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

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

Module - 1

Method Study I / work Simplification: Definition and objectives procedures, Selection of jobs.

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

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.

Module - 2

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.

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

Synthetic data: Development of standard data, machine time calculation, practical systems of PMTS (work factor system, motion time measurement system, basic motion time study) advantages.

Module - 3

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

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

Module - 4

Visual Effects of Line and Form: The mechanics of seeing psychology of seeing, general influences of lined and form.

Colour: colour and light - colour and objects - colour and the eye colour consistency - colour terms - reactions to colour and colour continuation - colour on engineering equipment's.

Module - 5

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

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

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.
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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

Measurement and Instrumentation Engineering			
Course Code	MMPY2**02**	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:

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

Module-1

Introduction to measurement and measurement System: Generalized measurement system and functional elements, Static and dynamic performance characteristics of measurement devices, Errors in measurements, Statistical analysis of data, Regression analysis, Chi-Square Testing, correlation, estimation of uncertainty and presentation of data, elementary principles of design of experiments.

Module-2

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

Module-3

Measurement of temperature, pressure and flow velocity: Measurement of temperature by intrusive (Thermocouples, Thermistors and Resistance Temperature Detector) and non-intrusive (pyrometers) techniques. Measurement of pressure - manometers, elastic type pressure gauges (Bourdon tube, diaphragm, and bellows), strain gauges - capacitive type pressure gauge - piezoelectric pressure sensor, Measurement of vacuum - McLeod gauge, thermal conductivity gauges, lonization gauge - Testing and calibration of pressure gauges-dead weight tester. Measurement of flow velocity- intrusive and nonintrusive types- Pitot and Pitot static tube, Hot wire Anemometer - Ultrasonic and laser Doppler velocity meter, particle image velocimetry.

Module-4

Measurement of gas composition, liquid level and noise: Measurement of gas composition-Sampling systems, sampling probe, molecular beam sampling probe-separation methods - gas hormatography, flame ionization detector, Spectroscopic techniques, non-separation methods- Non Dispersive infrared analyzer, Luminescence-based detectors- Principles of liquid level measurement-buoyancy force, differential pressure, capacitor and resistance level indicators, Measurement of noise-sound level meters.

Module-5

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

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:

1. A Course in Mechanical Measurement and Instrumentation & Control By A K Sawhney and Puneeth Sawhney
2. Mechanical and Industrial Measurements By AK Jain
3. A Text book on Measurement and Instrumentation by Sanal Kumar S and Palanivel S
4. Introduction to Measurement and Instrumentation by Arun K Ghosh,.PHI
5. Measurement and Instrumentation by U A Bakshi and A V Bakshi

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program

Skill Development Activities Suggested

- Quizzes
- Assignments
- Seminars

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Analyse the statistical data obtained through measurement	L1, L2, L3, L4
CO2	Conditioning the electronic data obtained through measurements	L1, L2, L3, L4
CO3	Acquire data inputs using sensors from a system	L1, L2, L3, L4
CO4	Select the correct transducers for measurement of temperature, pressure etc of fluids	L1, L2, L3, L4
CO5	Select the correct transducers for measurement of force, torque & power etc	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	2	-	3	3
CO2	1	2	2	3	2	3	2
CO3	2	2	2	2	3	3	2
CO4	2	2	3	3	2	-	2
CO5	1	2	2	3	3	-	-

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:

- 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 **oneSkill 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 andGolding, Tata McGraw Hill, New Delhi.
3. Fundamentals of Tool Design, ASTME.
4. Jigs and Fixtures by P.H.Joshi, McGraw Hill Education, 3rd edition, 2010.
5. An introduction to Jig and Tool design by Kempester M.H.A., VIVA Books Pvt. Ltd, 2004.

