples. **08 Hrs**

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

Module-2

Experimental Design: Classical experiments: factorial experiments, terminology, factors. Levels, Interactions, Treatment combination, randomization, 2-level experimental design for two factors and three factors. 3-level experiment deigns for two factors and three factors, factor effects, factor interactions, Fractional factorial design, Saturated design, Central composite designs, Illustration through numerical examples. **08 Hrs**

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

Module-3

Measures of Variability : Measures of variability, Concept of confidence level, Statistical distributions : normal, log normal and Weibull distributions. Hipothesis testing, Probability plots, choice of sample size illustration through numerical examples.
Analysis and interpretation of experimental data: Measures of variability, Ranking method, column effect method and ploting method, Analysis of variance (ANOVA), in factorial experiments : YATE's algorithm for ANOVA, Regression analysis, Mathematical models from experimental data, illustration through numerical examples. **08 Hrs**

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

Module-4

Taguchi's Orthogonal Arrays : Types orthogonal arrays, Selection of standard orthogonal arrays, Linear graphs and interaction assignment, dummy level technique, Compound factor method, modification of linear graphs, Column merging method, Branching design, Strategies for constructing orthogonal arrays.
Signal to Noise ratio (S-N Ratios) : Evaluation of sensitivity to noise, Signal to noise ratios for static problems, Smaller – the – better types, Nominal – the – better – type, larger – the- better – type. Signal to noise ratios for dynamic problems, Illustrations through numerical examples. **08 Hrs**

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

Module-5

Parameter Design and Tolerance Design: Parameter and tolerance design concepts, Taguchi's inner and outer arrays, Parameter design strategy, Tolerance deign strategy, Illustrations through numerical examples.
Reliability Improvement Through Robust Design : Role of S-N ratios in reliability improvement ; Case study; Illustrating the reliabilityimprovement of routing process of a printed wiring boards using robustdesign concepts**.**
08 Hrs

Teaching-Learning Process	1.Chalk and Talk /White board 2. 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:

- Three Unit Tests each of **20 Marks**
- 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:

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

Suggested Learning Resources:

Text books :

1. Quality Engineering using Robust Design - Madhav S. Phadake:Prentice Hall, Englewood Clifts, New Jersey 07632, 1989.
2. Design and analysis of experiments - Douglas Montgomery: Willey
3. Techniques for Quality Engineering - Phillip J. Ross: Taguchi 2nd

Reference Books :

1. Quality by Experimental Design - Thomas B. Barker - MarcelDekker Inc ASQC Quality Press, 1985
2. Experiments planning, analysis and parameter design optimization -C.F. Jeff Wu, Michael Hamada - John Willey Ed., 2002
3. Reliability improvement by Experiments - W.L. Condra, - MarcelDekker Inc ASQC Quality Press, 1985

Web links and Video Lectures (e-Resources):

- .VTU e-Shikshana Program
- VTU EDUSAT Program

Skill Development Activities Suggested :

- Quizzes / Activities
- Assignments
- Seminars

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Create designs that have a minimal sensitivity to input variation	
CO2	Reduce design costs	
CO3	Determine which design parameters have the largest impact onvariation	
CO4	Optimize designs with multiple outputs.	
CO5	Understand the Parameter Design and Tolerance Design.	

Program Outcome of this course

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

Mapping of COS and POs:

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

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

Semester- II

MAINTENANCE ENGINEERING & MANAGEMENT			
Course Code	22MPY243	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40 Hours	Total Marks	100
Credits	3	Exam Hours	3

Course Learning objectives:

- Students will learn about basis of actuators & pumps.
- Students will be introduced to various hydraulic components like valves, filters, accumulators etc.
- Students will be analysing various hydraulic & pneumatic logic circuits.

Module-1

MAINTENANCE CONCEPT: Need for maintenance-Challenges in maintenance-Objectives of maintenance-Maintenance organization- Scope of maintenance department-Maintenance management- Tero-Technology-Five zero concept-Maintenance performance measurement- Maintenance costs-Maintenance audit. **08Hrs**

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

Module-2

MAINTENANCE POLICIES: Planned vs unplanned maintenance- Preventive maintenance vs Breakdown maintenance-Predictive maintenance-Corrective maintenance-Opportunistic maintenance- Design out maintenance-Condition Based Maintenance (CBM) - Analysis of downtime-Repair time distribution (exponential, lognormal) - MTTR-System repair time-Maintainability prediction. **08 Hrs**

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

Module-3

MAINTENANCE LOGISTICS: Proactive and Reactive maintenance-Minimum vs Extensive maintenance-Work order form- Maintenance planning-Maintenance scheduling-Spare parts control & inventory management- Human factors in maintenance- Maintenance crew size-Replacement models. **08 Hrs**

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

Module-4

FAULT DIAGNOSIS: Nondestructive and destructive testing-Shock pulse monitoring-Condition monitoring-Lubrication practices-Wear Debris Monitoring (WDM)-Vibration monitoring-Corrosion control- Signature analysis-Computerized Maintenance Management System-Use of Fault Trees. **08 Hrs**

