

Syllabus

Semester-II

Industrial Design and Ergonomics			
Course Code	MMPT/MMPY201	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 Hrs. theory + 10 – 12 Hrs. laboratory	Total Marks	100
Credits	04	Exam Hours	03
Course Learning Objectives			
<ul style="list-style-type: none"> • 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			
<p>Method Study I / work Simplification: Definition and objectives procedures, Selection of jobs.</p> <p>Recording Tools and Techniques: Operation process chart, flow process charts (Man type-Material type), critical examination, Develop the improved method.</p> <p>Method Study II/ Work Simplification II: Tools for recording the movement of workers: String diagram, travel chart, multiple activity chart, and Man & Machine process chart, Two handed process chart (operator process chart), and principles of motion economy.</p>			
Module - 2			
<p>Work measurement / Time study: Objectives, purpose/use techniques, Time study equipment's, 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.</p> <p>Work Sampling: Procedure, sample size determination, estimation of standard time, advantages and disadvantages.</p> <p>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.</p>			
Module - 3			
<p>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.</p> <p>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.</p>			
Module - 4			
<p>Visual Effects of Line and Form: The mechanics of seeing psychology of seeing, general influences of lined and form.</p> <p>Colour: colour and light - colour and objects - colour and the eye colour consistency - colour terms - reactions to colour and colour continuation - colour on engineering equipment's.</p>			
Module - 5			
<p>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.</p> <p>Industrial Design in Practice: General design - specifying design equipments - rating the importance of industrial design – industrial design in the design process.</p>			

Course Outcomes:

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.	L1, L2, L3, L4
CO2	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
CO3	Demonstrate a sound knowledge of Man-Machine Interfaces and design of displays and controls in engineering systems	L1, L2, L3, L4
CO4	Determine the visual effects of line form and colour.	L1, L2, L3, L4
CO5	Determine the aesthetic concepts and demonstrate a sound knowledge of Ergonomics in industrial design engineering applications.	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 (Note : High - 3, Medium - 2, and Low - 1)

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

PRACTICAL COMPONENT OF IPCC**Practical Course Objectives:**

- To implement various process charts in varied applications.
- To rate various activities of the workers with set parameters.
- To estimate standard time in various industrial applications.
-

Sl. No.	Experiments
1	Preparing the Outline process chart and Multiple Activity Chart
2	Construct the Flow process chart for various applications
3	Experiments on the principle of motion economy by Two handed process chart.
4	Draw the Flow diagram and String diagram for various applications.
5	Rating practice using: pin board assembly, dealing a deck of cards and marble collection activity
6	Determining the standard time for simple operations using stopwatch time study
7	Measurement of parameters (heart beat rate, calorie consumption) using walking simulator
8	Measurement of parameters (heart beat rate, calorie consumption, revolutions per minute) using ergometer.

Laboratory Outcomes: At the end of the laboratory course, the student should be able to:

- Understand various process charts
- Practice rating activity and measurement of various parameters
- Determine standard time estimation

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 **25 Marks**
2. Two assignments each of **25 Marks/One Skill Development Activity of 50 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 the University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

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

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

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

Suggested Learning Resources:**Books**

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

Semester-II

Simulation and Modelling of Production Systems			
Course Code	MMPT202	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	03
Course Learning objectives:			
<ul style="list-style-type: none"> • Define the basics of simulation modelling and replicating the practical situations in organizations • Generate random numbers and random variants 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.			
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.			
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-Smirnov test -the Chi-square test.			
Module-4			
Random Variable Generation: Inversion transforms technique-exponential distribution, uniform distribution, weibul distribution, continuous distribution, generating approximate normal variates-Erlang distribution.			
Module-5			
Empirical Discrete Distribution: Discrete uniform -distribution 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.			

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. Two Unit Tests each of **25 Marks**
2. Two assignments each of **25 Marks** or **one Skill Development Activity of 50 marks** to attain the COs and POs

The sum of two 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. **Discrete Event System Simulation** - Jerry Banks & John S Carson II - Prentice Hall Inc.-1984.
2. **Systems Simulation** - Gordan. G. - Prentice Hall India Ltd - 1991.
3. **System Simulation with Digital Computer** - NusingDeo - Prentice Hall of India - 1979.
4. **Computer Simulation and Modeling** - Francis Neelamkovil - John Wiley & Sons - 1987.
5. **Simulation Modeling with Pascal** - Rath M. 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=WfEZMhpszT8>
- <https://www.youtube.com/watch?v=DBmYYpxjqvM>
- <https://www.youtube.com/watch?v=O46ZIKEjjHE>
- <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

- 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
C01	To understand principle of computer modelling and simulation.	L1, L2, L3, L4
C02	To understand the discrete event and statistical methods of simulation.	L1, L2, L3, L4
C03	To understand the random number generation.	L1, L2, L3, L4
C04	To understand the random variable generation.	L1, L2, L3, L4
C05	To understand the empirical discrete distribution and to understand the design and evaluation of simulation experiments.	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 (Note : High - 3, Medium - 2, and Low - 1)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
C01	1	2	2	2	-	3	3
C02	1	2	2	3	2	3	2
C03	2	2	2	2	3	3	2
C04	2	2	3	3	2	-	2
C05	1	2	2	3	3	-	-

Semester-II

Tool Engineering and Design			
Course Code	MMPT/MMPY203	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	03
Course Learning objectives: <ul style="list-style-type: none">• Students will understand the fundamental principles of tool design, including the design of single-point cutting tools, drills, and reamers.• Students will learn to design and evaluate milling cutters and broaches while applying general principles of clamping and analyzing various clamping devices.• Students will comprehend the principles of fixture and gauge design, enabling them to create effective designs that enhance manufacturing efficiency.• Students will explore the types and applications of press tools in metal forming, applying design techniques to develop and improve tool durability and performance.• Students will understand the principles of forming dies and tool layout, applying these concepts to optimize production processes.			
Module-1			
Introduction: Concept, meaning and definitions of tool, tool design and tool engineering. Tools-types, classification, features & applications. Design of Single Point Tool: Tool Signature, Selection of Tool Angles, Design of shank section for single point tool to account for strength and rigidity. Design of Multi Point Tools – Drills, Reamers			
Module-2			
Design of Peripheral Milling cutters, Broach. Location and Clamping: General principles of location, 3-2-1 Principle of Location, Principle of Radial location, General study of locating devices. General principles of clamping, Study of various Clamping devices.			
Module-3			
Design of Fixtures: Difference between a Jig and a Fixture, Design of Milling fixture, Study of other fixtures like Lathe fixture, Inspection fixture. Study of different types of Drill jigs. Design of Gauges: Types of gauges. Factors to be considered in the design of gauges, Design of Plug gauge, Design of Snap gauge.			
Module-4			
Design of Press Tools: A General study of Press operations. Elements of a Die, Strip layout, calculation of centre of pressure. Design of Blanking Die, Design of Piercing Die, Design of Progressive Die.			
Module-5			
Design of Forming Dies: Study of Drawing and Bending process, Design of Drawing Die, Design of Bending Die. Tool Layout and Cam Design of Single Spindle Automats: Classification of Automats and their applications. Tool layout and Cam design for automatic screw cutting machine.			

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. Two Unit Tests each of **25 Marks**
2. Two assignments each of **25 Marks** or **one Skill Development Activity of 50 marks** to attain the COs and POs.