Web links and Video Lectures (e-Resources):

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

Skill Development Activities Suggested

- Quizzes
- Assignments
- Seminars

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	• Understand the tool design concept and design 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
CO2	• 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
CO3	• 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
CO4	• 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
CO5	• 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

Advanced Foundry Technology			
Course Code	MMPY206	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

Course Learning objectives:

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

Module-1

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

Module-2

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

Module-3

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

Module-4

Steel Casting Practice: Common steel casting, their composition, structure and properties. Melting and refining of steel, Gating and risering system of steel castings cleaning of steel castings.
Aluminum Foundry Practice: Composition, properties and application of common aluminum alloy casting, Meltingand casting of AI−alloys, Gating and risering system of AI alloy casting.

Module-5

Copper alloy Foundry Practice: General characteristics of common cast copper alloys, Melting and casting of copper alloys, Gating and risering of cu-alloy castings.
Foundry Mechanization and Modernization: Introduction to modernization, Mechanization of foundry and its advantages, Mechanization of sand plant, moulding and core making mechanization in melting, pouring and shake out units, Material handling equipments and conveyor systems, Brief sketches and description of layouts of job,
Captive and mechanized foundries.

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:

Book:

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

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program

Skill Development Activities Suggested

- Quizzes
- Assignments
- Seminars

Course outcome (Course Skill Set)

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

Sl. No.	Description	Blooms Level
CO1	Understand the concept of solidification and design of gates and riser in casting.	L1, L2, L3,
CO2	Design casting and apply quality control techniques.	L1, L2, L3, L4,L5
CO3	Understand and design moulding for grey cast, malleable cast iron and ductile cast iron.	L1, L2, L3,
CO4	Understand and design steel, aluminum and copper alloy casting.	L1, L2, L3, l4
CO5	Modernize the casting techniques improving the efficient quality.	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**	**1**	**2**	**2**	**1**	**1**	**1**
CO2	**2**	**2**	**3**	**2**	**2**	**1**	**1**
CO3	**2**	**2**	**2**	**2**	**2**	**1**	**1**
CO4	**2**	**2**	**2**	**2**	**1**	**1**	**1**
CO5	**3**	**2**	**3**	**2**	**2**	**1**	**1**

Semester-II

Production Technology Laboratory			
Course Code	MMPYL207	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	Determination of Chip reduction co-efficient (reciprocal of chip thickness ratio) during single point turning.
2	Forces measurements during orthogonal turning. Measurement of Chip tool Interface temperature during turning using thermocouple technique
3	Simulation of Milling operations on a computer using CAM packages.
4	Simulation of Cutting operations on a computer using CAM packages.
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:

- 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=6zrrHb9kfIo
- https://www.youtube.com/watch?v=6zrrHb9kfIo
- https://www.youtube.com/watch?v=1bw0NhLUXck
- https://www.youtube.com/watch?v=NsCF30c_ong
- https://www.youtube.com/watch?v=j1jOGAB8WM8
- https://www.youtube.com/watch?v=6xa1x_Iqjzg
- https://www.youtube.com/watch?v=6OBYiijyjQ4
- 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

Course Learning objectives:

- 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

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**.**

Module-2

Decision Making under Uncertainty: Alternative criteria for decision under uncertainty. Numerical Examples; **Linear Programming Problem**: Formulation of LPPs, Solution of LPPs by graphical method.
Solution of LPP by simplex method: Concept of duality and solution of dual problems, Solution of LPP by dual simplex method.

Module-3

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

Module-4

Theory of Games: Two person zero sum game, Mini-max & Maxi-min strategies, Solution of game by dominance rules, arithmetic and algebraic methods, m×2 and 2×n games: Solution by method of sub games and graphical method. 3×3 games: Solution by method of matrices, approximate method using iterative procedure.
Waiting Line: Basic structure of queuing systems and characteristics, Expressions for [(M/M/l):(FCFS/∞/∞)] queuing model**.** Simple Problems

Module-5

Network Analysis: PERT and CPM, Network construction and determination of critical path, Calculation of ES, EF, LS, LF, TF, FF and IF, Crashing of projects to obtain minimum cost/minimum time schedule.
Simulation of Management Systems: Simulation and Monte Carlo method, Waiting line and inventory simulation models