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

Module-5

TOTAL PRODUCTIVE MAINTENANCE: TPM Philosophy-
Chronic and sporadic closses- Six big losses- Overall Equipment Effectiveness- Autonomous Maintenance-TPM Pillars-Reliabilityprediction-MTBF, MTTF-Reliability of series & parallel systems-
Reliability Centred Maintenance. **08 Hrs**

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:

6. Three Unit Tests each of **20 Marks**
7. 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:

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

Suggested Learning Resources:

Text Books:

1. Tanmoy Deb, "Maintenance Management and Engineering", AneBooks Pvt.Ltd. 2011.

References:

1. Charles E.Ebeling, "An Introduction to Reliability and Maintaibaility Engineering", McGraw Hill Education (India) Pvt.Ltd, 2013.
2. Seiichi Nakajima, "Introduction to Total Productive Maintenance", Productivity Press,1988.
3. MasajiTajiri and Fumio Gotoh, "Autonomous Maintenance inseven steps", ProductivityInc., Oregon, 1999.

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program.

Skill Development Activities Suggested

- Quizzes
- Assignments
- Seminars

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1		
CO2		
CO3		
CO4		
CO5		

Program Outcome of this course

Sl. No.	Description	Pos
PO1		
PO2		
PO3		
PO4		
PO5		
PO6		
PO7		

Mapping of COS and POs

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

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

Semester- II

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 modelling and replicating the practical situations in organizations
- Generate random numbers and random varieties 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 Modeling 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
3. 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

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

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)

Semester- II

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

Course Learning objectives:

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

Module-1	
Introduction to Industry 4.0: Introduction, core idea of Industry 4.0,origin concept of industry 4.0,Industry 4.0 production system, current state of industry 4.0, Technologies, How is India preparing for Industry 4.0 05Hrs	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-2	
A Conceptual Framework for Industry 4.0: Introduction, Main Concepts and Components of Industry 4.0, State of Art, Supportive Technologies, Proposed Framework for Industry 4.0. 05Hrs	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-3	
Technology Roadmap for Industry 4.0 : Introduction, Proposed Framework for Technology Roadmap, Strategy Phase, Strategy Phase, New Product and Process Development Phase. 05Hrs	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-4	
Advances in Robotics in the Era of Industry 4.0: Introduction, Recent Technological Components of Robots-Advanced Sensor Technologies, Internet of Robotic Things, Cloud Robotics, and Cognitive Architecture for Cyber-Physical Robotics, Industrial Robotic Applications- Manufacturing, Maintenance and Assembly. 05Hrs	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-5	
Obstacles and Framework Conditions for Industry 4.0 : Lack of A Digital Strategy alongside Resource Scarcity, Lack of standards and poor data security, Financing conditions, availability of skilled workers, comprehensive broadband infra- structure, 05Hrs	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Assessment Details (both CIE and SEE)

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

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

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program

Skill Development Activities Suggested

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

Course outcome (Course Skill Set)

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

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

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

Mapping of COS and Pos (indicative only)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	3	2	3	2	3	3
CO2	2	3	3	2	3	3	3
[illegible]							

MINI PROJECT WITH SEMINAR			
Course Code	**22MPD25**	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 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).

End of 2nd Semester

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI.

Scheme of Teaching and Examinations and Syllabus

M.Tech., Production Technology(MPY)

(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., title of the Programme (XXX) (Font 09 Capital, Calibri)
Choice Based Credit System (CBCS) and Outcome Based Education(OBE)

III SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Hours /Week			Examination				Credits
				Theory	Practical/ Mini–Project/ Internship	Tutorial/ Skill Development Activities	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	P	SDA					
1	PCC	22MPY31	Tool Design	03	00	02	03	50	50	100	4
2	PEC	22MPY32X	Professional Elective 3	03	00	00	03	50	50	100	3
3	OEC	22MPY33X	**Professional Elective 4**	03	00	00	03	50	50	100	3
4	PROJ	22MPY34	Project Work phase -1	00	06	00	--	100	--	100	3
5	SP	22MPY35	Societal Project	00	06	00	--	100	--	100	3
6	INT	22MPYI36	Internship	(06 weeks Internship Completed during the intervening vacation of II and III semesters.)			03	50	50	100	6
TOTAL				**09**	**12**	**03**	**12**	**400**	**200**	**600**	**22**

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

Professional elective 3		**Professional Elective 4**	
Course Code under 22MPY32X	**Course title**	**Course Code under 22MPY33X**	**Course title**
22MPY321	Applied Probability & Statistics	22MPY/MPT/MTE /MST/MSE/MAU/ MPE/MPD/331	Non Destructive Testing
22MPY/MPM/MTE/ MSE/MMD/MEA/M DE/MPE/MAU/MPD 322	Rapid Prototyping	22MPY332	Product Data Management
22MPY/MSE/ME M/MPE/MAU323	Composite Materials	22MPY/MPT333	Project Management
22MPY324	Organizational Behaviour	22MPY334	Industrial Safety Engineering
22MPY325	Industrial Robotics	22MPY335	Advance joining process

Note:

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

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

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

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

CIE marks shall be awarded by a committee comprising of HOD as Chairman, Guide/co-guide if any, and a senior faculty of the department. The CIE marks awarded, shall be based on the evaluation of Project Report, Project Presentation skill, and performance in the Question and Answer session in the ratio of 50:25:25.