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

Web links and Video Lectures (e-Resources):

- www.nptel.ac.in
- <https://youtu.be/bUrp8JMRwx4>
- <https://youtu.be/hheFVuUBpxo>
- <https://youtu.be/K39bnxmIz7Q>
- https://youtu.be/Hs_Pz80DD5Y
- <https://youtu.be/HVbbS15WreA>
- <https://youtu.be/SVo5ETboDTQ>
- <https://youtu.be/nfoUdm9WdE4>
- <https://youtu.be/6ZfAfjJTvvA>
- <https://youtu.be/nuCQTABjHLQ>
- https://youtu.be/J_d8IRT9r7E
- <https://youtu.be/LKEG3p3yx1g>
- <https://youtu.be/coLiMQ-hPvA>

Skill Development Activities Suggested

- 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
C01	<ul style="list-style-type: none"> Understand the tool design concept and design of single point cutting tool. Understand the Design of drills and reamers. Develop, design and evaluate shank design of single point cutting tool, drills and reamers 	L1, L2, L3, L5,L4,L6
C02	<ul style="list-style-type: none"> Understand the design of milling cutters and broaches. Develop, design and evaluate custom milling cutters and broaches Apply the general principles of clamping. Analyse various clamping devices 	L2, L3, L4, L5, L6
C03	<ul style="list-style-type: none"> Understand the fundamental principles of fixture and gauge design. Apply design techniques to create effective fixtures and gauges for specific machining operations Analyse the role of fixtures and gauges in enhancing manufacturing efficiency and precision Evaluate existing designs and suggest improvements based on specific production needs Develop and design custom fixtures and gauges 	L2, L3, L4, L5, L6
C04	<ul style="list-style-type: none"> Understand the types, functions and applications of press tools in metal forming Apply design principles to create press tools for specific manufacturing processes Analyse tool design elements, such as punches, dies, and clearance settings, to ensure accuracy and efficiency Evaluate tool manufacturing techniques and propose improvements for tool durability and performance Design and develop press tools based on real-world industrial requirements 	L1, L2, L3, L5,L4,L6
C05	<ul style="list-style-type: none"> Understand the principles and functions of forming dies. Apply die design techniques to develop effective forming dies Analyse tool layout for optimizing production processes 	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 (Note : High - 3, Medium - 2, and Low - 1)

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

Semester-II

Quality and Reliability Engineering			
Course Code	MMPT206	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
<p>Course Learning objectives:</p> <ul style="list-style-type: none"> • 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			
<p>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.</p> <p>Fundamentals of Probability and Statistics: Basic probability rules, Discrete and Continuous probability distributions and their applications in quality control, numerical problems.</p>			
Module-2			
<p>Control charts for Variables: Concept of variation, sources of variation and types. Objectives of control charts, Choice of variables, Subgroup size, and frequency of sampling, control limits. Process Capability analysis, Relationship of 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</p>			
Module-3			
<p>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.</p> <p>Failure Data Analysis : Introduction, Life Testing, Failure Data, Quantitative measures, MTTF, MTBF, Bathtub Curve, Mean Life, Introduction to Failure Mode and Effect Analysis.</p>			
Module-4			
<p>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.</p>			
Module-5			
<p>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.</p> <p>Maintainability and Availability: Introduction, Techniques available to improve maintainability and availability, trade-off among reliability, maintainability and availability, Simple problems.</p>			

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. Two Unit Tests each of **25 Marks**
2. Two assignments each of **25 Marks** or **one Skill Development Activity of 50 marks** to attain the COs and POs

The sum of two 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. Statistical Quality Control – Montgomery D.C. John Wiley & Sons, Inc
2. Statistical Quality Control – Grant and Leavenworth.
3. Quality Planning and Analysis - Juran, J.M and Gryna, F.M. - Tata McGraw Hill publishing Coimpany Ltd.,
4. Concepts in Reliability Engineering – Srinath K.S. - Affiliated East-West Press Private Limited, New Delhi
5. 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-edition-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_JSyINyNg
- <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=TFCcf14DyUo>
- <https://www.youtube.com/watch?v=3GkDnw94Xxk>
- <https://www.youtube.com/watch?v=WSr6AU0InMk>
- https://www.youtube.com/watch?v=d7T13E_IOMc
- https://www.youtube.com/watch?v=hmqsK_lifeI
- <https://www.youtube.com/watch?v=kWLOwKC8JIs>
- https://www.youtube.com/watch?v=TDPI_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 (Course Skill Set)

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

Sl. No.	Description	Blooms Level
C01	Explain the basic concepts of Quality engineering and apply various Probability distributions to the real world Quality problems	L1, L2, L3, L4
C02	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
C03	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
C04	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
C05	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 (Note : High - 3, Medium - 2, and Low - 1)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
C01	2	1	2	2	1	-	1
C02	2	2	3	3	2	-	1
C03	2	2	3	3	2	-	1
C04	2	2	2	2	1	1	1
C05	3	2	3	2	2	1	1

Semester-II

Production Engineering Laboratory			
Course Code	MMPTL207	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	1:0:2:0	SEE Marks	50
Credits	02	Exam Hours	03
Course objectives:			
CO1: To Understand usage of G and M codes and write CNC program for a given component and Use CAM package for simulating tool path, power requirement and cycle time, etc.			
CO2: To Measure cutting forces during machining using different Dynamometers			
CO3: To understand the basic statistical concepts of correlation and regression			
CO4: To build capabilities in the students for analyzing different situations in the industrial/ business scenario involving limited resources and finding the optimal solution with constraints.			
CO5: To understand and apply the control charts for variables and attributes in industries			
Sl. No	Experiments		
1	Simulation of Cutting operations on a computer using CAM packages.		
2	Simulation of 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. Measurement of Chip tool Interface temperature during turning using thermocouple technique		
5	Regression and Correlation analysis using any of the statistical packages.		
6	Use of software package to solve LPP problem.		
7	Use of software package to solve assignment and transportation problems.		
8	Use of software package to solve PERT and CPM problems.		
9	Plotting Quality Control chart for attributes using Software Packages. Plotting appropriate charts and diagrams relevant to various industrial Applications.		
10	Plotting Quality Control chart for variables using Software Packages. Plotting appropriate charts and diagrams relevant to various industrial Applications.		
Demonstration Experiments			
11	To become familiar with the use of a kinematics graphics simulator in order to perform robot motion and programming. To use trajectory planning concepts on the model of a single link robotic manipulator. To familiarize students with the use of a vision system.		
12	Study of Capstan lathe and its tooling and prepare a tool layout and job as per given drawing.		
13	Development of simple MIS application programs for use in Library.		
14	Development of simple MIS application programs for use in Bank		
Course outcomes (Course Skill Set):			
At the end of the course the student will be able to:			
<ul style="list-style-type: none">• Understand and use 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.• To obtain correlation coefficient and regression equation using statistical packages.• Convert the real world problem into mathematical model of OR and Solve it manually and by using software such as TORA, etc. (LPP, TP, AP, PERT/CPM etc.)• Plot and analyse Quality Control charts 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 an 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 down to 30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 01 tests for 100 marks, test shall be conducted after the 14th week of the semester.
- In 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 test marks 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 marks of test 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://www.youtube.com/watch?v=6zrrHb9kflo>
- <https://www.youtube.com/watch?v=6zrrHb9kflo>
- <https://www.youtube.com/watch?v=1bw0NhLUXck>
- https://www.youtube.com/watch?v=NsCF30c_ong
- <https://www.youtube.com/watch?v=j1jOGAB8WWM8>
- https://www.youtube.com/watch?v=6xa1x_lqjzg
- <https://www.youtube.com/watch?v=6OBYiijyQ4>
- <https://www.youtube.com/watch?v=CxWd48GKqnE>
- <https://www.youtube.com/watch?v=p-gvwkHePaU>
- <https://www.youtube.com/watch?v=cMH4ye5Eo-Q>