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

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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=-YBlR1UF-UY
- https://www.youtube.com/watch?v=rCLlyT547MY
- https://www.youtube.com/watch?v=lwX8HvF7DYM
- https://www.youtube.com/watch?v=JxnPBrNccqY
- https://www.youtube.com/watch?v=Wgkcrtjrr7s
- https://www.youtube.com/watch?v=v5ZfvATEoDY
- https://www.youtube.com/watch?v=xGkpXk-AnWU
- https://www.youtube.com/watch?v=YueJukoFBMU
- https://www.youtube.com/watch?v=fSuqTgnCVRg
- https://www.youtube.com/watch?v=KUskbAasVCY
- https://www.youtube.com/watch?v=Z-YqfAA9lew
- https://www.youtube.com/watch?v=_g0Aw99V2Dc
- https://www.youtube.com/watch?v=Nrmr8mfELcY
- https://www.youtube.com/watch?v=USr10xc98II
- https://www.youtube.com/watch?v=4OdutS9mSZA
- https://www.youtube.com/watch?v=j8CbEoF9c6Y

Skill Development Activities Suggested

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

Course outcome (Course Skill Set)

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

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

Program Outcome of this course

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

Mapping of COs and POs (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:

- 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

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

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

Module-2

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

Module-3

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

Module-4

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.

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.

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

Course Learning objectives:

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

Module-1

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

Module-2

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

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

Module-3

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

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

Module-4

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

DESIGN FOR FORGING: Introduction, open die forging. Closed die forging.

Module-5

DESIGN FOR POWDER METALLURGY: Introduction, Design guidelines, Background, Design for Powder Metallurgy parts. A review of design considerations in formed metal components, non metallic parts, Designing for heat treatment, Design for quality and mass production.

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

Skill Development Activities Suggested

- Quizzes
- Assignments
- Seminars

Course outcome (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	PO1
02	An ability to write and present a substantial technical report/document.	PO2
03	To be able to demonstrate a degree of mastery over the area as per the specialization of the program.	PO3
04	Understand contemporary issues in manufacturing engineering and develop relationship between product design and manufacturability to create safe, reliable, and cost-effective products.	PO4
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	PO5
06	Employ advanced prototyping methods to shorten design cycles and narrow alternatives without restricting innovation.	PO6
07	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**	**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:

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

Module-1

Mechanics of Metal Cutting: Mechanism of chip formation, Orthogonal & Oblique cutting, types of chips, built-up edge, Determination of shear plane angle, forces on the chips, forces in orthogonal cutting, Merchant circle diagram and analysis, Theory of Lee & Shaffer, coefficient of friction, power & energy relationship, velocity relationship, shear-strain, factors affecting forces and power, problems

Geometry Of Cutting Tools: Single point and multi point cutting tools, tools nomenclature, tool point reference systems, tool signature, Recommended tool angles, Effect of cutting parameters on tool geometry.

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 gagetype 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 **oneSkill 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=HYpgpMymDcI
- https://www.youtube.com/watch?v=fdQjDV7qGsM
- https://www.youtube.com/watch?v=IAl9-mTj3gc
- https://www.youtube.com/watch?v=U7exNCTgPcY
- https://www.youtube.com/watch?v=YDSdhiMksoQ

Skill Development Activities Suggested

- Quizzes
- Assignments
- Seminars

Course outcome (Course Skill Set)

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

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

Program Outcome of this course

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

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

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

Processional Elective - 4

Semester-II

Total Quality Management			
Course Code	MMPT/MMPY215**A**	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:

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
CO1	To understand the concept of Quality costs.	L1, L2, L3, L4
CO2	Understand the concept of problem solving using the process.	L1, L2, L3, L4
CO3	Understand the use of control charts for improving the process quality.	L1, L2, L3, L4
CO4	Illustrate design of experiments using Taguchi technique.	L1, L2, L3, L4, L5
CO5	Acquire basic knowledge of total quality management.	L1, L2, L3, L4, L5

Program Outcome of this course

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

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

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

Semester II

Modern Manufacturing Practices			
Course Code	MMPT/MMPY215**B**	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:

- 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

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.