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

course.

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

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

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
Scheme of Teaching and Examinations – 2022
M.Tech., title of the Programme (XXX) (Font 09Capital, Calibri)
Choice Based Credit System (CBCS) and Outcome Based Education(OBE)

IV SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Hours /Week		Examination				Credits
				Theory	Practical/ Field work	Duration in hours	CIE Marks	SEE Marks Viva voce	Total Marks	
				L	P					
1	Project	22MPY41	Project work phase -2	--	08	03	100	100	200	18
			TOTAL	--	**08**	**03**	**100**	**100**	**200**	**18**

Note:

1. Project Work Phase-2:

Students in consultation with the guide/co-guide (if any) in disciplinary project or guides/co-guides (if any) of all departments in case of multidisciplinary projects, shall continue to work of Project Work phase -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.

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

Programme Outcome:

PO1 - An ability to independently carry out research /investigation and development work to solve practical problems.

PO2 - An ability to write and present a substantial technical report/document.

PO3 - Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program

PO4 - Understand contemporary issues in manufacturing engineering and develop relationship between product design and manufacturability to create safe, reliable, and cost-effective products.

PO5 - Understand the process of converting customer needs into engineering specifications to create product designs that are sensitive to user needs and robust against unanticipated uses and misuse

PO6 - Employ advanced prototyping methods to shorten design cycles and narrow alternatives without restricting innovation.

PO7 - Understand and debate the roles and responsibilities of a product designer/manufacturer on society.

III SEMESTER

Semester- III

TOOL DESIGN			
Course Code	20MPY31	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:2	SEE Marks	50
Total Hours of Pedagogy	25 Theory + 10-12 Activities	Total Marks	100
Credits	04	Exam Hours	03

Course Learning objectives:

- Understanding tool design procedure, different tool making practices.
- To study design of Cutting tools, Inspection tools and Gauges.
- To study design of Drill Jigs, Fixtures and Press Working Tools.
- To understand bending of sheet metals, forming and drawing dies
- To understand tooling and tooling materials

Module-1

Tool-design Methods: Introduction, the design procedure, drafting and design techniques in tooling drawing
Tool-making Practices: Introduction, tools of the tool maker, hand finishing and polishing, screws and dowels, hole location, jig-boring practice, installation of drilling bushings, punch and die bushings, punch and die manufacture, EDM, EDM for cavity applications, tracer and duplicating mills for cavity applications, low-melting tool materials.
Tooling Materials and Heat Treatment: Introduction, properties of materials, ferrous tooling materials, non-ferrous tooling materials, non-metallic tooling materials, heat treatment and tool design. **05 Hrs**

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

Module-2

Design of Cutting Tools: Introduction, the metal cutting process, revision of metal cutting tools-single point cutting tools, milling cutters, drills and drilling, reamers, taps. Selection of carbide tools, determining the insert thickness for carbide tools.
Design of Tools for Inspection and Gauging: Introduction, workpiece quality criteria, principles of gauging, types of gages and their applications, amplification and magnification of error, gage tolerances, selection of material for gauges, indicating gages, automatic gauges, gauging positionally tolerance parts, problems. **05 Hrs**

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

Module-3

Design of Drill Jigs: Introduction, types of drill jigs, general considerations in the design of drill jigs, drill bushings, methods of construction, drill jigs and modem manufacturing.
Design of Fixtures: Introduction, types of fixtures, fixtures andeconomics.
Design of Press-working Tools: Power presses, cutting operations, types of die-cutting operations - and their design, evolution of blanking and progressive blanking. **05 Hrs**

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

Module-4

Design of Sheet Metal Bending, Forming and Drawing Dies: Introduction, bending dies, forming dies, drawing dies. Evolution of a draw die, progressive dies and selection of progressive dies. Strip development for progressive dies, evolution of progressive dies, examples of progressive dies. Extrusion dies, drop forging dies and auxiliary tools, problems.
Tool Design for Joining Processes: Introduction, tooling for physicaljoining processes, tooling for soldering and brazing, tooling for mechanical joining processes, problems. **05 Hrs**

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

Process	3. Video Demonstration or Simulation.