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

Sl. No.	Description	Blooms Level
CO1	Understand usage of G and M codes and write CNC program for a given component and Use CAM package for simulating tool path, power requirement and cycle time, etc.	L3
CO2	Measure cutting forces during machining using different Dynamometers.	L3
CO3	To understand the basic statistical concepts of correlation and regression.	L3
CO4	To analyze different situations in the industrial/ business scenario involving limited resources and find the optimal solution with constraints.	L4
CO5	To understand and apply the control charts for variables and attributes in industries	L3

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.	PO3

Mapping of COs and POs (Note : High - 3, Medium - 2, and Low - 1)

	PO1	PO2	PO3
CO1	2	3	2
CO2	2	2	3
CO3	2	2	2
CO4	3	2	2
CO5	2	2	3

Processional Elective -3

Semester-II

Quantitative Decision-Making			
Course Code	MMPT/MMPY214A	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	2:2:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
<p>Course Learning objectives:</p> <ul style="list-style-type: none"> • To provide greater insight into Quantitative Decision-Making processes with strong fundamentals. • To understand how people perceive and decide about risk and transform domain situation to LPP and solve it. • To formulate domain situations into Transportation, Assignment, and Travelling salesman problems and derive Optimum solutions. • To formulate game theory problems and obtain solutions using different methods and to understand the fundamentals of Queues. • To develop an appropriate network diagram for the given problem and analyse the project using CPM/PERT, Crash the project and obtained minimum cost/time schedule. • To identify situations for Simulation and solve simulation problems using Monte-Carlo method 			
Module-1			
<p>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.</p>			
Module-2			
<p>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 method.</p>			
Module-3			
<p>Transportation and Assignment Problems: Structure of transportation problem and various methods to find IBFS, Optimality test of transportation problems by MODI method, Solution for degeneracy and unbalanced transportation problems, Time minimisation problems, Assignment problems and solution by Hungarian method, Flight scheduling problems, and Travelling Salesman-problem (TSP).</p>			
Module-4			
<p>Theory of Games: Two person zero sum game, Mini-max & Maxi-min strategies, Solution of game by dominance rules, arithmetic and algebraic methods, $m \times 2$ and $2 \times n$ 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 $[(M/M/1):(FCFS/\infty/\infty)]$ queuing model. Simple Problems</p>			
Module-5			
<p>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</p>			

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. Two Unit Tests each of **25 Marks**
2. Two assignments each of **25 Marks** or **one Skill Development Activity of 50 marks** to attain the COs and POs

The sum of two 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. 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.
3. Operations Research - H. A. Taha- Prentice Hall of India
4. Introduction to Operations Research - Hillier and Liberman- McGraw Hill International
5. 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=-YBIR1UF-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=Wgkcrtrjrr7s>
- <https://www.youtube.com/watch?v=v5ZfvATEoDY>
- <https://www.youtube.com/watch?v=xGkpXk-AnWU>
- <https://www.youtube.com/watch?v=YueJukoFBMU>
- <https://www.youtube.com/watch?v=fSuqTgnCVRg>
- <https://www.youtube.com/watch?v=KUskbAasVCY>
- <https://www.youtube.com/watch?v=Z-YqfAA9lew>
- <https://www.youtube.com/watch?v=g0Aw99V2Dc>
- <https://www.youtube.com/watch?v=Nrmr8mfELcY>
- <https://www.youtube.com/watch?v=USr10xc98II>
- <https://www.youtube.com/watch?v=4OdutS9mSZA>
- <https://www.youtube.com/watch?v=i8CbEoF9c6Y>

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

	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

Semester-II

Operations Management			
Course Code	MMPT/MMPY214B	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	2:2:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
Course Learning objectives:			
<ul style="list-style-type: none"> • Understand the fundamentals of operations management, its historical development, and factors affecting productivity. • Learn and apply various forecasting techniques to predict demand. • Develop and apply methods for aggregate planning and master scheduling to optimize resource utilization. • Understand and analyse MRP and CRP processes to efficiently manage production planning and capacity. • Apply scheduling rules and heuristics to optimize scheduling in job and flow shops. 			
Module-1			
<p>OPERATIONS MANAGEMENT CONCEPTS: Introduction, Historical development, The trend: Information and Non-manufacturing systems, Operations management, Factors affecting productivity.</p> <p>OPERATIONS DECISION MAKING: Introduction, Management as a science, Characteristics of decisions, and Framework for decision making, Decision methodology, Decision support systems, Economic models, and Statistical model.</p>			
Module-2			
<p>FORECASTING DEMAND: Forecasting objectives and uses, Forecasting variables, Opinion and Judgmental methods, Time series methods, Exponential smoothing, and Regression and correlation methods.</p>			
Module-3			
<p>AGGREGATE PLANNING AND MASTER SCHEDULING: Introduction- planning and scheduling, Objectives of aggregate planning, Aggregate planning methods, Master scheduling objectives, Master scheduling methods.</p>			
Module-4			
<p>MATERIAL AND CAPACITY REQUIREMENTS PLANNING: MRP and CRP objectives, Benefits, MRP inputs and outputs, MRP logic, Systemrefinements, Safety stock, lot sizing and system updating, CRP inputs and outputs, Loading concepts.</p> <p>SCHEDULING OF OPERATIONS: need for scheduling, loading of machines, scheduling context, Introduction to scheduling flow shops, scheduling of job shops, input output control, operational control issues in mass production systems, operations planning and control based on the theory of constrains.</p>			
Module-5			

JOB SHOP SCHEDULING: Single Machine Scheduling: Concept, measures of performance, SPT rule, Weighted SPT rule, EDD rule, minimizing the number of tardy jobs.

FLOW-SHOP SCHEDULING: Introduction, Johnson's rule for 'n' jobs on 2/3 machines, CDS heuristic. Job Shop Scheduling: Types,, Heuristic procedure, scheduling 2 jobs on 'm' machines.

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 have to answer five full questions, selecting one full question from each module.

Suggested Learning Resources:

Books

1. Operations Management Monks J.G McGraw Hill International Editions - 1987.
2. Production and Operations Management Pannerselvam. R PHI 2nd edition
3. Production and Operations Management Chary, S.N TataMcGraw Hill. 3rd edition
4. Operation management (theory and practice) by B Mahadevan, 3rd edition
5. Production and operations management by Everett Adam, Jr. Ronald J Ebert

Web links and Video Lectures (e-Resources):

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

Skill Development Activities Suggested

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

Course outcome

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

Sl. No.	Description	Blooms Level
CO1	Explain the evolution and significance of operations management, identifying productivity factors.	L2,L3,L4
CO2	Apply forecasting techniques like regression and exponential smoothing to predict demand.	L2,L3,L4
CO3	Analyze aggregate planning and scheduling to align production with demand.	L3,L4,L5
CO4	Evaluate MRP and CRP processes to optimize production planning and capacity management.	L3,L4,L5
CO5	Implement scheduling rules and heuristics to minimize tardy jobs and optimize flow in job shops.	L3,L4,L5

Program Outcome of this course

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

Mapping of COs and POs (Note : High - 3, Medium – 2, and Low – 1)