Module-2

Just in Time Production – Primary purpose, profit through cost reduction, Elimination of over production, Quality control, Quality Assurance, Respect for Humanity, Flexible work Force, JIT Production Adapting to changing production Quantities, process layout for shortened lead Times, Standardization of operation, Automation.
Sequence and scheduling used by suppliers: Monthly and daily Information. Sequenced withdrawal system by sequenced schedule table, problems and counter measures in applying the Kanban system to sub-contractors.

Module-3

Just-in-Time Production with Total Quality Control just in time concept, cutting lot sizes, cutting set-up times, cutting purchase order costs, the JIT cause-Effect chain, Scrap/Quality Improvements, Motivational effects, Responsibility effects, small Group improvement Activities, withdrawal of Buffer Inventory, the total Quality Control Concept.

Module-4

Total Quality Control-Introduction-Total Quality Control concepts, responsibility, learning from the west, TQC concepts categorized, Goals, Habit of improvement, perfection, Basics, process control, Easy to see Quality control as facilitator, small lot sizes, Housekeeping, Less than full capacity scheduling, Daily machine checking, Techniques and Aids, Exposure of problems, Fool proof Devices, Tools of Analysis, QC Circles, TQC in Japanese-owned US Electronics plant, TQC in Japanese-owned Automotive plants.

Module-5

Plant Configurations: Introduction-ultimate lant configuration, job shop Fabrication, Frame Welding, Forming Frame parts from Tubing, Dedicated production lines, overlapped production, the daily schedule, Forward Linkage by means of Kanban, physical merger of processes, Adjacency, mixed Models, Automated production Lines, Pseudo Robots, Robots, CAD and Manufacturing, Conveyors and stacker Cranes, Automatic Quality Monitoring.

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**oneSkill 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
CO1	1	2	2	3	3	3	1
CO2	3	2	2	2	3	-	3
CO3	1	2	2	2	2	3	2
CO4	2	2	2	3	2	3	2
CO5	3	2	2	2	3	-	2

Semester II

Advanced Materials and Processing			
Course Code	MMPT/MMPY215**C**	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:

- 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 **oneSkill 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.ShacklefordMc Millan, NY7th edition
3. Powder Metallurgy-Metals Hand Book, ASM, USAVol.7, 1974
4. Composite Materials - Science and Engineering, Chawla K.K Springer - Verlag, Newyork2nd edition, 1998

Web links and Video Lectures (e-Resources):

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=0LR2I2YEdaA

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
CO1	**2**	**1**	**2**	**2**	**3**	**3**	**2**
CO2	**1**	**1**	**2**	**2**	**2**	**3**	**1**
CO3	**1**	**1**	**2**	**2**	**3**	**3**	**2**
CO4	**1**	**1**	**2**	**2**	**3**	**3**	**1**
CO5	**1**	**2**	**2**	**2**	**3**	**3**	**1**

Semester II

Non Destructive Testing			
Course Code	MMPT/MMPY215**D**	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:

- 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

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

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

Module-2

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

Module-3

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

Module-4

Eddy current Testing: instrumentation of ECT, inspection of welds, advanced eddy current testing,Multi-frequency ECT, 3D phase array ECT, Remote field ECT, Magnetically based eddy current. Flux leakage, Computer modelling of ECT, Digital signal Processing, Eddy current imaging; eddy current imaging system, imaging and characterisation of defects, Eddy current array instrumentation for fixed position scanning.

Module-5

Magnetic particle Flaws detection: Principle of Magnetic Flaw detection, Types and methods of Magnetisation, Magnetic particles, Dry and Wet methods of Magnetic Particles inspection, Use of fluorescent Coated Magnetic particles, Industrial applications, Working of a Few Commercially available Magnetic Crack Detectors, Flaw detection in Rods, pipes and a short work piece, Precautions, Limitations, Residual magnetism, Need for Demagnetisation Research Techniques using Magnetic Particle Methods.