Module-5

Tooling for Casting: Introduction, tooling for sand casting, shell moulding, metal moulding and die-casting, problems.
Tool Design for NC Machine Tools: Revision of NC control, fixture design for NC machine tools, cutting tools and tool-holding methods, automatic tool changers and tool positioners.
Plastics as Tooling Materials: Introduction, plastics commonly used as tooling materials, application of epoxy plastic tools, constructionmethods, metal forming operations with Urethane dies, calculating forces for Urethane pressure pads, problems. **05 Hrs**

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 **one Skill Development Activity of 40 marks** to attain the COs and POs
3. 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. Tool Design - Cyril Donaldson, GH Lecain and VC Goold - TMH Publishing Co Ltd., New Delhi, - 3rd editions, 2000.
2. Fundamentals of Tool Design – ASTME - PHI (P) Ltd., New Delhi -1983.

Reference Books:

1. Cutting Tool Design - Rodin - Mir publications -1968.
2. Metal cutting & Tool Design - Arshinov -Mir Publishers, Moscow – 1970.
3. Press working of metals – Hinman -McGraw Hill – 1950.

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program

Skill Development Activities Suggested

- Quizzes
- Assignments
- Seminars

Course outcome (Course Skill Set)

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.	
CO2	Design the mill cutters, broach and clamping devices.	
CO3	Understand the application of jigs and fixtures, gauges and design them.	
CO4	Understand the concept of press tools and its dies.	
CO5	Design forming dies and understand the classification and application of automats	

Program Outcome of this course

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

Mapping of COS and POs

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

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

Semester- III

PROFESSIONAL ELECTIVE – III

APPLIED PROBABILITY AND STATISTICS			
Course Code	20MPY321	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	25 Theory + 10-12 Activities	Total Marks	100
Credits	04	Exam Hours	03

Course Learning objectives:

- To understand statistical thinking.
- To study about probability distribution and its functions.
- To study about various testing hypothesis.

Module-1

Introduction to statistics: Statistical Thinking, Collecting data, Statistical Modeling Framework, measure of central tendency and variance, Importance of Data summary and Display, Tabular and Graphical display. **08 Hrs**

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

Module-2

Discrete Random Variables and Probability distribution: Discrete Random variables, Probability distributions and Probability mass functions, Cumulative distribution functions, Mean and Variance of a discrete random variable, discrete uniform distribution, Binominal distribution, Hyper Geometric distribution, Poisson distribution, Applications. **08 Hrs**

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

Module-3

Continuous Random Variables and Probability Distributions: Continuous random variables, Probability distributions and probability density functions, cumulative distribution functions, Mean and Variance of a continuous random variable, uniform distribution, Normal distribution, Normal approximation to Binominal and Poisson distribution, Exponential distribution. **08 Hrs**

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

Module-4

Testing of Hypothesis: Estimation theory, Hypothesis testing, Inference on the mean of a population (variance known and unknown), Inference on the variance of a normal population, Inference on a population proportion, Testing for Goodness of Fit, Inference for a difference in Means, Variances known, Inference for a difference in means of two normal distributions, Variances unknown, Inference on the Variances of two normal populations, Inference on two population proportions. **08 Hrs**

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

Module-5

Simple Linear Regressions and Correlation: Simple Linear Regression, Properties of Least square Estimators and Estimation of variances, Transformations to a straight line, Correlation.
Multiple linear regressions: Multiple linear regressions model, least square estimation of parameters, Matrix approach to multiple linearregression, properties of least square estimators and estimation of variance. **08 Hrs**

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 **one Skill Development Activity of 40 marks** to attain the COs and POs
3. 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. Applied statistics and Probability for Engineers – Douglas C Montgomery, George C Runger, 2nd Edn, John Wiley and Sons, ISBN-0-471-17027-5, 1999.
2. Statistics for Management, Richard I Levin, David S Rubin,6thEdn, Prentice Hall India, ISBN-81-203-0893X.

Reference Books:

1. Probability and Statistics in Engineering - William W Hines,Douglas C Montgomery - John Wiley and Sons – 2ndEdn,
2. Business Statistics for Management and Economics - Daniel, Terrell - Houghton Mifflin Company – 6Edn, ISBN-0-395-62835-0.
3. Probability and Statistics - by Walpole & Mayer - MacMillanPublishing Company - 1989.

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program

Skill Development Activities Suggested

- Quizzes
- Assignments
- Seminars

Course outcome (Course Skill Set)

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.	
CO2	Design the mill cutters, broach and clamping devices.	
CO3	Understand the application of jigs and fixtures, gauges anddesign them.	

CO4	Understand the concept of press tools and its dies.	
CO5	Design forming dies and understand the classification and application of automats	

Program Outcome of this course

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

Mapping of COS and POs

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

III Semester

RAPID PROTOTYPING			
Course Code	22MPY/MPM/MTE/MSE/MMD/MEA /MDE/MPE/MAU/MPD322	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40 Hours	Total Marks	100
Credits	3	Exam Hours	3

Course Learning objectives:

- To impart the knowledge, basic concept and importance of metrology.
- To educate the students on different types of measurement systems.
- To impart the knowledge about the various measuring instruments to measure the linear, angular, form and surface finish measurements.
- To introduce the applications of computer and laser in the field of metrology, quality control and inspection.