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

Semester-II

Design for Manufacturing and Assembly			
Course Code	MMPT/MMPY214C	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	2:2:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
<p>Course Learning objectives:</p> <ul style="list-style-type: none"> • Understand the principles of manufacturability and design for manufacture. • Design casting and weldment for economic production quantity. • Understand the concept of assembly, its design and true position of datum system. • Design parts cut to length and screw machine parts of various processes, open and closed die forging. • Design guidelines and background for powder metallurgy part and reviewing of formed parts. 			
Module-1			
<p>INTRODUCTION: General design principles for manufacturability, Process Capability, Feature tolerance, Geometrical tolerance, Surface finish, Review of relationship between attainable Tolerance grades, and different machining processes, Economics of process selection, Principles of Design for Manufacture, Quality Manufacturability, Introduction to Tolerance Charting Technique.</p>			
Module-2			
<p>DESIGN OF CASTINGS: Redesign of castings based on parting line considerations, Minimising core requirements, other design consideration, economic production quantities.</p> <p>DESIGN OF WELDMENTS: Advantages of weldments, Design for economical and efficient welding, Redesigning cast members using weldments, use of welding symbols, Economic production quantities, Design recommendations,</p>			
Module-3			
<p>DESIGN FOR ASSEMBLY: Applications of selective assembly, Design recommendations for different fastening arrangements, Automatic assembly, control of axial play in assemblies, Design for easy assembly, Design for easy disassembly.</p> <p>TRUE POSITION THEORY AND DATUM SYSTEMS: Theoretically exact dimension, virtual size concept, assembly considerations as applied to True Position Tolerancing, examples, Grouped datum systems, different types examples.</p>			
Module-4			
<p>DESIGN FOR MACHINING: Parts cut to length, screw machined products, Machined round holes, Moulded parts, Parts produced buy planning. shaping & slotting, Broached parts, Ground parts, roller burnished parts, Gears, Economical deburring, re dimensioning of parts based on manufacturing datum.</p> <p>DESIGN FOR FORGING: Introduction, open die forging. Closed die forging.</p>			
Module-5			
<p>DESIGN FOR POWDER METALLURGY: Introduction, Design guidelines, Background, Design for Powder Metallurgy parts. A review of design considerations in formed metal components, non metallic parts, Designing for heat treatment, Design for quality and mass production.</p>			

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. Two Unit Tests each of **25 Marks**
2. Two assignments each of **25 Marks** or **one Skill Development Activity of 50 marks** to attain the COs and POs

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

Web links and Video Lectures (e-Resources):

- <https://www.youtube.com/watch?v=igWfQpxI100>
- <https://www.youtube.com/watch?v=6BTofPdLbNo>
- <https://www.youtube.com/watch?v=SXPpS2vjoRI>
- <https://dfmpro.com/manufacturing-processes/dfmpro-for-machining/>
- <https://www.youtube.com/watch?v=n-2oOq3Ao9U>

Skill Development Activities Suggested

- Quizzes
- Assignments
- Seminars

Course outcome (Course Skill Set)

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

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

Program Outcome of this course		
Sl. No.	Description	POs
01	An ability to independently carry out research/investigation and development work to solve practical problems	P01
02	An ability to write and present a substantial technical report/document.	P02
03	To be able to demonstrate a degree of mastery over the area as per the specialization of the program.	P03
04	Understand contemporary issues in manufacturing engineering and develop relationship between product design and manufacturability to create safe, reliable, and cost-effective products.	P04
05	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	P05
06	Employ advanced prototyping methods to shorten design cycles and narrow alternatives without restricting innovation.	P06
07	Understand and debate the roles and responsibilities of a product designer/manufacturer on society.	P07

Mapping of COs and POs (Note : High - 3, Medium - 2, and Low - 1)

	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

Semester-II

Theory of Metal Cutting			
Course Code	MMPT/MMPY214D	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	2:2:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	03
Course Learning objectives: <ul style="list-style-type: none">• Understand and analyze the fundamentals of different cutting tool materials.• Understand and analyze Mechanics of metal cutting.• Understand and analyze cutting force and its measurements using dynamometers 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.			
Module-2			
Tool Materials And Their Properties: Characteristics of tool materials, types of tool materials – carbon tool steels, high speed steels, cast alloys, cemented carbides, ceramics, diamonds, SIALON, CBN, UCON, recommended cutting speeds for the above tools, discussion on die steels, air, water, oil hardening of tools and their applications.			
Tool Wear, Tool Life: Mechanisms of tool wear, Sudden & gradual wear, crater wear, flank wear, tool failure criteria, tool life equations, effect of process parameters on tool life, tool life tests, conventional & accelerated tool wear measurement, machinability index			
Module-3			
Measurement Of Cutting Forces: Reasons for measuring cutting forces, Classification of cutting force dynamometers – mechanical, hydraulic, pneumatic, optical, inductance, piezoelectric, and strain gage type dynamometers.			
Dynamometers For Machine Tools: Dynamometers for lathe, drilling, grinding and milling, Calibration of dynamometers.			
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.			
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.			

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. Two Unit Tests each of **25 Marks**
2. Two assignments each of **25 Marks** or **one Skill Development Activity of 50 marks** to attain the COs and POs

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

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program
- https://www.youtube.com/playlist?list=PLSGws_74K018JY-1RyIj0cm4yppa1h54r
- <https://www.youtube.com/watch?v=HYpgpMymDeI>
- <https://www.youtube.com/watch?v=fdQjDV7qGsM>
- <https://www.youtube.com/watch?v=IAI9-mTj3gc>
- <https://www.youtube.com/watch?v=U7exNCTgPcY>
- <https://www.youtube.com/watch?v=YDSdhiMksoQ>

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
C01	Explain the fundamentals of different cutting tool and materials	L1, L2
C02	Explain Mechanics of metal cutting.	L1, L2, L3, L4
C03	Explain cutting force and its measurement using dynamometers and temperature distribution during metal cutting	L1, L2, L3, L4
C04	Explain tool wear and tool life -mechanisms and effects.	L1, L2, L3
C05	Explain the Thermal Aspects and selection of cutting fluids and Optimum cutting speed and cost techniques	L1, L2, L3, L4

Program Outcome of this course

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

Mapping of COs and POs (Note : High - 3, Medium - 2, and Low - 1)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
C01	1	2	2	2	-	3	3
C02	1	2	2	3	2	3	2
C03	2	2	2	2	3	3	2
C04	2	2	3	3	2	-	2
C05	1	2	2	3	3	-	-

Processional Elective - 4

Semester-II

Total Quality Management			
Course Code	MMPT/MMPY215A	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	2:2:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
Course Learning objectives: <ol style="list-style-type: none"> 1. Understand various approaches to TQM 2. Understand the characteristics of quality leader and his role. 3. Develop feedback and suggestion systems for quality management. 4. Enhance the knowledge in Tools and Techniques of quality management. 			
Module-1			
Principles and Practice: Definition, basic approach, gurus of TQM, TQM Framework, awareness, defining quality, historical review, obstacles, benefits of TQM. Quality Management Systems: Introduction, benefits of ISO registration, ISO 9000 series of standards, ISO 9001 requirements			
Module-2			
Leadership: Definition, characteristics of quality leaders, leadership concept, characteristics of effective people, ethics, the Deming philosophy, role of TQM leaders, implementation, core values, concepts and framework, strategic planning communication, decision making			
Module-3			
Customer Satisfaction and Customer Involvement: Customer Satisfaction: customer and customer perception of quality, feedback, using customer complaints, service quality, translating needs into requirements, customer retention, case studies. Employee Involvement – Motivation, employee surveys, empowerment, teams, suggestion system, recognition and reward, gain sharing, Performance appraisal, unions and employee involvement, case studies			
Module-4			
Continuous Process Improvement: process, the Juran trilogy, improvement strategies, types of problems, the PDSA Cycle, problem-solving methods, Kaizen, reengineering, six sigma, case studies. Statistical Process Control : Pareto diagram, process flow diagram, cause and effect diagram, check sheets, histograms, statistical fundamentals, Control charts, state of control, out of control process, control charts for variables, control charts for attributes, scatter diagrams, case studies.			
Module-5			
Tools and Techniques: Benching marking, information technology, quality management systems, environmental management system, and quality function deployment, quality by design, failure mode and effect analysis, product liability, total productive maintenance.			