Assessment Details (both CIE and SEE)

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

Continuous Internal Evaluation:

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

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

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

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each 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 Edditon 2000Narosa Publishing House
- Welding Technology O.P. KhannaDhanpatRai Publication 2008

Web links and Video Lectures (e-Resources):

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

Skill Development Activities Suggested

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

Course outcome

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

Sl. No.	Description	Blooms Level
CO1	Distinguish the destructive and non-destructive testing and find effectiveness.	L1, L2, L3, L4
CO2	Ultrasonic testing is to detection of defect, measurement of their parameters assessment of their hazard assessment feasibility operation of the particular tested objected	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**

Course objectives:

- 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

Introduction:
Need for the compression in product development, history of RP systems, Survey of applications, Growth of RP industry, and classification of RP systems.

Module-2

Stereo Lithography Systems:
Principle, Process parameter, Process details, Data preparation, data files and machine details, Application.

Module-3

Selective Laser Sintering:
Type of machine, Principle of operation, process parameters, Data preparation for SLS, Applications.

Module-4

Fusion Deposition Modeling:
Principle, Process parameter, Path generation, Applications.

Module-5

Solid Ground Curing: Principle of operation, Machine details, Applications.
Laminated Object Manufacturing: Principle of operation, LOM materials. Process details, application.

Course outcome (Course Skill Set)

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

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.

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:

- Two Unit Tests each of **25 Marks**
- Two assignments each of **25Marks**or**oneSkill 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. Stereo lithography and other RP&MTechnologies-PaulF.Jacobs-SME,NY1996.
2. Rapid Manufacturing-F lham D.T&DinjoyS.S-VerlogLondon2001.

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
CO1	2	1	2	2	3	3	2
CO2	1	1	2	2	2	3	1
CO3	1	1	2	2	3	3	2
CO4	1	1	2	2	3	3	1
CO5	1	2	2	2	3	3	1

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:

- 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:

- 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**oneSkill 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 of40% of the maximum marks meant for SEE.

OR

MCQ (Multiple Choice Questions) are preferred for 01 credit courses, however, if course content demands thegeneral 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 nothavethe 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
CO1	1	2	2	2	3	3	2
CO2	3	2	2	2	3	1	2
CO3	1	2	2	2	2	3	2
CO4	2	2	2	3	2	3	2
CO5	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:

- 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:

- 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**oneSkill 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
CO1	Evolution of technologies, Industrial revolution	L1, L2, L3, L4
CO2	Explain Data Science, information, types, acquisition and analysis	L1, L2, L3, L4,L5
CO3	Explain meaning of Artificial Intelligence, History, Levels and Types of AI.	L1, L2, L3, L4,L5
CO4	Explain Internet on Things and its Architecture, Applications and Merits	L1, L2, L3, L4,L5
CO5	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
CO1	**1**	**1**	**2**	**2**	**3**	**3**	**2**
CO2	**1**	**1**	**2**	**2**	**2**	**3**	**1**
CO3	**1**	**2**	**2**	**2**	**3**	**2**	**2**
CO4	**2**	**1**	**2**	**1**	**3**	**3**	**1**
CO5	**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:

- 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:

- 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:

1. Two Unit Tests each of **25 Marks**
2. Two assignments each of **25Marks**or**oneSkill 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
CO1	Introduction to Total Quality Control and The Seven New QC Tools.	L1, L2, L3, L4
CO2	Applying the Seven New QC Tools, Affinity diagram, Need, Process and Examples.	L1, L2, L3, L4,L5
CO3	Explain Systematic diagram and matrix diagram, Need, Process, Examples	L1, L2, L3, L4,L5
CO4	Matrix data analysis, PDPC & arrow diagram method**,** Need, Process, Examples	L1, L2, L3, L4,L5
CO5	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)

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