Module-1

Metrological concepts: Abbe's principle – need for high precision measurements – problems associated with high precision measurements. Standards for length measurement – shop floor standards and their calibration – light interference – method of coincidence – slip gauge calibration – measurement errors. **8Hrs**

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

Module-2

Various tolerances and specifications: Gauging principles – selective assembly – comparators. Angular measurements: principles and instruments. Thread measurements –surface and form metrology – flatness, roughness, waviness, roundness etc. – computer aided metrology – advantages and limitations. **8Hrs**

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

Module-3

Laser metrology: Applications of lasers in precision measurements – laser telemetric system – laser interferometer – speckle measurements – laser inspection – dimensional measurement techniques. **8Hrs**

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

Module-4

Co-ordinate measuring machine: contact and noncontact CMM – causes of errors – accuracy specifications – contact and non-contact probes. **8Hrs**

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

:Module-5

Introduction to CMM: Calibration of CMM – measuring scales – Moiré fringes in linear grating – advantages and applications of CMM. **8Hrs**

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 **one Skill Development Activity of 40 marks** to attain the COs and POs.
3. 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.R.K.Jain and S.C.Gupta, "Engineering Metrology", Dhanpat Rai and Sons, 2000

References:

1. "Hand book of industrial metrology", ASME
2. Hume, "Metrology", McDonald
3. Sharp, "Metrology", ELBS
4. Taher, "Metrology", ELBS
5. Ted Busch, "Fundamentals of dimensional metrology", 3rd Edition, Delmar Publishers

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program

Skill Development Activities Suggested

- Quizzes
- Assignments
- Seminars

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	To understand the principle of measuring standards and calibration.	
CO2	To understand the various tolerances used in measurement.	
CO3	To understand the use of lasers in measurement & inspection.	
CO4	To understand the working principle of CMM.	

Program Outcome of this course

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

Mapping of COS and POs

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

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

III Semester

COMPOSITE MATERIALS			
Course Code	22MPY/MSE/MEM/MPE/MAU323	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- To know the concept & scope of operations management in Business context.
- Understand the concept of forecasting & inventory control.
- Understand the need for scheduling & resource planning.

Module-1

INTRODUCTION TO COMPOSITE MATERIALS: Definition, classification and characteristics of composite materials – fibrous composites, laminated composites, particulate composites. Properties and types of reinforcement and matrix materials. **08 Hrs**

Teaching-Learning Process	1. Chalk and Talk are used for Problem Solving./White board 2.Power-point Presentation

Module-2

FIBRE REINFORCEMENT PLASTIC PROCESSING: Layup and curing, fabricating process – open and closed mould process – hand layup techniques – structural laminate bag molding production procedures for bag molding – filament winding, pultrusion, pulforming, thermo–forming, injection, injection molding, liquid molding, blow molding. **08 Hrs**

Teaching-Learning Process	1. Chalk and Talk are used for Problem Solving./White board 2.Power-point Presentation

Module-3

FABRICATION OF COMPOSITES: Cutting, machining, drilling, mechanical fasteners and adhesive bonding, joining, computer aideddesign and manufacturing, tooling, fabrication equipment. Ceramic Matrix composites and their fabrication technologies. **08 Hrs**

Teaching-Learning Process	1. Chalk and Talk are used for Problem Solving./White board 2.Power-point Presentation

Module-4

Application of composites: Characterization of composites, computer aided design and analysis of composites, Application of industrial experimentation for fabrication and testing of composites. **08 Hrs**

Teaching-Learning Process	1. Chalk and Talk are used for Problem Solving./White board 2.Power-point Presentation

Module-5

STUDY PROPERTIES OF MMC'S: Physical Mechanical, wear, machinability and other properties. Effect of size, shape and distribution of particulate on properties. Advanced composites such as Polymer based Sandwich structures of Nano composites. Introduction to shape memory alloys. **08 Hrs**

Teaching-Learning Process	1. Chalk and Talk are used for Problem Solving./White board 2.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 **one Skill Development Activity of 40 marks** to attain the COs and Pos.
3. 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. Operations Management: Theory and Practice- B. Madhavan, Pearson Education India
2. Production and Operations Management: R. Pannerselam- Prentice Hall of India Pvt., Ltd.

Reference Books :

1. Operations Management for Competitive Advantages: Chase and Aquilano, TMH Publications
2. Operations Management: William Stevenson TMH Publications
3. Operations Management: Robert Russell and Bernard Taylor, Pearson Publisher

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program

Skill Development Activities Suggested

- Quizzes / Activities
- Assignments
- Seminars

Course outcome (Course Skill Set)

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.	
CO2	Identify, describe rule of mixture and failure criteria for composites.	
CO3	Develop competency in one or more common composite manufacturing techniques, and be able to select the appropriate technique for manufacture of composite materials.	
CO4	Understand and analyse fabrication of composites and design of structure of composites.	
CO5	Understand and recommend composites for different applications and MMCs	

Program Outcome of this course

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

Mapping of COS and POs

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

III Semester

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 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	
Organizational Behaviour : Definition, Need for studying Organizational Behaviour, Disciplines involved in the study of Organizational Behaviour, -Contributing disciplines and area like psychology, social psychology, economics, anthropology etc. Application of Organizational Behaviour in Business. **05 Hrs**	
Teaching-Learning Process	1 .Chalk and Talk / White board. 2. Power Point Presentation. 3. Video Demonstration or Simulation.