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. Two Unit Tests each of **25 Marks**
2. Two assignments each of **25 Marks** or **one Skill Development Activity of 50 marks** to attain the COs and POs

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

Web links and Video Lectures (e-Resources):

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

Skill Development Activities Suggested

- 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
C01	To understand the concept of Quality costs.	L1, L2, L3, L4
C02	Understand the concept of problem solving using the process.	L1, L2, L3, L4
C03	Understand the use of control charts for improving the process quality.	L1, L2, L3, L4
C04	Illustrate design of experiments using Taguchi technique.	L1, L2, L3, L4, L5
C05	Acquire basic knowledge of total quality management.	L1, L2, L3, L4, L5

Program Outcome of this course

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

Mapping of COS and POs (Note : High - 3, Medium - 2, and Low - 1)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
C01	2	1	2	3	3	-	2
C02	2	2	2	3	3	-	3
C03	2	2	2	3	3	-	3
C04	1	1	2	3	3	-	2
C05	1	3	2	3	3	-	2

Semester II

Modern Manufacturing Practices			
Course Code	MMPT/MMPY215B	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	2:2:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
Course Learning objectives:			
<ul style="list-style-type: none"> • To introduced Students to the concept of Just-In –Time (JIT) production & TQC • To develop understanding about the effective use of Kanaban as per Toyota production system. • To develop understanding of the JIT approach to speed up product delivery, with minimum cost • To gain the knowledge about enhancing the efficiency and improving quality with reduction in cost • To understand the different plant configuration & their characteristics, Automation & Robotics 			
Module-1			
<p>Need of CPC for a company, what CPC can do, CPC-getting the right tool. JIT – Introduction – The spread of JIT Movement, some definitions of JIT, core Japanese practices of JIT, Creating continuous Flow Manufacture, Enabling JIT to occur, Basic elements of JIT, Benefits of JIT.</p>			
Module-2			
<p>Just in Time Production – Primary purpose, profit through cost reduction, Elimination of over production, Quality control, Quality Assurance, Respect for Humanity, Flexible work Force, JIT Production Adapting to changing production Quantities, process layout for shortened lead Times, Standardization of operation, Automation. Sequence and scheduling used by suppliers: Monthly and daily Information. Sequenced withdrawal system by sequenced schedule table, problems and counter measures in applying the Kanban system to sub-contractors.</p>			
Module-3			
<p>Just-in-Time Production with Total Quality Control just in time concept, cutting lot sizes, cutting set-up times, cutting purchase order costs, the JIT cause-Effect chain, Scrap/Quality Improvements, Motivational effects, Responsibility effects, small Group improvement Activities, withdrawal of Buffer Inventory, the total Quality Control Concept.</p>			
Module-4			
<p>Total Quality Control-Introduction-Total Quality Control concepts, responsibility, learning from the west, TQC concepts categorized, Goals, Habit of improvement, perfection, Basics, process control, Easy to see Quality control as facilitator, small lot sizes, Housekeeping, Less than full capacity scheduling, Daily machine checking, Techniques and Aids, Exposure of problems, Fool proof Devices, Tools of Analysis, QC Circles, TQC in Japanese-owned US Electronics plant, TQC in Japanese-owned Automotive plants.</p>			
Module-5			
<p>Plant Configurations: Introduction-ultimate lant configuration, job shop Fabrication, Frame Welding, Forming Frame parts from Tubing, Dedicated production lines, overlapped production, the daily schedule, Forward Linkage by means of Kanban, physical merger of processes, Adjacency, mixed Models, Automated production Lines, Pseudo Robots, Robots, CAD and Manufacturing, Conveyors and stacker Cranes, Automatic Quality Monitoring.</p>			

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. Two Unit Tests each of **25 Marks**
2. Two assignments each of **25Marks** or **one Skill Development Activity of 50 marks** to attain the COs and POs

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

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program

Skill Development Activities Suggested

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

Course outcome (Course Skill Set)

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

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

Program Outcome of this course

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

Mapping of COS and POs (Note : High - 3, Medium - 2, and Low - 1)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
C01	1	2	2	3	3	3	1
C02	3	2	2	2	3	-	3
C03	1	2	2	2	2	3	2
C04	2	2	2	3	2	3	2
C05	3	2	2	2	3	-	2

Semester II

Advanced Materials and Processing			
Course Code	MMPT/MMPY215C	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	2:2:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
Course Learning objectives:			
<ul style="list-style-type: none"> • Classify materials and physical characteristics. • Understand iron carbon equilibrium diagram, TTT diagram, heat treatment process of various steels. • Understand alloys of various nonferrous metals. • Understand polymers, ceramics and their mechanical – thermal properties. • Identify the composites and their structure and Understand applications of ceramics. 			
Module-1			
Classification and characteristics: Metals, Ceramics, Polymers and composites. General properties and structure: Atoms, molecules bonds in solids, Crystalline - Defects in Metallic structure, Dislocations and plastic deformation - Strengthening mechanism - grain size, dislocation - Cold work, precipitation hardening, dispersion hardening - phase reactions, fatigue and Creep behavior			
Module-2			
Ferrous Alloys: Iron carbon equilibrium diagrams - Steels and cast irons - properties, structure, composition and applications transformation hardening in steels - TIT diagrams - Heat treatment processes - Effect of alloying elements - High alloy steels, Stainless steel types, tool Steels, Manganese steels, heat resistant steels, HSLA, Maragingsteels			
Module-3			
Non Ferrous alloys: Alloys of copper, Aluminium, nickel, magnesium, titanium, lead, tin, Zinc - composition, heat treatment, structure, properties and application.			
Module-4			
Polymers and polymerizations: Structure and properties of thermoplastics and thermo sets – Engineering Applications - property modifications - Mechanical and thermal behaviour – processing methods. Ceramics :Nature and structure of Ceramics - Refractory Abrasives glasses - glass ceramics - Advanced ceramics processing methods.			
Module-5			
Composites : Definition - classification and characteristics of composite materials - Volume fraction - laminated composites particulate composites, fibrous composites - Types of reinforcements, their shape and size - production and properties of fiber reinforced plastics, Metal Matrix composites and ceramic matrix composites -Applications. Processing of Polymers: composites, ceramics - thermal spraying - Ion beam machining diamond coating techniques tribological Applications.			