Module-2	
Individual behaviour: Personality, perception, learning, attitudes inter-personal behaviour – Group and inter-group behaviour. **05 Hrs**	
Teaching-Learning Process	1 .Chalk and Talk / White board. 2. Power Point Presentation. 3. Video Demonstration or Simulation.

Module-3	
Group Dynamics : Formal and Informal Group, Group Norms, Group Cohesiveness, Group Behaviour and Group Decision –making **05Hrs**	
Teaching-Learning Process	1 .Chalk and Talk / White board. 2. Power Point Presentation. 3. Video Demonstration or Simulation.

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. **05Hrs**	
Teaching-Learning Process	1 .Chalk and Talk / White board. 2. Power Point Presentation. 3. Video Demonstration or Simulation.

Module-5	
Management of change- Conflict Management- Organisation Health, Development and Effectiveness. Management of culture, Cross Cultural Management **05 Hrs**	
Teaching-Learning	1 .Chalk and Talk / White board. 2. Power Point Presentation.

Process	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 **one Skill Development Activity of 40 marks** to attain the COs and POs
3. 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. Stephen. P. Robbins – Prentice Hall, India. - 9th edition 2001
2. Organizational Behavior – Fred Luthans – McGraw Hill – 1997

Reference Books:

1. Human Behavior at work– Keith Davis – Prentice Hall India – 2007.
2. Organizational Psychology – Robin, Kolb, etc – 1996

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program

Skill Development Activities Suggested

- Quizzes
- Assignments
- Seminars

Course outcome (Course Skill Set)

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	
CO2	Identify personality, interpersonal and intergroup behaviour.	
CO3	. Identify group types, norms and decision making	
CO4	Explain nature and development of leadership and Identify types of power.	
CO5	Solve problems of the management of conflict, development, effectiveness and cross cultural management	

Program Outcome of this course

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

Mapping of COS and POs

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

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

III SEMESTER

INDUSTRIAL ROBOTICS			
Course Code	22MPY325	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory +	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, motion time measurement system, basic motion time study) advantages. **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

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	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

Process	

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

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.
3. 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:

Textbooks :

1. Robotics engineering an integrated approach - Richard D Klafter, Thomas A Chmielewski,Michael Negin – Prentice Hall of India Pvt. Ltd. - Eastern Economy Edition, 1989.
2. Robotics: Control Sensing, Vision, intelligence - Fu KS Gomaler RC, Lee C S G –McGraw Hill Book Co. - 1987.

Reference books:

1. Handbook of Industrial Robotics - Shuman Y. Nof - John Wiley &Sons, New York -1985.
2. Robotics Technology and Flexible Automation - Deb SR - McGrawHill Book Co. - 1994

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program

Skill Development Activities Suggested

- Quizzes
- Assignments
- Seminars

Course outcome (Course Skill Set)

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	1	3	3	2
CO2	2	1	2	2	3	3	2
CO3	2	1	2	2	1	2	2

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

Semester- III

NON DESTRUCTIVE TESTING			
Course Code	22MPY/MPT/MTE/MST/MSE/MAU/ MPE/MPD/331	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	25 Theory +10-12 Activities	Total Marks	100
Credits	3	Exam Hours	03

Course Learning objectives:

- To understand the different non destructive methods.
- To understand different inspection principles.
- To understand the basics of Holography.

Module-1

Introduction to ND testing: selection of ND methods, visual inspection, leak testing, Liquid penetration inspection, its advantages and limitation, Magnetic particle inspection: Methods of generating magnetic field, types of magnetic particles and suspension liquids steps in inspection –application and limitations. **05 Hrs**

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

Module-2

Eddy current inspection: principles, operation variables, procedure, inspection coils, and detectable discounts by the method. Microwave inspection: Microwave holography, applications and limitations. **05 Hrs**

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

Module-3

Ultrasonic inspection: Basic equipment characteristics of ultrasonic waves, variables inspection, inspection methods pulse echo A,B,C scanstransmission, resonance techniques ,transducer elements couplets, search units, contact types and immersion types inspection standards- standard reference blocks. **05 Hrs**

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

Module-4

Radiography inspection: principles, radiation source X-rays and gamma rays, X-ray-tube, radio graphic films, neutron radiography, Thermal inspection principles, equipment inspection methods, applications. **05 Hrs**

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

Module-5

Optical Holography: Basics of Holography, recording and reconstruction – Acoustical Holography: systems and techniques applications. Indian standards for NDT. **05 Hrs**

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.
3. 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:

Reference Books

1. Non Destructive Testing – Mc. Gonnagle JJ – Garden and reach NewYork.
2. Non Destructive Evolution and Quality Control - volume 17 ofmetals hand book 9 edition Asia internal 1989.
3. The Testing instruction of engineering materials - Davis H.ETroxel G.E wiskovil C.T -McGraw hill.

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program

Skill Development Activities Suggested

- Quizzes
- Assignments
- Seminars

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Distinguish the destructive and non-destructive testing and findeffectiveness.	
CO2	Find the surface defect using liquid penetrant and magnetic particletest and eddy current test.	
CO3	Learn the mechanism of flaw detection using ultrasonic wavesystem.	
CO4	Understand the operations of microwave and radiography inspectionsystem.	
CO5	Understand the basics of holography and interferometry and its application in defect detection.	

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

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

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

PRODUCT DATA MANAGEMENT			
Course Code	22MPY332	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	25 Theory + 10-12 Activities	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- Explain the concepts, tools and techniques for managing product data.
- Analyze various processes in the product data management frameworks.
- Evaluate risks in large and complex workflow management environments.
- Develop product data management plans for various types of organizations.
- Understand The Sun Microsystems, Inc., Mentor Graphics Corporation and ABB.

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

Module-2	
Workflow Management in PDM: Structure Management, Engineering Change Management, Release Management, Version Management, Configuration Management. **05Hrs**	
Teaching-Learning Process	1 .Chalk and Talk / White board. 2. Power Point Presentation. 3. Video Demonstration or Simulation.

Module-3	
Creating Product Structures: Part centric approach, CAD centric approach, Product Structure configuration, Managing Product Structures, PDM Tools: Matrix One, Team Centre, Windchill. Enovia, PDM resources on the Internet. **05 Hrs**	
Teaching-Learning Process	1 .Chalk and Talk / White board. 2. Power Point Presentation. 3. Video Demonstration or Simulation.

Module-4	
PDM Implementation Case Studies: Sun Microsystems, Inc., Mentor Graphics Corporation, Ericsson Radio Systems AB, Ericsson Mobile Communications AB, ABB Automation Technology Products, SaabTech Ellectronic AB **05 Hrs**	
Teaching-Learning Process	1 .Chalk and Talk / White board. 2. Power Point Presentation. 3. 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 Ellectronic AB. **05 Hrs**	
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 Mark** or **one Skill Development Activity of 40 marks** to attain the COs and Pos.
3. 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. 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 -

Reference Books :

1. Wind-chill - RS.O Reference manuals - 2000.

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program

Skill Development Activities Suggested

- Quizzes
- Assignments
- Seminars

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Explain the concepts, tools and techniques for managing product data.	
CO2	Explain various processes in the product data management frameworks.	
CO3	Assess risks in large and complex workflow management environments.	
CO4	Compose product data management plans for various types of organizations.	
CO5	Discuss the Sun Microsystems, Inc., Mentor Graphics Corporation and ABB	

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

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

PROJECT MANAGEMENT

Course Code	22MPY/MPT333	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40 HOURS	Total Marks	100
Credits	3	Exam Hours	3

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, understands 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	1 .Chalk and Talk / White board. 2. Power Point Presentation. 3. 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	1 Chalk and Talk / White board. 2 Power Point Presentation. 3 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	1 Chalk and Talk / White board. 2 Power Point Presentation 3 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	1 Chalk and Talk / White board. 2 Power Point Presentation. 3 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	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 **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. 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 (Course Skill Set)

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 and Execution Control.	L1, L2, L3, L4
CO4	Apply the risk management plan and analyse the role of stakeholders.	L1, L2, L3, L4,L5
CO5	Understand the contract management, Project Procurement, Service level Agreements and productivity.	L1, L2, L3, L4

Program Outcome of this course

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

PO6	Employ advanced prototyping methods to shorten design cycles and narrow alternatives without restricting innovation.	PO6
PO7	Understand and debate the roles and responsibilities of a product designer/manufacturer on society.	PO7

Mapping of COS and POs

	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)

Semester III

INDUSTRIAL SAFETY ENGINEERING

Course Code	22MPT335	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40 Hours Theory	Total Marks	100
Credits	3	Exam Hours	3

Course Learning objectives:

- To impart the knowledge about safety rules & regulation.
- To educate the students on different about safety and operational procedure in industries.

Module-1

Safety management: Need for safety - safety and productivity - planning for safety -formulation of safety policy - safety management techniques - job safety analysis – safety sampling technique- incident recall technique - plant safety inspection - safety organizations and its functions. **8Hrs**

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

Module-2

Accident prevention: Nature and causes of accidents - accident proneness - cost of accidents - accident prevention methods -accident reporting and investigation – personal protective equipments - safety education and training – damage control and disaster control. **8Hrs**

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

Module-3

Operational safety: General safety considerations in material handling – manual and mechanical - safety in machine shop – safety in use of hand and portable (power) tools - safety in use of electricity – safety in welding and cutting – principles of guarding – safety in grinding - safety in heat treatment shop – safety in gas furnace operation. **8Hrs**

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

Module-4

Occupational health and hygiene: Concept and spectrum of health - levels of prevention - functional units of occupational health service - activities of occupational health unit – occupational and work related diseases such as silicosis – asbestosis - lead, nickel, chromium and manganese toxicity - prevention and control – gas poisoning - effects and prevention - hearing conservation programme - physical and chemical hazards - control measures. **8Hrs.**

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

Module-5

Fire engineering and explosion control: Fire triangle - classification of fires - fire properties of solid, liquid and gas - building evaluation for fire safety - fire load - fire resistance materials and fire testing. **8Hrs.**

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 **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:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.