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. Two Unit Tests each of **25 Marks**
2. Two assignments each of **25 Marks** or **one Skill Development Activity of 50 marks** to attain the COs and POs

The sum of two 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. Engineering Metallurgy, Raymond and Higgens ELBS/EA
2. Introduction to Material Science and Engineering, James.F.ShackelfordMc Millan, NY7th edition
3. Powder Metallurgy-Metals Hand Book, ASM, USA Vol.7, 1974
4. Composite Materials - Science and Engineering, Chawla K.K Springer - Verlag, Newyork2nd edition, 1998

Web links and Video Lectures (e-Resources):

<https://www.youtube.com/watch?v=a9uqc9NVNMg>

<https://www.youtube.com/watch?v=zwnblxXyERE>

<https://www.youtube.com/watch?v=IPbwBOsKZ7E>

<https://www.youtube.com/watch?v=0LR212YEdaA>

Skill Development Activities Suggested

- Industry Visits
- Seminars
- Research Projects
- Hands-On Workshops

Course outcome (Course Skill Set)

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

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

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

Mapping of COS and POs (Note : High - 3, Medium - 2, and Low - 1)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
C01	2	1	2	2	3	3	2
C02	1	1	2	2	2	3	1
C03	1	1	2	2	3	3	2
C04	1	1	2	2	3	3	1
C05	1	2	2	2	3	3	1

Semester II

Non Destructive Testing			
Course Code	MMPT/MMPY215D	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	2:2:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
Course Learning objectives:			
<ul style="list-style-type: none"> • To inspect a component in a safe, reliable and cost effective manner without causing damage to the equipment • To determine whether a weld is strong or has potential defects that could compromise its integrity • To understand Ultrasonic testing for detection of defect, measurement of the parameters, assessment of their hazard assessment feasibility • To study Liquid penetration testing to provide visual evidence of surface discontinuities in solid non-porous materials • To understand Magnetic Particle inspection, to detect surface and subsurface flaws in ferromagnetic Materials 			
Module-1			
<p>Introduction: Definition of Non-destructive testing, Need for NDT techniques and its applications, Types of NDT techniques, benefits from Non-destructive Testing, nature of flaws ,various steps involved in NDT, uses of Non-destructive techniques.</p> <p>Non-Destructive Testing of Welds: Definition of weld, types of weld joints, Welding processes; Gas welding, shielded metal arc welding, TIG spot welding, submerged arc welding, Defects in welded joints, Defects associated with residual stresses, Testing, measurement and control (TMC) of welds, Testing of welded joints; destructive test, Non-destructive tests</p>			
Module-2			
<p>Ultrasonic Testing : Introduction frequency of ultrasonic Waves, Generation of Ultrasonic waves, Piezo-electric materials for Ultrasonic Transducers, Types of Ultrasonic Waves, Different kinds of Ultrasonic Transducers, Types of ultrasonic waves, Reflection, Refraction and scattering of Ultrasonic beam, working of ultrasonic Flaws detectors, industrial application, Pulse-echo and through transmission Testing, Scanner assemblies for transmission and pulse-echo techniques, types of scan, shear wave and surface wave applications, Resonance techniques, use of Ultrasonic for thickness measurements.</p>			
Module-3			
<p>Liquid Penetrant Testing: Types of Penetrants, Types of developers, Penetration time, Inspection, Post emulsifiable fluorescent penetrants system, Water washable fluorescent penetrants, Low and High temperature penetrants, High sensitivity fluorescence penetrant examination, Advanced LPT techniques; Ultrasonic pumping to enhance performance, ultrasonically enhanced penetrant inspection of small weldments, Mechanised remote liquid penetrant testing of piping of reactors.</p>			
Module-4			
<p>Eddy current Testing: instrumentation of ECT, inspection of welds, advanced eddy current testing, Multi-frequency ECT, 3D phase array ECT, Remote field ECT, Magnetically based eddy current. Flux leakage, Computer modelling of ECT, Digital signal Processing, Eddy current imaging; eddy current imaging system, imaging and characterisation of defects, Eddy current array instrumentation for fixed position scanning.</p>			
Module-5			
<p>Magnetic particle Flaws detection: Principle of Magnetic Flaw detection, Types and methods of Magnetisation, Magnetic particles, Dry and Wet methods of Magnetic Particles inspection, Use of fluorescent Coated Magnetic particles, Industrial applications, Working of a Few Commercially available Magnetic Crack Detectors, Flaw detection in Rods, pipes and a short work piece, Precautions, Limitations, Residual magnetism, Need for Demagnetisation Research Techniques using Magnetic Particle Methods.</p>			

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**

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

Web links and Video Lectures (e-Resources):

- [https://www.asnt.org/MajorSiteSections/About/Introduction_to_Nondestructive_Testing.aspx#:~:text=Nondestructive%20testing%20\(NDT\)%20is%20the,part%20can%20still%20be%20used.](https://www.asnt.org/MajorSiteSections/About/Introduction_to_Nondestructive_Testing.aspx#:~:text=Nondestructive%20testing%20(NDT)%20is%20the,part%20can%20still%20be%20used.)
- <https://www.youtube.com/watch?v=tIE3eK0g6vU>
- https://www.youtube.com/watch?v=9qw0Dka_YcU
- <https://www.youtube.com/watch?v=qpgcD5k1494>
- <https://www.youtube.com/watch?v=bHTRmTQDZzg>

Skill Development Activities Suggested

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

Course outcome

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

Sl. No.	Description	Blooms Level
CO1	Distinguish the destructive and non-destructive testing and find effectiveness.	L1, L2, L3, L4
CO2	Ultrasonic testing is to detection of defect, measurement of their parameters assessment of their hazard assessment feasibility operation of the particular tested object	L1, L2, L3, L4
CO3	Find the surface defect using liquid penetrant and magnetic particle test and eddy current test.	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 (Note : High -3, Medium - 2, and Low - 1)

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

Ability/ Skill Enhancement Courses (Offline)

Semester II

Basics of Rapid Prototyping			
Course Code	MMPT/MMPY258A	CIE Marks	50
Teaching Hours/Week(L:T:P:S)	1:0:0:0	SEE Marks	50
Total Hours of Pedagogy	15	Total Marks	100
Credits	1	Exam Hours	1
<p>Course objectives:</p> <ul style="list-style-type: none"> • To provide knowledge on different types of Rapid Prototyping systems and its applications in various fields. • Gain knowledge about the principles, methodologies, and techniques used in developing products and bringing them to market • Explore different materials and their properties to understand how they can be used effectively in prototyping. 			
Module-1			
<p>Introduction: Need for the compression in product development, history of RP systems, Survey of applications, Growth of RP industry, and classification of RP systems.</p>			
Module-2			
<p>Stereo Lithography Systems: Principle, Process parameter, Process details, Data preparation, data files and machine details, Application.</p>			
Module-3			
<p>Selective Laser Sintering: Type of machine, Principle of operation, process parameters, Data preparation for SLS, Applications.</p>			
Module-4			
<p>Fusion Deposition Modeling: Principle, Process parameter, Path generation, Applications.</p>			
Module-5			
<p>Solid Ground Curing: Principle of operation, Machine details, Applications. Laminated Object Manufacturing: Principle of operation, LOM materials. Process details, application.</p>			
<p>Course outcome (Course Skill Set) At the end of the course the student will be able to:</p> <ol style="list-style-type: none"> 1. Understand and use techniques for processing of CAD models for rapid prototyping. 2. Understand and apply fundamentals of rapid prototyping techniques. 3. Use appropriate tooling for rapid prototyping process. 4. Use rapid prototyping techniques for reverse engineering. 			
<p>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.</p>			
<p>Continuous Internal Evaluation: Two Unit Tests each of 25 Marks Two assignments each of 25Marks or one Skill Development Activity of 50 marks to attain the COs and POs The sum of two 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.</p>			
<p>Semester End Examinations (SEE) SEE paper shall be set for 50 questions, each of the 01 marks. The pattern of the question paper is MCQ (Multiple Choice Questions). The time allotted for SEE is 01 hour. The student has to secure a minimum of 40% of the maximum marks meant for SEE.</p>			
OR			
<p>MCQ (Multiple Choice Questions) are preferred for 01 credit courses, however, if course content demands the general question paper pattern that followed for 03 credit course, then</p>			

1. The question paper will have ten questions. Each question is set for 10 marks.
2. There will be 2 questions from each module. Each of the two questions under a module may or may not have the sub-questions (with maximum sub-questions of 02, with marks distributions 5+5, 4+6, 3+7).
3. The students have to answer 5 full questions, selecting one full question from each module.