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

Suggested Learning Resources:

Text Books:

1. Heinrich H. W, "Industrial accident prevention", McGraw Hill Company, New York, 1980

References:

1. Frank P. Lees, "Loss prevention in process industries", Vol. I, II & III, Butterworth, London, 1980

2. Brown D. B, "System analysis and design for safety" Prentice Hall, New Jercy, 1976

3. Derek James, "Fire prevention hand book", Butter Worths and Company, London, 1986

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program.

Skill Development Activities Suggested

- Quiz
- Assignments
- Seminar

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Understand the need for safety in Engineering practices.	
CO2	Understand the significance of occupational health & hygiene.	
CO3	To understand the principles of fire Engineering & Explosion control.	

Program Outcome of this course

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

Mapping of COS and POs

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

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

Advance Joining Process			
Course Code	22MPY335	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:2	SEE Marks	50
Total Hours of Pedagogy	25 Theory + 10-12 Activities	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- To understand the various welding techniques.
- To learn the different inspection techniques& symbols in welding.
- Identify welding design technique.

Module-1

Distortion- methods to avoid distortion, Stresses in Joint Design. **Electro Slag**, Welding Electron Beam Welding, Plasma arc Welding, LaserBeam Welding, Explosion Welding, Diffusion Welding, Ultrasonic Welding, Friction welding and Thermit welding. **05 Hrs**

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

Module-2

Welding and cladding of dissimilar materials, overlaying and surfacing. Advanced soldering and brazing processes - different types. Welding of plastics. **05 Hrs**

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

Module-3

Inspection of Welds: Destructive techniques like Tensile, Bend, and Nick break, Impact &Hardness. Non-Destructive techniques like 'X' rays, Ultrasonic, Magnetic particle, Dye Penetrate, Gamma ray inspection.
Welding Symbols- Need for, Representing the welds, Basic weld symbols, Location of Weld, Supplementary symbols, Dimensions ofwelds, Examples. **05 Hrs**

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

Module-4

Welding Design - Introduction, Principles of sound welding design, Welding joint design.Welding positions, Allowable strengths of welds, under steady loads.
Quality Control in Welding - Introduction, Quality assurance v/s Quality control, Weldquality, Discontinuities in welds, their causes and
remedies and Quality conflicts.**05 Hrs**

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

Module-5

Computer-Aided Welding Design – Introduction, Principles of soundwelding design, Welding joint design, Welding positions, Allowable strengths of welds. Idler steady loads,Weld throat thickness, Solved
and um solved examples.**05 Hrs**

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 **one Skill Development Activity of 40 marks** to attain the COs and POs
3. 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:

Reference Books:

1. Welding Engineering Handbook - A.W.S.
2. Welding Engineering - Rossi - McGraw Hill.
3. Advanced Welding processes – Nikodaco & Shansky - MIRPublications.

eb links and Video Lectures (e-Resources):

- VTU e-Shikshana Program

VTU EDUSAT Program

Skill Development Activities Suggested

- Quizzes
- Assignments

Seminars

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Understand the concept of joining processes for various materialsand methods to avoid distortion.	
CO2	Understand various non-conventional welding process.	
CO3	Inspect the welds using DT and NDT techniques and learn the weldsymbols.	
CO4	Design the welding and applying quality control techniques.	
CO5	Apply computer software for weld design	

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

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

PROJECT WORK PHASE – 1			
Course Code	**22MPY34**	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	**22MPYI36**	CIE Marks	50
Number of contact Hours/Week	**6 Weeks**	SEE Marks	50
Credits	**06**	Exam Hours	03

Course Objectives:

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

The objectives are further,

- To put theory into practice.
- To expand thinking and broaden the knowledge and skills acquired through course work in the field.
- To relate to, interact with, and learn from current professionals in the field.
- To gain a greater understanding of the duties and responsibilities of a professional.
- To understand and adhere to professional standards in the field.
- To gain insight to professional communication including meetings, memos, reading, writing, public speaking, research, client interaction, input of ideas, and confidentiality.
- To identify personal strengths and weaknesses.
- To develop the initiative and motivation to be a self-starter and work independently.

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

Each student, is required to

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

Course outcomes:

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

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

Continuous Internal Evaluation

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

Semester End Examination

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

IV SEMESTER

PROJECT WORK PHASE -2

Course Code	**22MPY41**	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.