Suggested Learning Resources:

Books

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

Web links and Video Lectures (e-Resources):

- <https://www.youtube.com/watch?v=Fi7RXDUuX7I>
<https://www.youtube.com/watch?v=u4Juqawh2Zo>
<https://www.youtube.com/watch?v=faGyF81LadA>
<https://www.youtube.com/watch?v=848x-5rKhNk>
<https://www.youtube.com/watch?v=WHO6G67GJbM&t=7s>
<https://www.youtube.com/watch?v=y4N4AxKQPec>
<https://www.youtube.com/watch?v=m0b3WIS2nqw>

Skill Development Activities Suggested

- Creating videos in CAD model
- Exporting videos to RP machine
- Building the parts
- Post processing operations

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Introduction to RP system.	L1, L2, L3, L4
CO2	Stereo Lithography Systems, Principle, Process parameter, Process details & Applications	L1, L2, L3, L4, L5
CO3	Explain Selective Laser Sintering processes	L1, L2, L3, L4, L5
CO4	Fusion Deposition Modelling Systems, Principle, Process parameters	L1, L2, L3, L4, L5
CO5	Acquire basic knowledge Solid Ground Curing & LOM Principle of operations.	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 (Note : High - 3, Medium – 2, and Low – 1)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
C01	2	1	2	2	3	3	2
C02	1	1	2	2	2	3	1
C03	1	1	2	2	3	3	2
C04	1	1	2	2	3	3	1
C05	1	2	2	2	3	3	1

Semester II

Introduction to Maintenance Engineering			
Course Code	MMPT/MMPY258B	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	1:0:0:0	SEE Marks	50
Total Hours of Pedagogy	15	Total Marks	100
Credits	1	Exam Hours	1
Course Learning objectives: <ul style="list-style-type: none"> To understand the fundamentals Maintenance and Safety Engineering. To learn the concepts of Accident Preventions and safety acts. To analyze the Principles and Practices of Maintenance Planning and Maintenance Policies. 			
Module-1			
Introduction to the Development of Industrial Safety and Management: History and development of Industrial safety: Implementation of factories act, Safety and productivity, Safety organizations. Safety committees and structure.			
Module-2			
Accident Preventions and Protective Equipment: Personal protective equipment, Survey the plant for Locations, Part of body to be protected, Education and training in safety, Prevention causes and cost of accident, Housekeeping, First aid, firefighting equipment, Accident reporting.			
Module-3			
Safety Acts: Features of Factory Act, Introduction of Explosive Act, Boiler Act, ESI Act, Industrial hygiene, Occupational safety, Diseases prevention, Ergonomics, Occupational diseases, stress, fatigue, safety and the physical environment, engineering methods of controlling chemical hazards.			
Module-4			
Principles and Practices of Maintenance Planning: Basic Principles of maintenance planning – Objectives and principles of planned maintenance activity, Sound Maintenance systems – Reliability and machine availability, Equipment Life cycle.			
Module-5			
Maintenance Policies and Preventive Maintenance: Maintenance categories – Merits of each category –Preventive maintenance, Maintenance schedules: Repair cycle, Principles and methods of lubrication, Fault Tree Analysis, Total Productive Maintenance: Methodology and Implementation.			
Course outcome (Course Skill Set): At the end of the course the student will be able to: <ul style="list-style-type: none"> Explain comprehensively the Maintenance and Safety Engineering. Apply the techniques required to Accident Preventions Perform Maintenance Policies and Preventive Maintenance 			

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:

5. Two Unit Tests each of **25 Marks**
6. Two assignments each of **25Marks** or **one Skill Development Activity of 50 marks** to attain the COs and POs

The sum of two 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 Examinations (SEE)

SEE paper shall be set for 50 questions, each of the 01 marks. The pattern of the question paper is MCQ(Multiple choice questions). The time allotted for SEE is **01 hour**. The student has to secure a minimum of 40% of the maximum marks meant for SEE.

OR

MCQ (Multiple Choice Questions) are preferred for 01 credit courses, however, if course content demands the general question paper pattern that followed for 03 credit course, then

1. The question paper will have ten questions. Each question is set for 10 marks.
2. There will be 2 questions from each module. Each of the two questions under a module may or may not have the sub-questions (with maximum sub-questions of 02, with marks distributions 5+5, 4+6, 3+7).
3. The students have to answer 5 full questions, selecting one full question from each module.

Suggested Learning Resources:

Books

1. Industrial Maintenance Management Srivastava, S.K. - S. Chand and Co.
2. Occupational Safety Management and Engineering Willie Hammer – Prentice Hall
3. Installation, Servicing and Maintenance Bhattacharya, S.N. - S. Chand and Co.

Web links and Video Lectures (e-Resources):

<https://study.com/academy/lesson/workplace-accident-definition-types-effects.html>
<https://www.ehs.washington.edu/workplace/accident-prevention-plan>
<https://www.youtube.com/watch?v=ssLQ7sLnIJ8>
<https://www.prometheusgroup.com/posts/6-maintenance-planning-principles-for-success-in-planningscheduling>
<https://www.fiixsoftware.com/blog/putting-your-tpm-plan-into-action-a-step-by-step-guide/>

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 fundamentals Maintenance and Safety Engineering.	L1, L2, L3, L4
CO2	To learn the concepts of Accident Preventions and safety acts.	L1, L2, L3, L4, L5
CO3	To analyse the Principles and Practices of Maintenance Planning and Maintenance Policies.	L1, L2, L3, L4, L5
CO4	To Apply the techniques required to Accident Preventions	L1, L2, L3, L4, L5
CO5	To Perform Maintenance Policies and Preventive Maintenance	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 (Note: High - 3, Medium - 2, and Low - 1)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
C01	1	2	2	2	3	3	2
C02	3	2	2	2	3	1	2
C03	1	2	2	2	2	3	2
C04	2	2	2	3	2	3	2
C05	1	2	2	2	3	2	2

Semester II

An Outline of Emerging Technologies			
Course Code	MMPT/MMPY258C	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	1:0:0:0	SEE Marks	50
Total Hours of Pedagogy	15	Total Marks	100
Credits	1	Exam Hours	1
Course Learning objectives: <ul style="list-style-type: none"> To understand the emerging technologies in the context of Industrial and Production Engineering. To study data science as a tool for decision making in Engineering. To understand the concept of AI, IOT and other Emerging Technologies. To study the role of ethics in modern Technology driven era. 			
Module-1			
Introduction to Emerging Technologies: Evolution of technologies, Introduction to Industrial revolution, Historical background of the Industrial Revolution, Human to Machine Interaction, Future trends in emerging technologies.			
Module-2			
Data Science: Overview for Data Science, Definition of data and information, Data types and representation, Data Value Chain, Data Acquisition, Data Analysis, Data Curating, Data Storage.			
Module-3			
Artificial Intelligence (AI): Concept of AI, meaning of AI, History of AI, Levels of AI, Types of AI.			
Module-4			
Internet of Things (IoT): Overview of IOT, meaning of IOT, History of IOT, Architecture of IOT, Advantages of IOT, Applications of IOT at Manufacturing, Agriculture, Smart home, Smart city.			
Module-5			
Ethics, Professionalism and Other Emerging Technologies: Technology and ethics, General ethical Principles, Digital privacy. Other Technologies: Block chain technology, Cloud and quantum computing, Cyber security, Additive manufacturing (3D Printing)			
Course outcome (Course Skill Set) At the end of the course the student will be able to: <ul style="list-style-type: none"> Identify different emerging technologies Select appropriate technology and tools for a given task Identify necessary inputs for application of emerging technologies Understand the latest developments in the area of technology. 			

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. Two Unit Tests each of **25 Marks**
2. Two assignments each of **25Marks** or **one Skill Development Activity of 50 marks** to attain the COs and POs

The sum of two 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 Examinations (SEE)

SEE paper shall be set for 50 questions, each of the 01 marks. The pattern of the question paper is MCQ (Multiple choice questions). The time allotted for SEE is **01 hour**. The student has to secure a minimum of 35% of the maximum marks meant for SEE.

OR

MCQ (Multiple Choice Questions) are preferred for 01 credit courses, however, if course content demands the general question paper pattern that followed for 03 credit course, then

1. The question paper will have ten questions. Each question is set for 10 marks.
2. There will be 2 questions from each module. Each of the two questions under a module may or may not have the sub-questions (with maximum sub-questions of 02, with marks distributions 5+5, 4+6, 3+7).
3. The students have to answer 5 full questions, selecting one full question from each module.

Suggested Learning Resources:

Books

1. Emerging exponential technologies, Dr. Deepak G Kulkarni and Dr. Prayag P Gokhale. Himalaya Publishing House.
2. Introduction to Emerging Technologies Course Module, Tesfahunegn Minwuyelet (MSC) & Makonnen Wagaw (Ph.D.) CH-1, 4 & 5 from BDU, Girma Debela (MSc) CH-2 from ASTU.

Web links and Video Lectures (e-Resources):

- <https://www.youtube.com/watch?v=Keq0gNtXuss>
- <https://www.britannica.com/event/Industrial-Revolution>
- <https://www.simplilearn.com/top-technology-trends-and-jobs-article>
- <https://www.heavy.ai/learn/data-science>
- <https://engineering.purdue.edu/ME/Research/HumanMachine>
- <https://study.com/academy/lesson/types-of-data-text-numbers-multimedia.html>
- <https://www.simplilearn.com/data-analysis-methods-process-types-article>
- <https://builtin.com/artificial-intelligence>
- <https://www.techtarget.com/iotagenda/definition/Internet-of-Things-IoT>
- <https://archive.ethicsandtechnology.eu/wp-content/uploads/downloadable-content/Brey-2017-Ethics-Emerging-Tech.pdf>

Skill Development Activities Suggested

- Creating videos on modern Technologies
- Visiting industries to learn/train on modern technologies

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
C01	Evolution of technologies, Industrial revolution	L1, L2, L3, L4
C02	Explain Data Science, information, types, acquisition and analysis	L1, L2, L3, L4,L5
C03	Explain meaning of Artificial Intelligence, History, Levels and Types of AI.	L1, L2, L3, L4,L5
C04	Explain Internet on Things and its Architecture, Applications and Merits	L1, L2, L3, L4,L5
C05	Acquire basic knowledge of Ethics, Professionalism and Other Emerging Technologies	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 (Note : High - 3, Medium – 2, and Low – 1)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
C01	1	1	2	2	3	3	2
C02	1	1	2	2	2	3	1
C03	1	2	2	2	3	2	2
C04	2	1	2	1	3	3	1
C05	1	2	2	2	3	3	1

Semester II

An over view of Quality Tools			
Course Code	MMPT/MMPY258D	CIE Marks	50
Teaching Hours/Week(L:T:P:S)	1:0:0:0	SEE Marks	50
Total Hours of Pedagogy	15	Total Marks	100
Credits	1	Exam Hours	1
Course objectives: <ul style="list-style-type: none"> To understand the fundamentals of Quality tools and techniques To understand the process of managing quality and managing services To impart the knowledge and implementation of quality tools. 			
Module-1			
Introduction: Total Quality Control and The Seven New QC Tools Relation diagram, KJ method (affinity diagram), Systematic diagram, Matrix diagram, Matrix data analysis, Process decision program chart(PDPC), Arrow diagram.			
Module-2			
Seven QC Tools: Applying the Seven New QC Tools, Affinity diagram ,Need, Process and Examples.			
Module-3			
Systematic diagram and matrix diagram, Need, Process, Examples			
Module-4			
Matrix data analysis, PDPC & arrow diagram method: Need, Process, Examples			
Module-5			
Education to introduce the seven new QC tools conclusion: Implementation of seven new QC tools, Strategic Plan for implementation of seven new QC tools.			
Course out-come (Course Skill Set) At the end of the course the student will be able to: <ul style="list-style-type: none"> Obtain Increased customer and staff satisfaction Obtain Increased reach to a target population Get better dissemination of information, products, or evidence-based practices Obtain quality enhancement of services or programs Obtain quality enhancement of data systems Ensure Organizational design improvements 			
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: <ol style="list-style-type: none"> Two Unit Tests each of 25 Marks Two assignments each of 25Marks or one Skill Development Activity of 50 marks to attain the COs and POs The sum of two 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 Examinations (SEE) SEE paper shall be set for 50 questions, each of the 01 marks. The pattern of the question paper is MCQ (Multiple Choice Questions). The time allotted for SEE is 01 hour . The student has to secure a minimum of 40% of the maximum marks meant for SEE.			

OR

MCQ (Multiple Choice Questions) are preferred for 01 credit courses, however, if course content demands the general question paper pattern that followed for 03 credit course, then

1. The question paper will have ten questions. Each question is set for 10 marks.
2. There will be 2 questions from each module. Each of the two questions under a module may or may not have the sub-questions (with maximum sub-questions of 02, with marks distributions 5+5, 4+6, 3+7).
3. The students have to answer 5 full questions, selecting one full question from each module.

Suggested Learning Resources:

Books

1. **MANAGEMENT FOR QUALITY IMPROVEMENTS, Norman Bodek Shigeru Mizuno,**
2. **Quality Management for Organizations Using Lean Six Sigma Techniques, Erik Jones, 1st Edition**

Web links and Video Lectures(e-Resources):

- <https://www.youtube.com/watch?v=rIF8E5O1RUI>
- <https://asq.org/quality-resources/affinity#:~:text=The%20affinity%20diagram%20organizes%20a,%2C%20complex%20issue%2C%20or%20problem.>
- https://www.youtube.com/watch?v=R5xITJk_V90
- <https://www.youtube.com/watch?v=QOy2gYuWxSc>
- <https://www.youtube.com/watch?v=-uc7jRFuOQQ>
- https://www.youtube.com/watch?v=0hzqHwu1i_I
- <https://www.youtube.com/watch?v=QJVHNvoKyJM>
- <https://www.4cpl.com/blog/7-qc-tools-for-quality-improvement-with-a-strategic-plan/>

Skill Development Activities Suggested

- Identify production problems and quality control issues and contact the professionals to devise and implement the solutions in the industries (through field visits)
- One can benefit from learning about various management tools for quality control to ensure that the final product fulfils the quality requirements and conforms to industry standards. (through field visits)

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
C01	Introduction to Total Quality Control and The Seven New QC Tools.	L1, L2, L3, L4
C02	Applying the Seven New QC Tools, Affinity diagram, Need, Process and Examples.	L1, L2, L3, L4,L5
C03	Explain Systematic diagram and matrix diagram, Need, Process, Examples	L1, L2, L3, L4,L5
C04	Matrix data analysis, PDPC & arrow diagram method, Need, Process, Examples	L1, L2, L3, L4,L5
C05	ImplementationofsevennewQCtools,StrategicPlanforimplementationofsevennewQCtools.	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 (Note : High - 3, Medium – 2, and Low – 1)

	P01	P02	P03	P04	P05	P06	P07
C01	2	1	2	2	3	3	2
C02	1	1	2	2	2	3	1
C03	3	2	2	1	3	3	1
C04	1	1	2	2	1	3	1
C05	1	2	2	2	3	3	1